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Efficiency and Distributional Effects of Federal College Subsidies during the Great Depression

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Efficiency and Distributional Effects of Federal College Subsidies during the Great Depression

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Abstract

We conduct the first quantitative assessment of federal college subsidies during the 1930s. Overlapping generation households invest in children's education to maximize multigenerational utility, and the government subsidizes college to maximize enrollment subject to a budget constraint and recipients satisfying ability and income qualifications. A modelling innovation assigns children educational ability through a random regression to the population mean correlated with father's presumed ability ranking via his percentile in fathers' earnings distribution. Simulating the theoretical model, the equilibrium that replicates actual education distributions estimates federal college subsidies increased graduation rates of the cohort of White Americans reaching college age during the 1930s by 22.12% for men and 19.16% for women; the mean ability of subsidy recipients exceeded non-subsidized students' mean .4 s.d. The program favored middle income groups. Most benefits accrued to high ability students with fathers in the 4th through 6th deciles of fathers' earnings distribution. The subsidies had no effect on the graduation rates of high ability students in the bottom two deciles of fathers' earnings. A more universal government policy that maximized stipends subject only to the budget and income criteria would have increased annual stipends by about 50 thousand while only decreasing college students' mean ability .13 s.d. Gender biases favoring higher male graduation rates remain a puzzle.

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The 6.4% graduating college in the cohort of White Americans born between 1902 and 1906 increased to 7.0% for the cohort born between 1907 and 1911. However, only 6.2% of the cohort born between 1912 and 1916 had graduated college by 1940 when its youngest members were 24 years old. Economists and historians attribute the decrease in college graduation to the disastrous income effects of the Great Depression during which this last cohort attended college (Campbell and Siegal: 489-92). Scholars have also argued that the federal government's introduction of a college work study program to subsidize college attendance aided thousands of students to enroll or stay enrolled who otherwise would have not attended college (Lyon, 1969: 52; Levine, 1986:197). Hence, the college subsidy program is credited with ameliorating the Great Depression's negative effects on human capital investment.

This paper provides estimates of the impact of direct federal subsidies on college attainment and graduation rates for the cohort born between 1912 and 1916 who attended college during the 1930s. Thus, it provides the first quantitative analysis of the federal government's inaugural national scale college subsidization program introduced during 1934 to cover women as well as men. Our findings shed light on several issues germane to public economics: what effect did the federal government's college subsidy program have on college attainment and graduation rates, and who (in terms of gender, ability, and family background earnings) benefited?

Organization of the Paper

The paper is organized as follows. First, following a brief review of related literature, we construct a theoretical model with families making investment decisions in children's education and the government subsidizing college enrollment by providing eligible applicants income stipends for work performed on campus during the school year. The overlapping generations model captures essential aspects of government and family behavior described in the historical record. Parents and children each live two periods. During their first period of life, the young (G2) receive consumption support from their parents (G1), attend school, then, after school completion but before marriage, contribute to household consumption through labor market earnings. Becoming

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householders in their second period of life, the new parental generation supports their family's consumption and the education costs of the children through family earnings accruing during its parental period. There is no borrowing for college, an assumption we deem reasonable for the Great Depression period. Each generation has an endowment of labor hours they supply to the market each period, although they may suffer unemployment. The adult generation takes as given its education level (previously decided during childhood), its earnings (taken from census data for G1 and estimated by OLS regression on 1940 census data for G2), and its number of children. Taking its budget as given, the government allocates college stipends to the pool of applicants by choosing the size of the education subsidy to maximize the number of stipends subject to constraints on the minimum ability and family income needs of subsidy recipients. After defining equilibrium and discussing its properties, we simulate the theoretical model by assigning its key parameters values from the 1940 census and other relevant data sources. Constrained by the historically relevant parameter values, the equilibrium of the simulated model that replicates actual college enrollment and graduation rates provides estimates of the effects of the college subsidy program and a host of related findings such as who benefitted from the subsidies with respect to gender, academic ability, and family background traits like father's percentile position in the distribution of G1 earnings.

Relationship to the Literature

Although historians working with mostly qualitative evidence conclude the subsidies had substantial positive effects on enrollment, graduation, and student composition by income, we found no research that quantified such effects through economic modelling and econometric techniques (Levine, 1986; Lyon, 1969). Related literatures using econometric techniques such as differences in differences on Danish high school student data to estimate the enrollment effects of a national subsidy reform (Nielsen et al., 2010), or a regression discontinuity design on student data from a specific college to estimate the effects of financial aid decisions on enrollment decisions (van der Klaauw, 2002) find positive effects of subsidies. Another literature examining college subsidies uses structural econometric models on individualized data covering students and schools to estimate subsidy effects

on structural parameters such as tuition prices to examine effects on enrollment, and student welfare (Epple et al., 2006). Our objective is to formulate a model and method capable of answering the counterfactuals how much did the subsidy program effect enrollment and graduation rates and what were the distributional effects of the national program. Lack of data connecting individual students' education choices, family backgrounds, abilities, and data on the colleges themselves precludes such methods. Our research design is most similar to what a recent review of macroeconomic research describes as model-fitting to make theory-based quantitative statements about the effects of policies on economic outcomes and welfare (Glandon et al, 2023). The paper has two methodological innovations: it fits equilibrium outcomes of household and government optimization programs to the actual distribution of education attainment data; to overcome the most difficult empirical issue (lack of data on students' academic ability) it introduces a randomized parent-child ability transmission process that is tied to household census data by correlating a child's ability to her father's percentile position in his generation's male earnings distribution.

The Model

After a brief initial trial at the University of Minnesota during the fall of 1933, the Federal Emergency Relief Administration (FERA) college subsidy program began during the winter term of 1934. The outline and framework of the program were devised in Washington, but its implementation was decentralized to individual educational institutions charged with the task of setting up efficient screening procedures to evaluate the financial standings and scholastic abilities of thousands of students who applied for stipend assistance. The historical record and government data summarizing the program provide basic information describing the objectives and organization of the program as well as key benchmark data we use to assess the credibility of our simulations. During the eight years the program ran, the government spent about $93 million in stipends that were received by about 12.5 percent of all White college students. Each participating college received grants that targeted monthly allotments of $15 per student, and students were selected based on income need, the ability to do college work,

and character. For gender equity, stipends were proportionately allocated between men and women according to their past enrollment in the institution. Government records indicate about 38 percent of stipends went to women.

All stakeholders involved in the setup of the program agreed the subsidies should be restricted to students whose financial status was such "as to make impossible his attendance at college without this aid" (Lyon: 45). However, there was disagreement concerning if the stipends should function primarily as an arm of the Roosevelt Administration's antidepression employment programs (and thus be granted to the largest number of students possible) or be restricted to those students deemed academically qualified to attend college. Partly due to political reasons, academic purists won the debate, see below. Thus, we model student selection (from the pool eligible due to financial need) as maximizing the number of stipend recipients subject to a minimum ability qualification. We consider the minimum ability qualification (determined endogenously in the model) to reflect college administrators' assessment of who was college material.

Modelling these issues requires families' education decisions and the government subsidy awards consider the academic ability of children. To circumvent the fact that the census data do not provide direct information on ability, we introduce a method of simulating a distribution of academic abilities that is correlated with father's inferred ability. The simulation assumes that: 1. ability is normally distributed in the G2 population; 2. a child's percentile in the G2 ability distribution is correlated with the father's percentile ranking in the G1 generation's wage distribution; 3. the child's ability is further based on a randomly assigned regression toward the G2 population mean. We argue these assumptions are reasonable if fathers' wages are significantly correlated with father's ability, and ability, in addition to being partially inherited (nature) is also affected by family well-being (nurture). The first condition is likely true for the G1 generation who by the 1930s had been in the labor market for multiple decades, and the second and third receive substantial corroboration in the research literature (Bowles & Gintis: 2002; Black et al: 2009; Willoughby et al.: 2021). To connect academic ability to the opportunity cost

of human capital investment, we assume one important component of academic ability is the number of years it takes a student of a given ability to complete one grade at school. [1]

Denote ability by the variable a, and assume it is normally distributed across the G2 distribution of children with a mean of 1, a standard deviation equal to .15, and has a cdf denoted by F(a). Let w denote the father's wage percentile in the distribution of G1 men's wages and $\tilde{x}$ be a normal random variable with mean 0 and sd d. The mechanism assigning each child an ability level is:

$$A. \quad a = \hat{a} + b \cdot [F^{-1}(w) - \hat{a}] + \tilde{x}.$$

Here "a" represents child ability, $\hat{a}$ the G2 cohort's mean ability, and b is the effect of the father's relative earnings position on a child's ability.[2] Thus, each child is assigned an ability in the G2 ability distribution that is a random regression to the G2 mean that is based on her father's position in the G1 wage percentile ranking. Under this specification, for the group of children whose father's wage is at the 50th percentile, the *average* ability will equal the population mean. For fathers above the 50th percentile, children benefit from a fraction b of the amount above the mean plus a random component, and for fathers below the 50th percentile, children are only penalized a fraction b of the shortfall. The parameter b expresses the magnitude of the relationship between a father's earnings position and his children's ability. If the father's wage percentile is not that accurate a predictor of a child's ability, b will be small and the standard deviation of $\tilde{x}$ large. At b equal zero, a child's ability is independent of the father's wage ranking and is just a random draw about the population mean, while at b equal 1, father's wage ranking is a strong predictor of his child's ability which (in the G2 distribution of abilities) is mostly within d

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[1] It seems natural that the average student should take one year to complete a year of schooling. Too many mothers without market earnings necessitated omitting mother's earnings percentile from the specification, and education provides too coarse a filter.

[2] Although we do not intend the similarity to be meaningful, the s.d. conforms to the range of standard IQ tests. This specification is subjected to robustness tests in appendix one. Note that a father's effect on his children's ability is assumed to be a combination of father's ability and his income rank. The standard deviation of $\tilde{x}$ is presumed larger than it might be because this assignment mechanism omits mother's ability attributes.

standard deviations of the ability corresponding to the father's percentile ranking. Hence, model simulations that replicate the actual data provide information about the size of the actual b. Interestingly, specifying b equal to 1 fails to achieve an equilibrium that replicates the actual data.

Households

People live for two periods, but the duration of a household is one period. Thus, each person lives one period in their parents' household, from birth until they marry, and one period during which they become a parent-householder. The householder period lasts from age at first marriage until death. During the current period, each household maximizes multigeneration utility by choosing education investments for its children.[3] We allow education investments to differ between sons and daughters in the same household. Denoting the utility of consumption by U(c), and allowing households to choose the education levels of children, a household's maximization problem at time t applies a time discount β to the utility of future consumption and is defined by the recursive equation:

1. $$V\left(e_{pt}, a_t, n_t^d, n_t^s\right) = \max_{e_{dt}, e_{st}} \left\{ \sum_x [\omega_t^x \cdot U(C_t^x)] + \beta\left[\omega_t^d \cdot \mathbb{E}V\left(e_{dt}, a_{t+1}, n_{t+1}^d, n_{t+1}^s\right) + \omega_t^s \cdot \mathbb{E}V\left(e_{st}, a_{t+1}, n_{t+1}^d, n_{t+1}^s\right)\right] \right\}$$

s.t.

$$C_t^p + \sum_{x/p} n_t^x \cdot C_t^x = w_t^p \cdot h_t^p \cdot l_t^p + \sum_{x/p}\left[n_t^x \cdot \left(W_t(e_{xt}) \cdot h_t^x \cdot \left(M_t^x - \left(6 + \frac{e_{xt}}{a_t}\right)\right) - C' \cdot \frac{\max\{e_{xt}-12,0\}}{a_t}\right)\right].$$

The left side of the budget constraint is total household consumption during period t, and the right side is total household earnings which includes parental earnings during the householder period plus earnings of children after school completion but before marriage. Let X = {p,s,d} designate the parents, daughters, and sons of a household at some time period. Then x is a generic element of X and x designates a specific p, d, or s. For convenience, the

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[3] Given the setup, since parents' altruism extends across the lifetime of their children (whose 2nd period utility depends on the expected utility of their children) households in the current period care about the utility of three generations, parents, children, and grandchildren (G3).

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notation x/p removes parents so summing over it only counts the household's children. C_t^x is the consumption of a type x person during period t, and n_t^x is the number of type x persons in the household. Hence, ω_t^x is the weight placed on a type x person's utility during period t, such that $\omega_t^p = 1$ and $\omega_t^x = \beta' \frac{n_t^x}{n_t^s + n_t^d}$ for x equals s or d and β' is the level of altruism by which parents further discount the utility of the future households of their children. In turn, $W(e_{xt})$ is the gender-appropriate wage of a G2 with education e_{xt} and zero experience and C' is the annual cost of college measured in dollars, so the last term in the budget constraint equals the cost of college attendance conditional on attending college. Furthermore, each household type during period t is endowed with a fixed number of annual labor hours (h_t^x), remaining life expectancy (l_t^p), and age at first marriage (M_t^x) all taken as population averages.[4] Expectations are with respect to G2 (and G3) future wages, hours, and number of children. All are assumed to be point forecasts; expected wages are based on wage regressions from the 1940 census that control for education, experience, gender, and location, and are adjusted for inflation; annual hours and number of children for G2 and G3 are census-based population averages (See appendix). Observe from the budget constraint that this setup utilizes expected lifetime earnings and consumption for G2 agents, and householder period earnings and consumption for G1 agents. We assume families expect a daughter's future husband will have the same education as she does with probability one, a simplification of the assumption early 20th Century families *believe* daughters will marry men of similar education and become homemakers.[5] Note that if education is equal for sons and daughters or a household had children of only one gender, then the above recursive equation collapses to the traditional Bellman equation.

In this model, the cost of precollege education is incurred as the opportunity cost of foregone earnings when spending time in school rather than entering the labor market. Hence, higher ability children face lower costs of

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[4] Second period longevity l_t^p is equal to the difference of male life expectancy and male age at first marriage, M_{t-1}^s.

[5] We deem these last simplifying assumptions reasonable expectations for early 20th Century Whites.

investing in education and families' human capital investment decisions take their children's ability into account. The model posits a continuum of households each described by a vector of characteristics $v = (v_1 \ldots v_k)$ whose components include parents' wage, work hours, experience, location, number of children of each sex and children's ability, etc. Household types v are distributed throughout the population according to a distribution function $H(v)$ that is assumed to have a density $h(v)$ that is continuously differentiable.

The Government

The historical record shows the government empowered college authorities to act as its agents to allocate college stipends according to an implicit social welfare function that positively valued the number of stipend recipients, their income need, and the academic ability of recipients (US National Youth Administration:49; Lyon).[6] In the model, a student applicant is considered income eligible if the student's family income is insufficient to finance college. The budget criterion is derived from household budget data of the era. The government choice variables derived endogenously are the stipend granted to successful applicants and a minimum ability level which the government (through college administrators) considers to be the academic ability required to succeed in college. Taking its total budget and the family income criterion as given, and deciding on the minimum ability to qualify, the government chooses a uniform stipend level for students. Its policy provides a stipend to all income eligible applicants of qualifying ability level.

Government Policy is denoted by a set $\{B, S, A\}$. B is the total budget in dollars available for education subsidies; S is the dollar amount of the subsidy per student recipient per year, and the mapping $A: R^2 \to \{0, 1\}$ is a selection mechanism that sorts subsidy applicants into those who are accepted and those who are not. The government's budget for the G2 cohort is $33.23 million, an amount that is constant throughout the paper (see the appendix for a discussion explaining how this budget is derived). The uniform subsidy amount is $S = \frac{\$s}{student}$.

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[6] In some institutions character was also considered. The model ignores character.

Thus, $\frac{B}{S} = N(S)$ is the number of annual stipends that can be supported by the subsidy S. We refer to N(S) as the government's supply of stipends.

Selection into the subsidy program is based on a college affordability condition $I(v)$, and a minimum ability:

$$A(I(v), \bar{a}) = \begin{smallmatrix} 1 \ accept \ if \ I(v) < C' \ and \ a > \bar{a} \\ 0 \ otherwise \ do \ not \ accept \end{smallmatrix}.$$

C' is the cost of college. It includes tuition and room and board for nine months plus three months consumption spending on the student while at home during the summer. To further describe the affordability condition, suppose a family is of type v and the government imposes a need-based eligibility condition determined by v. With some minor adjustments, the government's need criterion is based on the idea that if the annual consumption a family can afford to spend on a nonworking student exceeds the annual cost of college, the family's earnings are sufficient to cover college costs. To make this determination, the government assumes a family with given parental earnings could spend a specific amount on the annual consumption of a potential college student. If the family's allotted consumption per student plus the summer earnings of the college student are insufficient to cover C', the student is considered need eligible. The need-based condition requires that the family cannot afford to send either sons or daughters to college, hence,

$$I(v) = \max\left\{ \frac{w_i \cdot h_t^p}{n_i^s + 4} + \widetilde{h_t^s} \cdot \widetilde{w_t^s} - \frac{1}{4} \frac{w_i \cdot h_t^p}{n_i + 4}, \frac{w_i \cdot h_t^p}{n_i^d + 4} + \widetilde{h_t^d} \cdot \widetilde{w_t^d} - \frac{1}{4} \frac{w_i \cdot h_t^p}{n_i + 4} \right\}.$$

The max in this equation is taken over similar expressions denoting the earnings available for sons or daughters to attend college. Explaining the expression for sons which occurs before the comma, the first term of I(v) defines allotted consumption spending per son in a family i with $w_i \cdot h_t^p$ parental earnings and n_i^s sons. The term $\widetilde{h_t^s} \cdot \widetilde{w_t^s}$ represents summer earnings of a son in college, and $\frac{1}{4} \frac{w_i \cdot h_t^p}{n_i + 4}$ is the consumption spending per child during the summer (the indirect college cost part of C'). The expression after the comma is analogous for daughters. In

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each case, the summer earnings of a college student equals the gender specific earnings of a high school graduate with no experience who works during the summer while attending college.[7]

We represent the government's decision problem with two different policies. The *selective policy* represents the government's actual policy. Its objective is a constrained maximization with the government choosing S to maximize the number of tuition stipends it supports in the income *eligible* population subject to its budget constraint and a minimum ability to qualify for a stipend.

$$\underset{S}{Max}\, N(S)$$

$$\text{subject to minimum a } = \bar{a} \text{ and } S \cdot N(S) \leq B.$$

As discussed above, the minimum ability is administrators' belief about an applicant's college qualifications.

The second model of government decision making is constructed to represent what the government would have done had proponents of a more *universal policy* prevailed and the subsidy had been chosen to maximize awarded stipends without an emphasis on ability levels. Importantly, even if no ability requirement is explicitly imposed, households facing the costs of schooling ensure the existence of an endogenously determined minimum ability of subsidy students. Under the universal policy, the government:

$$\underset{S}{Max}\, N(S)$$

$$\text{subject to } S \cdot N(S) \leq B.$$

In a later section of the paper, we compare the distributional properties of the two education policies.

Subsidy Allocations

We examine two types of allocations, equilibrium, and rationed. The former is a traditional equilibrium, the government exhausts its budget, every qualifying student receives a subsidy, and subsidy demand equals supply.

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[7] The allotted consumptions of I(v) are based on Department of Commerce estimates of family budgets from the 1930s. In our formulation, a family with earnings W and n>0 total children consumes W/(n+4) per child leaving the remainder for the parents. See the appendix.

In the second allocation type, some students who qualify for a subsidy do not receive one because the government budget is depleted before all eligible demand is fulfilled. In such a rationing allocation, there is no price adjustment mechanism capable of equilibrating supply and demand. A rationing allocation can occur in the simulation because with a finite number of households there can be discontinuous jumps in the demand for stipends due to missing ability levels among the households.[8] When an equilibrium would have occurred if not for some missing ability level, the government's best option for maximizing the number of stipends granted is to choose a stipend S where demand exceeds supply and then ration supply among eligible students. The selective policy has an equilibrium while the universal policy requires rationing. We begin by defining equilibrium and discussing its properties. Afterwards, we discuss the rationing allocation.

Equilibrium

For a given subsidy and minimum ability requirement, households' utility maximizations generate an aggregate demand for stipends denoted by D(S, a). An equilibrium for the selective policy is defined by a government policy $\{B, \ S^*, A\}$ such that:

1. S^* maximizes the government's objective function subject to its budget constraint and an unknown a^* predetermined by the government but exogenously determined in the model.
2. All households maximize intergenerational utility.
3. Supply of college stipends equals Demand for stipends, $N(S^*) = D(S^*, a^*)$.

A Replication Equilibrium is an equilibrium that satisfies the additional conditions:

4. The simulated proportions of men and women with some college in the G2 cohort equal the actual G2 proportions for each.
5. The simulated proportions of men and women graduating college in the G2 cohort equal the actual proportions for each.

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[8] This issue would not occur in the theoretical model because there is a continuum of households with a continuous density function over characteristics including ability.

To explore the properties of an equilibrium in the theoretical model, we reformulate the government's budget constraint and its objective function. Recall $D(S, a)$ equals the effective aggregate demand for college stipends from the eligible population when the subsidy is S and the minimum ability to qualify is a. For a fixed S, the set of all minimum ability qualification levels that are budget-feasible is $B(S) = \{a | S \cdot D(S, a) \leq B\}$. Let $a(S) = \inf\{a | a \in B(S)\}$. The following proposition is proved in the appendix.

Proposition 1: Let S* and a* be the optimal stipend and minimum ability chosen by the government at an equilibrium. Then,

$$a^* = a(S^*).$$

Proposition 1 allows rewriting the government objective as a constrained Lagrangian:

$$\underset{S}{Max} \, N(S) + \lambda \cdot [a(S) - a].$$

Where $a(S)$ is the minimum ability of the tuition grant applicant pool when the subsidy equals S and a is the government's (unknown to us) minimum ability criterion. Assuming $a(S)$ is differentiable, the FOC for the government's objective is:

$$-\frac{B}{S^2} = -\lambda \cdot a'(S).$$

Because the budget condition is binding at a(S) implying supply equals demand, any S satisfying the conditions 1-3 which includes the government's FOC is one of a continuum of candidates for an equilibrium, see Figure 1. However, we are interested in finding a stipend S^* and minimum ability $a(S^*)$ that supports a replication equilibrium, a requirement that further restricts the possible equilibria. Among the continuum of possibilities, the replication equilibrium is determined by the government's choice of the minimum ability required to do college work and receive a stipend. This ability level is unknown and must be determined endogenously in the model.
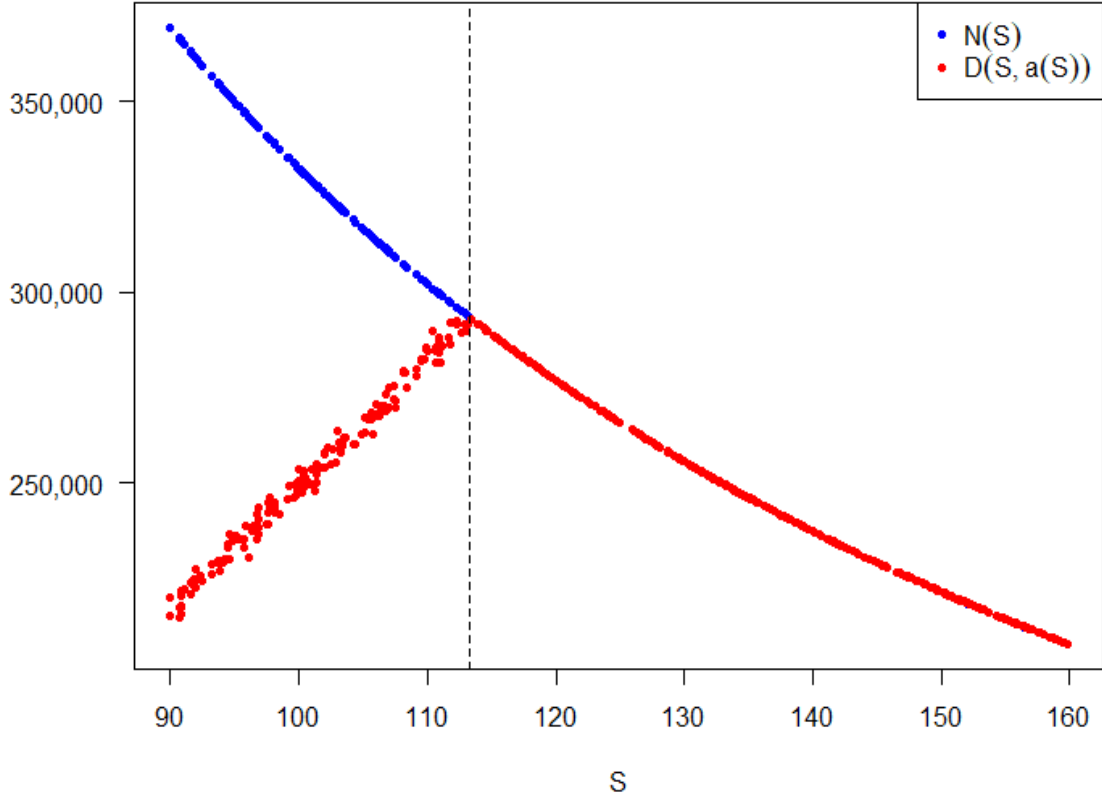
Figure 1 – Supply and Demand of Stipends. The demand curve is generated by simulating $D(S, a(S))$ for 500 randomly generated values of S on the interval [90,160] using the procedure described above. Supply of stipends is determined by $N(S) = \frac{B}{S}$. Note that for $S > \$113.2788$ (to the right of the dashed line in the figure), the constraint $S \cdot D(S, a) \leq B$ is binding at $a = a(S)$, where supply and demand are equal. For $S < \$113.2788$ (to the left of the dashed vertical line), the subsidy is too small to generate enough demand for stipends and supply exceeds demand at every positive value of a, thus a(S) = 0. At $S = \$113.2788$, supply exceeds demand by .01 stipends and $a(\$113.2788) = 0.5337319$. This means there is an income eligible G1 household not receiving a subsidy whose children have ability 0.5337319 who would demand stipends if the ability eligibility cutoff decreased by any amount. However, if the ability cutoff were lowered by any amount, there would be excess demand, so no equilibrium exists for $S = \$113.2788$. Thus, 0.5337319 = a(113.2788) = inf {a|D(113.2788,a)<= B/S}. This is important for the universal college allocation, see below at pages 26 – 27.

Simulation of the theoretical model requires adapting to the fact that the actual economic environment contains a finite number of households. Therefore, the distribution of children's abilities and household

characteristics is discrete, and it is possible that no replication equilibrium exists because of discontinuous jumps in demand caused by missing ability levels. When this occurs, the only feasible allocations involve rationing. Based on Proposition 1, our method of identifying S^* and $a(S^*)$ is to estimate a(S) from simulated data obtained by computing aggregate demands for stipends for each of a set of S values, and finding for each simulation on S the minimum ability (among all income eligible applicants) for which the government's budget constraint is satisfied. From the simulated (S, a) pairs, we construct a(S). The search for an equilibrium is confined to the (S, a(S)) pairs. A simulated replication equilibrium must satisfy all the equilibrium conditions 1 – 5. Figure 2 depicts the plot of a(S) from simulating 500 randomly selected values of S in the range [90, 160]. [9]

The Rationing Allocation and the Universal Subsidy Policy

From Figure 1 we observe that the government *could* supply many stipends by choosing a small subsidy. However, many of those stipends would not be taken up because of deficient demand. Hence, it is clear that the optimal stipend cannot generate excess supply. The two possible cases are either an equilibrium with the supply of stipends equalling the demand for stipends, or an excess demand allocation with the government supplying stipends to qualified applicants until its budget is depleted. Such rationing (which is empirically relevant) occurs under the universal policy. For the universal policy, denote the optimal subsidy and the minimum ability student receiving it by S^U and a^U.   Because $a(S) = 0$ implies the government has unspent funds, maximizing N(S) subject only to budget feasibility conditions occurs when $S^U = infimum\{S|a(S) > 0\}$. However, there is no equilibrium at this subsidy amount (see the text below Figure 1). Furthermore, there is no equilibrium at a subsidy amount near S^U either. At any smaller subsidy there is excess supply implying the government has unspent funds, and because the set described in the definition of S^U is open there cannot be an equilibrium N(S) close by and

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[9] Recall that S measures a yearly subsidy. Since we know the government targeted monthly subsidies of about \$15 to students, the replication equilibrium is expected to approximate 9 times \$15 or \$135 per student per year.
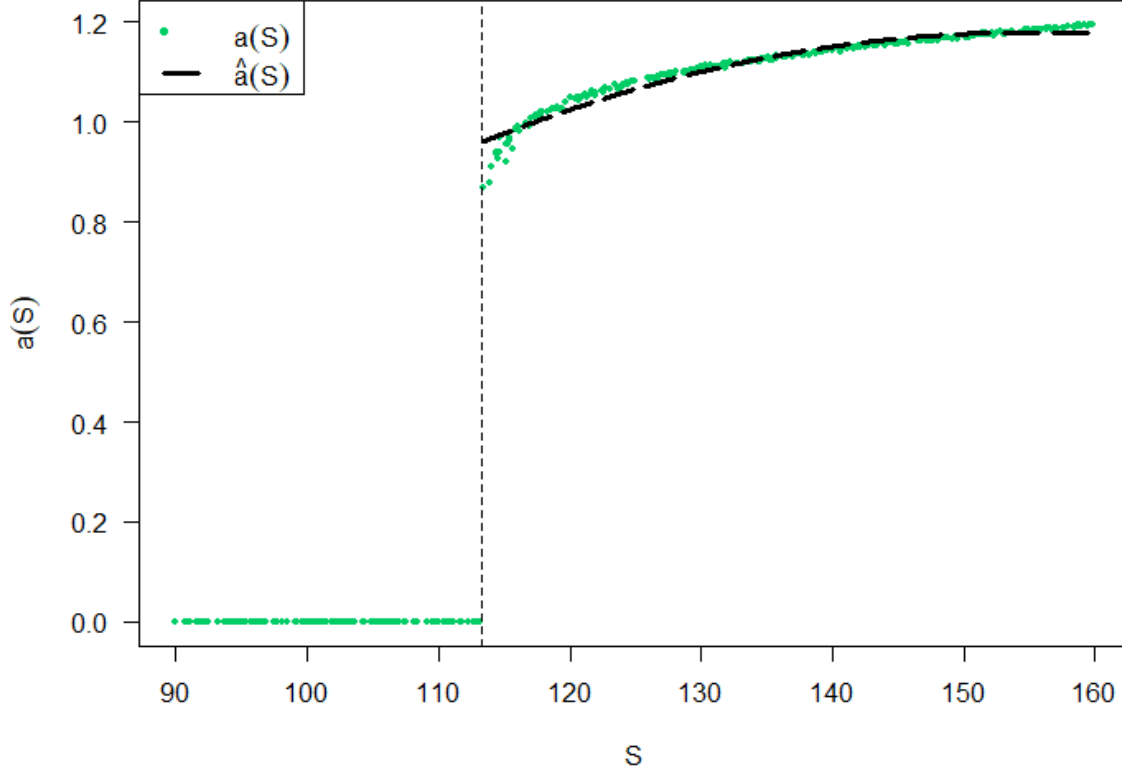
Figure 2 - The green curve is the plot of a(S) generated by the random sample of S on the interval [90, 160], and the black curve is a quadratic regression of the generated a(S) values against the random sample. The regression equation is $\hat{a}(S) = -1.851 + 0.03908S - 0.0001260S^2$ with $R^2 = 0.9574$. Note that in figure 2, $a(S) = 0$ for $S < \$113.2788$, since $D(\$113.2788,0) < N(\$113.2788)$ and thus $B(\$113.2788) = \mathbb{R}_+$. For $S > \$113.2788$, there exists some $a = a(S) > 0$ such that $D(S,a) = N(S)$, which corresponds with the jump in the plot. These observations are also reflected in Figure 1 as well.

right of S^U(see Figure 1). Unable to equate supply and demand, the government maximizes its objective by slightly increasing the subsidy to create excess demand, and then providing the enhanced subsidy to all eligible applicants until it depletes its budget. For further description of the universal education policy with rationing see pages 25 – 26.

Computing the Replication Equilibrium

To simulate the replication equilibrium, we use the 1940 Census 1% Sample distributed by IPUMS at the University of Minnesota. We divide the data into three generational cohorts: G1 (born during or before 1907), G2 (born from 1912 through 1916), and G3 (born after 1926). For each non-Hispanic White G1 man in the dataset, we take his hourly wage w_t^p, the number of all his children, $n_t^a = n_t^s + n_t^d$, his number of sons and

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daughters, n_t^s and n_t^d, respectively, [10] and his children's assigned ability, a_t to compute the solution of the recursive utility maximization equation 1 by performing the maximization:

$$2. \quad \max_{(e_{st},e_{dt})\in D} \left\{ U(C_t^p) + \Sigma_{x/p} \frac{n_t^x}{n_t^s+n_t^d} \left(U(C_t^x) + \beta \mathbb{E} U(C_{t+1}^{p_x}) \right) \right\}$$

Subject to a set of consumption feasibility constraints individualized for children and parents that resemble the constraint in the household's recursive maximization problem discussed for the theoretical model earlier. For a detailed description and discussion of these consumption constraints see the appendix.

In the computations, $U(c) = \frac{c^{1-\theta}}{1-\theta}$ is a constant intertemporal elasticity of substitution (CES) utility function and D is the set of integer-valued ordered pairs (e_{st}, e_{dt}) that satisfy constraints on compulsory education laws and college affordability for each family (See the Appendix for consumption equations and feasible educational investments). The objective reflects the sum of parents' second period utility and the average of their children's lifetime utility with children's expected second period utilities discounted to reflect both a time discount rate, β_d, and a discount for parents' level of altruism for the future households of their children, β_a, where $\beta = \beta_d \cdot \beta_a$. We assume households' education decisions treat children in a mostly egalitarian manner. Children of the same gender receive the same level of educational investment, sons' and daughters' educations only differ when the household desires to send children to college but can only afford to pay for one gender. In the latter case, sons or daughters are chosen to attend college with probabilities p and 1-p, respectively. The gender not attending college completes high school.

For given S and a(S), performing the household maximization for every G1 in the sample generates a demand for subsidies $D(S, a)$ by the G2 cohort. Furthermore, by Proposition 1, a replication equilibrium must fall on the demand curve $D(S, a(S))$. Our method of parametrizing the computational model is to select mean or median

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[10] We explain our methodology for calculating G1's hourly wages, number of children, and sex of the children from Census data in the Appendix.

values for the White population for those parameters for which individual data is not available. For example, mean life expectancies and mean age at first marriage are used to parametrize the length of G1 and G2 householder periods. Lifetime hours worked during a householder period are based on average hours worked per week (adjusted for annual unemployment rates) multiplied by life expectancy at age at first marriage. The average hours per week and unemployment rates are annual numbers based on calculations encompassing the relevant era for a generational cohort. G1 wages are based on actual 1940 census individual data (adjusted for inflation when necessary), and G2 wages are regression estimates from the 1940 census data. All expectations are point forecasts. Members of the G2 cohort expect to parent the median number of children ever birthed by White women in their parents' generation, and expectations for the wages, children, etc. of the G3 cohort are static extrapolations of G2 values. As noted earlier, the government spent about $93 million in stipends during the eight-year period from academic year 1935 through the academic year beginning in 1942. However, total subsidies must also include those expended during the eighteen-month period from January 1934 through June 1935, and we must also recognize that birth cohorts other than G2 would have received substantial amounts of these funds. We arrive at a budget B = $33.23 million for the G2 cohort by assuming that G2 students' receipt of stipends was equal to their proportion of college age students during each of the 9.5 years, and that spending during the initial eighteen-month period was proportional to the entire period. The specific data values used to parameterize the model and restrict the simulations are exhibited in Table 2 in the appendix where we discuss the sources and selection of these parameters in more detail.

The Replication Equilibrium

We simulate a Replication Equilibrium at $S^* = \$137.01124$, which equals $15.22 per month for a 9-month school year matching the $15 per month average stipend targeted by the government. At the replication equilibrium (hereafter characterized by S*= $137), the endogenously determined minimum ability of stipend recipients $a^* = a(S^*) = 1.1344$. The replication equilibrium does a remarkable job replicating key benchmarks

of the actual data. Figure 3 shows the actual and simulated distributions of educational attainment by gender. As shown in Table 1, the differences between the simulated and actual college graduation and attainment rates each equal zero through two decimal points for both genders. Government records report that during the entire life of the program, about 12 and one-half percent of all college students received stipends and about 38% of recipients were women (Lyon: 63). For G2 college students, the model simulates 12.9% received stipends and 38.1% of stipend recipients were women.

Program Effects: Increases in College Attainment and Ability Comparisons, Who Benefitted?

The model's two primary predictions pertain to the subsidy program's effect on the percentage of students attaining some college and graduating respectively, and the relative abilities of enrolled college students who did and did not receive stipends. The replication equilibrium implies the college subsidy program had a large effect on college attainment and graduation rates. With respect to college attainment, the simulations imply that the government college subsidy program increased the rates at which G2 women attained some college or graduated by 12.12 and 18.37 percent, respectively. Increases for men were greater at 17.06 and 23.63 percent, respectively. Without the subsidy program, college graduation rates for the G2 cohort would have been about 4.41% compared to 5.22% with the subsidy for women, and for men, 6.22% without the subsidies compared to 7.69% with them.

Ability of Stipend Recipients, Efficiency Goals

Critics of the college subsidies came from both conservatives and liberals. Some on the right argued the program was an encroachment of big government spending on higher education decisions, and some on the left argued the spending should be directly targeted to unemployed workers (Levine). An important response to these criticisms was that the college subsidy program's targeting of high ability students from income needy families was necessary to maintain or even increase the productive capacity of the US economy. The subsidies were said to enhance economic efficiency and were far from wasteful. We now examine how the subsidy-
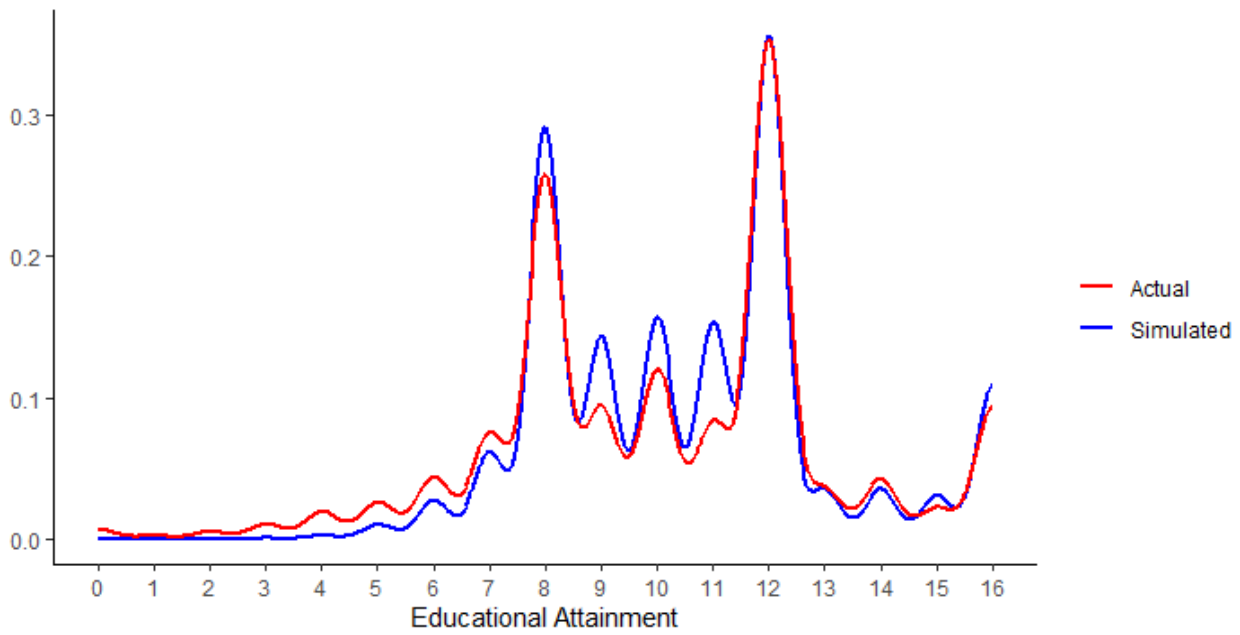
Women
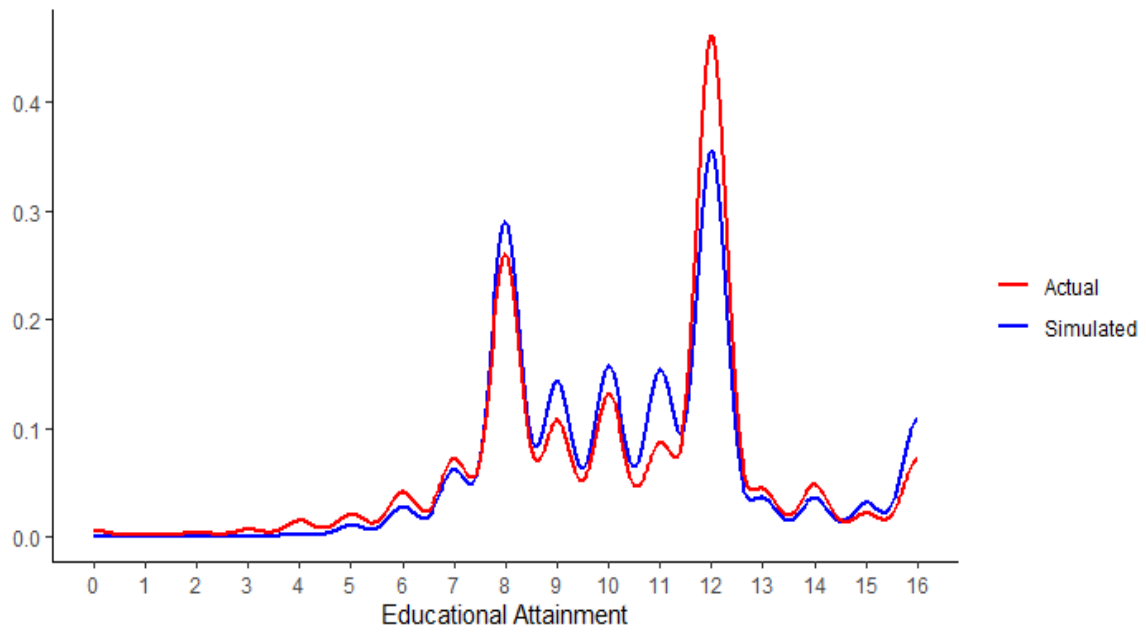
Men

Figure 3

Table 1

Education	Actual (Men)	Simulated (Men)	Difference	Actual (Women)	Simulated (Women)	Difference
0	0.0051	0.0000	0.0051	0.0038	0.0000	0.0038
1	0.0018	0.0000	0.0018	0.0011	0.0000	0.0011
2	0.0039	0.0001	0.0038	0.0027	0.0001	0.0026
3	0.0082	0.0005	0.0077	0.0046	0.0005	0.0041
4	0.0151	0.0017	0.0134	0.0105	0.0017	0.0088
5	0.0201	0.0071	0.0130	0.0147	0.0064	0.0083
6	0.0340	0.0193	0.0147	0.0293	0.0182	0.0111
7	0.0576	0.0434	0.0142	0.0513	0.0400	0.0113
8	0.2006	0.2058	-0.0052	0.1866	0.1589	0.0277
9	0.0726	0.1020	-0.0294	0.0770	0.1064	-0.0294
10	0.0929	0.1110	-0.0181	0.0942	0.1209	-0.0267
11	0.0634	0.1081	-0.0447	0.0615	0.1233	-0.0618
12	0.2749	0.2522	0.0227	0.3315	0.3006	0.0309
13	0.0273	0.0248	0.0015	0.0307	0.0235	0.0072
14	0.0330	0.0252	0.0078	0.0343	0.0239	0.0104
15	0.0170	0.0220	-0.0050	0.0154	0.0233	-0.0079
16	0.0726	0.0769	-0.0043	0.0508	0.0522	-0.0014
13-16	0.1498	0.1489	-0.0009	0.1313	0.1230	-0.0083

driven increase in college attainment affected the ability levels of students attending college, and we use this information to assess who benefitted from the subsidies in terms of family background such as father's earnings. According to contemporary sources, stipend recipients were superior in academic ability to non-stipend recipients. Furthermore, the historical record shows that the government and college administrators placed great emphasis on their findings that the average ability level of stipend recipients was significantly higher than that of currently enrolled non-stipend college students (Lyon, 1969: 10). The National Youth Administration that assumed responsibility for the program in 1935 reported that average grades of subsidized students exceeded that of non-subsidized students at over four of five colleges nationwide (76-77). During the first full year of the program, the average academic grades of subsidy recipients exceeded or equaled that of non-subsidy students at 35 of 39 colleges surveyed. Results from large public universities illustrate this finding. At Ohio State University, where

over a third of subsidy recipients scored above the 90th percentile of the college entrance examination, stipend recipients' average score was 77 compared to about 50 for non-recipients. At the University of Illinois, 15% of subsidy students compared to 9% of non-subsidy students made the honor roll (Levine: 199).

The replication simulations corroborate these findings. Although the 1.20 mean ability of even non-subsidy students was high (1.33 s.d. above the population mean), the replication equilibrium's stringent minimum ability qualification for program participation of 1.13 (.87 s.d. above the mean) appears to have guaranteed that subsidy students would excel compared to non-subsidy students. In the replication equilibrium, the mean ability of subsidy students is 1.26, .4 s.d. greater than the 1.20 for non-subsidy students.

During this period, even for high ability children, educational investments were significantly biased toward children from well-to-do families. For example, a 1935 study of Pennsylvania found that 93% and 57% of students with IQ scores 110 or above in families with above average SES graduated high school and college, respectively. The comparable percentages for the same IQ group raised in below average SES families were 72% and 13% (Levine, 213). The combination of a high minimum ability qualification with need-based eligibility might be expected to attenuate this bias toward children in high SES families. If so, it would substantiate claims that, in addition to its efficiency benefits, the subsidy program had a significant egalitarian effect on college enrollment. Did the subsidies allow large numbers of high ability students from lower-income families to attend college who could not have done so otherwise? The answer is yes and no.

In one sense, the findings provide considerable evidence for the egalitarian claim. The college subsidy program disproportionately admitted students from families with incomes appreciably lower than non-subsidy students. The simulated median family earnings of G2 subsidy recipients of $1208 was significantly below the simulated $2018 median for college students who did not receive subsidies. These median earnings differences suggest that without the subsidy program, family incomes of college students nationwide would have been very

high and consistent with the findings of the previously cited Pennsylvania study. To assess this, consider a study by the National Resources Council that reported that during 1935 a family with about $2000 would just reach the top quintile in US family incomes (Kneeland: 730). Thus, the simulated $2018 median earnings of nonsubsidized college students' fathers (just above the top quintile of family incomes) indicates the very high social status of college students who would have still been enrolled had there been no government subsidization.

However, the claim that the program significantly increased college enrollment of high ability students from lower income families is only correct in the technical sense that subsidized students' family earnings were lower than non-subsidized students. In fact, the college subsidy program was largely a boon confined to higher ability students from the middle-earnings classes. Before examining this issue in the context of the replication equilibrium, we note independent evidence for this conclusion is provided by a NYA study for 1939-40. The NYA reported that the median family income of White subsidy recipients was $1150, an apparently low family income (NYA: 67). However, this income was not all that different from the $1160 median income for families of two or more people reported by the National Resources Committee (Levine: 204; Kneeland: 729). The similar median family incomes of actual subsidy recipients and the general population suggests that although the subsidy program did alter the composition of college student bodies from the counterfactual case of no subsidies significantly, the college subsidy program did not reach deeply into lower levels of the family income distribution.

Examining output from the replication equilibrium substantiates this conclusion. Figure 4 depicts, for each decile of the G1 father's earnings distribution, the percentages of G2 members with ability 1.13 or greater who graduated college. Since this figure only counts students of ability 1.13 or greater, it illustrates the large discrepancies in college graduation rates among high ability students by father's earnings status. A high ability student with a father in the top decile of earnings was 4.3 times more likely to graduate college than a similar student with a father in the 6th decile and 32.5 times more likely than a high ability student whose father was in

the 3rd decile. Among high ability students whose fathers' earnings fell in the bottom two deciles, virtually none became college graduates.

Figure 4 also shows that college graduation rates for high ability students were higher among students whose fathers were in the middle deciles (4th-6th) than for the 7th and 8th deciles of the earnings distribution (presumably because applicants with fathers earning in the latter two deciles could not demonstrate sufficient need). This finding is the basis for our conclusion that the college subsidy program largely benefited middle income families. Figure 5 plots college graduation rates by father's earnings decile for the cases with and without the subsidy program to illustrate the within decile effects of the college subsidy program. From Figure 5, we see that the subsidy program primarily increased college graduation rates of high ability students only in the 3rd through 7th deciles. Moreover, the rates of increase were centered in the 4th through 6th deciles, reaching a maximum in the middle decile. As should be expected, the subsidies had no effect on the graduation rates of high ability students in the top two deciles of G1 men's earnings distribution since these students were presumably ineligible due to a lack of financial need. Less expected is the finding that the subsidy program had virtually no effect on the graduation rates of students with fathers in the bottom two deciles and almost none in the 7th. The subsidy program increased graduation rates for high ability students in the 5th decile by a factor of 97.5 (from .002 to .195) and increases for the 4th and 6th deciles were also large.

Were the Ability Qualification and Stipend Set Too High?

Earlier we mentioned there was an internal debate within the Roosevelt Administration between those who wanted the college subsidy program to restrict stipends to needy high ability students and those who saw the program as an extension of the government's overall employment generating policies. In this section, we will examine what differences might have occurred had the latter viewpoint prevailed. To approach this issue, we set a benchmark for the possible reduction in stipends that would be caused by increases in the minimum ability qualification. The government's FOC for the replication equilibrium provides a method of approximating the

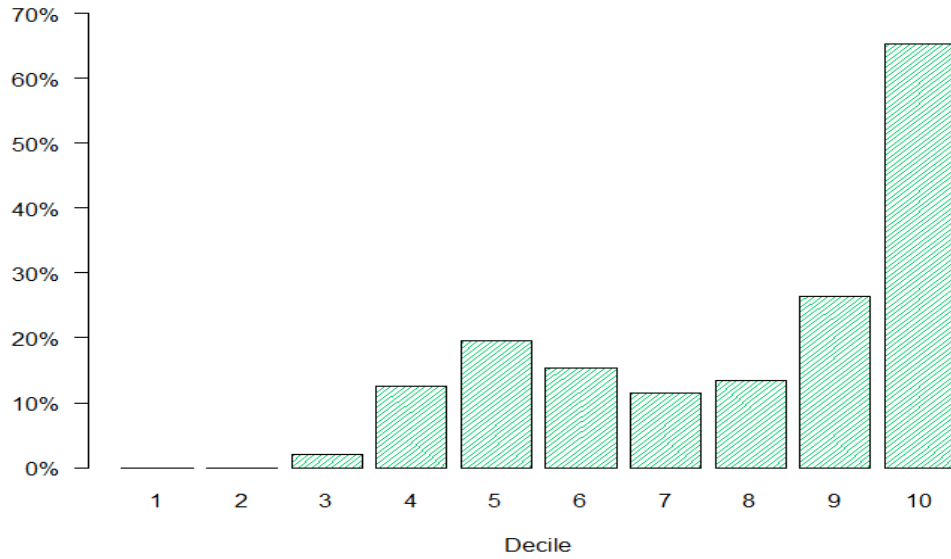**College Graduation of High Ability Students by Father's Wage Decile**

Figure 4- The height of each bar represents the proportion of all G2 high ability students whose father's earnings were in the designated decile who had graduated college by 1940 when the youngest members of the cohort were 24-years old.

College Graduation of High Ability Students by Father's Wage Decile
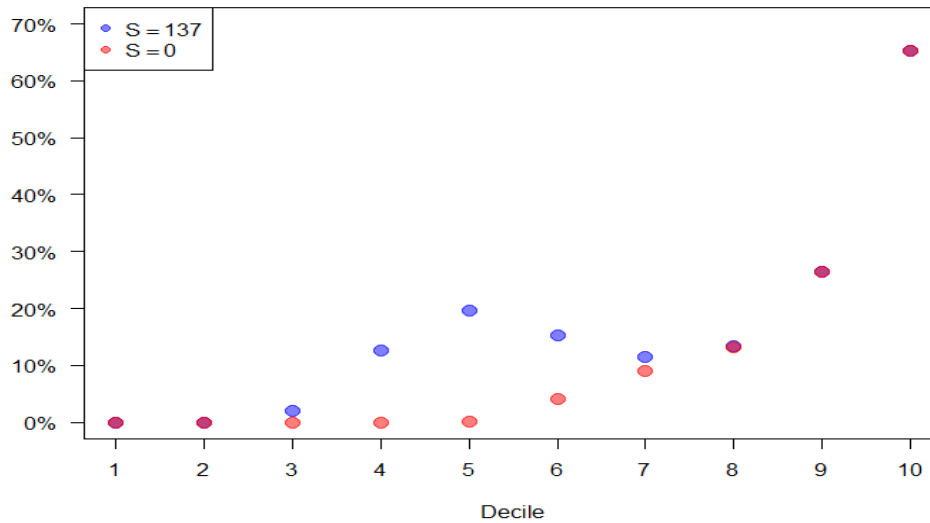
Figure 5 – Percent college graduation by father's wage decile with and without the subsidy program for G2s with ability greater than or equal to $a^* = 1.13$, the ability cutoff for stipend eligibility in the replication equilibrium. Since the sample for the figure only contains the academically eligible population (ability 1.13 or greater) the differences between the red and blue points reflect the effect of the subsidy program solely by father's earnings component of socioeconomic status.

25

number of stipends not granted to students because of the high ability qualification. The Lagrangean represents

the shadow cost (in terms of stipends lost) of an increase in the ability requirement.

Utilizing the regression estimate of a(S) and inputting the replication equilibrium S* value, into the FOC we

find that the lagrange multiplier, lamda, equals 377,081 stipends. Inferring that a one unit increase in the

minimum ability criterion to 2.13 would cost this large number of stipends (all of them), we infer that a decrease

in the ability qualification from 1.13 to say 1.00 would increase total stipends by about 49 thousand. A large gain

that would entail offering stipends to students of average ability.

Now suppose proponents of the universal college policy had prevailed in the policy debate. In this case, the

government's objective function would have changed to the second objective of maximizing the total stipends

delivered subject only to its budget constraint, see discussion on pages 15 through 17. As discussed earlier, from

Figure 1 we observe that the government could *supply* large numbers of stipends by choosing a very small subsidy.

However, at low subsidy levels, there would be deficient demand because stipends would not be taken by any

families. It is clear that under the universal policy that seeks to maximize delivered stipends, the optimal stipend

payment cannot generate excess supply. The two possible cases are either an equilibrium with the supply of

stipends equalling the demand for stipends, or an excess demand allocation with the government supplying

stipends to applicants until its budget is depleted.

Under the universal policy, household's constrained utility optimization imposes a minimum ability among

need eligible students who demand and receive a subsidy. Denoting the optimal subsidy and minimum ability

under the universal policy by S^U and a^U, it is clear that a government maximizing N(S) subject only to budget

feasibility conditions will choose $S^U = infimum\{S|a(S) > 0\} = \$113.278$. However, we have shown that

there is no equilibrium at this subsidy amount. Moreover, there cannot be an equilibrium at a subsidy amount

close to this amount either. At any smaller subsidy there is excess supply implying the government has unspent

funds, and because the set described in the definition of S^U is open there cannot be an equilibrium N(S) close by

and right of S^U (see Figure 1). We rectify this technicality by recognizing that in practice the government must choose stipend levels in one cent increments. Thus, its choices are a subsidy equal to $113.27 or $113.28. With the subsidy $113.27, there is excess supply and unspent budget, so the maximum number of stipends that can be delivered occurs with the greater of these two subsidies. Redefining the optimal $S^U = \$113.28$, we find that when the government offers the stipend $S^U = \$113.28$, there is still no positive ability qualification that equates supply and demand. The quantity of stipends demanded and supplied are 293,347.02 and 293,343.93, respectively. Thus, there is excess demand equal to 3.09 stipends that cannot be allocated due to rationing.

How does the universal subsidy policy compare to the selective policy found in the replication equilibrium? First observe that the universal policy would have allocated an additional 50,809.08 stipends. The minimum ability stipend recipient under the universal program (ability .569) would have been much lower than the 1.13 in the replication equilibrium under the selective policy. However, from an equity perspective, the relevant comparison for the universal policy would be with the lowest ability non-stipend college students which is .575 under both the selective and the universal policies. More, importantly, comparing both policies, the mean abilities of the subsidized and non-subsidized students are very similar. The mean ability of subsidized students under the universal policy is 1.179 compared to 1.198 for non-subsidized students under both policies. Hence, the difference in the mean abilities of subsidized and non-subsidized college students is one-eighth of a standard deviation. By abandoning the high qualification requirements for subsidized students in favor of a more universal policy, the government, with the same budget, could have offered about 50 thousand more stipends with very little change in the average ability of students.

What would the distributional consequences of this change have been? Obviously implementation of the universal policy increases the percentage of college students who were subsidized (from 12.87% under the selective policy to 16.55% under the universal policy). Nonetheless, even the universal education policy would have remained largely a program for the middle earnings classes. Comparing the two policies, the mean earnings

of stipend recipients actually increases a little, from $1208 under the selective policy to $1295 under the universal policy. The much higher mean earnings of non-subsidized students remains the same at $2018. The reason for the increase in the mean earnings of subsidy recipients under the universal policy is that the high ability requirements of the selective policy were mainly rationing out income eligible but still relatively higher ability students in the fourth through sixth deciles of the G1 fathers' earnings distribution.

Had the universal education policy been adopted, there still would have been virtually no students with fathers in the bottom two deciles of the G1 earnings distribution graduating college, and this includes high ability students. Figure 6 shows that, had the Roosevelt Administration adopted the universal education policy, virtually all of the gains in college graduation would have still accrued to students from families in the middle three deciles of the G1 earnings distribution. The results from the universal education policy suggest that relaxing the ability requirements for subsidy eligibility would not have affected the higher education choices of students from families in the lowest deciles of the G1 earnings distribution. Relaxing the ability requirement with a fixed budget induces a tradeoff with respect to the size of the subsidy. High ability students from low earning families were not choosing college because of the prohibitive costs of staying in school, and the size of the stipends were not sufficient to have made a difference!

What would have to change to induce appreciable increases in college participation among high ability students in the bottom three deciles of the G1 earnings distribution? Tightening the income eligibility rules may have increased their participation, but only if doing so would lead to small enough eligibility populations that the equilibrium subsidy could increase sufficiently to attract low earning families. However, this change would likely be self-defeating of overall government objectives (fewer high ability students from the middle classes) and for exactly that reason, likely politically untenable. It appears that only increases in the budget would be effective in increasing college graduation rates among low earning families. This inference can be illustrated by looking at the earnings requirements facing a household deciding if a child should attend college.

From the perspective of a family, the cost of sending a child to college can be covered if the previous annual consumption it had been spending on the child plus the difference between her summer earnings and consumption exceeds college costs. This expression is given by $\frac{W_i}{4+N_i} + \frac{1}{4}[\widetilde{W}_0(12) - \frac{W_i}{4+N_i}] > \$590$. Even assuming fulltime employment were available for the father and the student during the summer, for a household at the 20th percentile of the G1 earnings distribution with an only child son, the left side of this inequality equals \$455, insufficient to cover college costs. Adding the selective subsidy and continuing to assume fulltime summer employment raises the available income to \$592 and the student is borderline able to attend college. If the one child is a daughter, her lower wages decrease the summer earnings ensuring she cannot afford to attend college. Obviously, the more likely situations where households have multiple children and full employment is unavailable make matters worse.

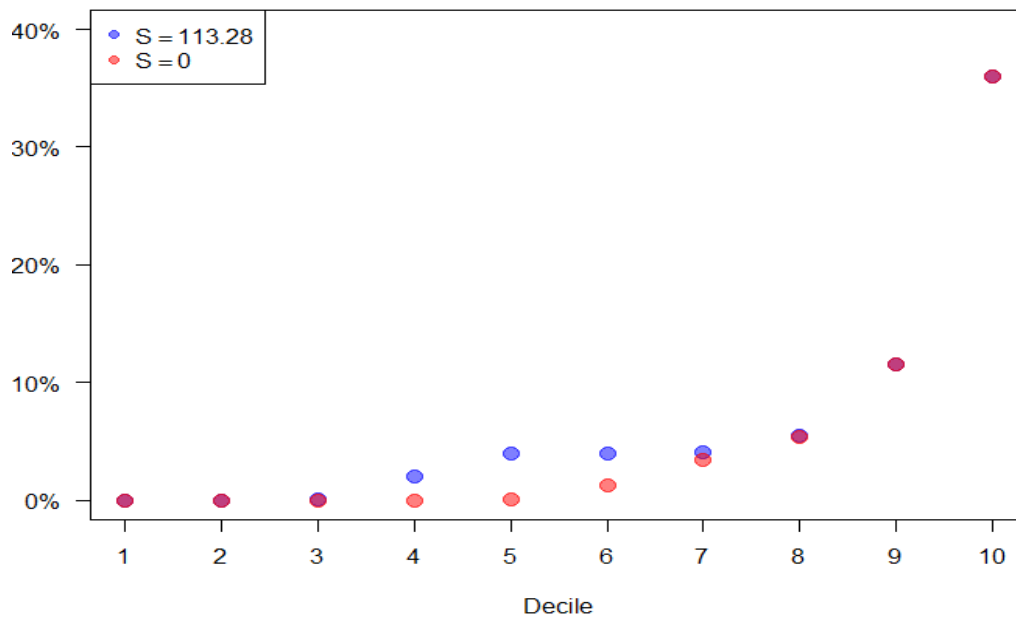**College Graduation of Students by Father's Wage Decile, Universal Policy**

Figure 6

Gender Equity

Overall, about 13 % of G2 White women and 15% of White men attained some college by 1940 implying women were about 46% of G2 college attendees during the 1930s. Thus, the replication equilibrium has households sending sons to college with probability .55 when they must choose between sending sons or daughters. According to Figure 7, the gender bias in college attendance favored women in the middle deciles of father's earnings distribution and favored men in the two highest deciles. There was no bias in the two lowest deciles because virtually no children from these two lowest earning households attended college. Comparing Figures 7 and 8 shows that women's higher enrollment rates in the middle deciles of fathers' earnings were primarily driven by higher rates of attendance but lower graduation rates, men had higher graduation rates at all deciles. Overall, it appears there was some bias favoring sons in the college decisions of families. The male bias appears to extend to the government's subsidy program, although there are some complicating factors. Women only received 38.12% of the government's college stipends. Interestingly, women's percentage of stipends would have declined to 35.38% under the universal subsidy program, and that result turns out to be informative.

College administrators reported that women college students were less likely to need government stipends (Levine; Lyon). If families were treating the college decision equally for daughters and sons, this would be a puzzling result, because there should not have been a large gender difference in need. Furthermore, any observed difference would be expected to affect women more than sons because women's lower market wages at grade 12 would decrease their ability to defray the cost of college by working during the summer. However, if the gender bias showed up when families were income constrained to send all children to college, it would help explain the reported remarks of college administrators. The earnings constraint forcing families to choose between sons and daughters would most often be binding in the middle income ranges where the policy was most effective at increasing college enrollment. Men's ten point advantage in their probability of being chosen (by their parents)

to attend college would be expected to have a significant overall effect on gender enrollment rates. And, because the universal education policy has a greater percentage of students with stipends, somewhat paradoxically, it would accentuate the gender bias in college attendance. [11]

Figure 7 illustrates these points nicely. Implementation of the selective college subsidy program actually increased the gender gap in college graduation rates. Largely this is because, had there been no college subsidy program (S = 0), the gender differences in graduation for students from the bottom half of the G1 earnings distribution would have been zero simply because virtually no one would have gone to college. With the selective subsidy, sons benefitted more from the fact that subsidies were especially effective at increasing graduation rates for high ability students in the middle deciles of the earnings distribution where the explicit bias favoring sons shows up. The observation that there is still a gender difference in graduation rates favoring men, implies there are some explanatory factors not addressed by this model. [12]

Robustness of the Simulations

How robust are the findings from the simulated replication equilibrium? To examine this issue we assessed the sensitivity of the simulation estimates to changes in those parameters of the model with which we had some degree of freedom to manipulate during the calibration process. Our primary focus concerned the subsidy program's effects on college graduation and enrollment rates as well as its distributional effects. Small changes

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[11] We initially attempted to calibrate the model by setting schooling decisions by families to be gender neutral. Hence, we set the probabilities that a family sends daughters or sons to college when it cannot afford to send both genders at .5 each. With this assumption we could not find a replication equilibrium that represented the correct propotion of women among stipend recipients. The replication equilibrium was achieved when sons were given a probability of .55 in cases when a household could send only one gender to college. This change not only implies there was a gender bias in families' decisions to send sons or daughters to college, but as discussed above also helps explain certain puzzles noted in the historical record.

[12] Possibly women attending college in the 1930s were dropping out to marry upper classmen. The percentage of all male college students who would have received a stipend under the universal policy was .193 versus .131 for women. Under the selective policy these percentages were 14.5 for men and for women 10.8.

in the specified parameters of the model generally resulted in an alternative replication equilibrium (demand minus supply equal zero with respect to two decimal points) with small changes in the key outputs of interest. For example, the three most arbitrary parameter specifications of the model are calibration of the CES utility functon (theta equal .75), father's linear effect on children's ability (parameter b in equation 1) and the remittance amounts sons and daughters provide their parents while working and living at home before marriage. Even small changes in theta (.70 and .80) fail to produce replication equilibria, as do values of theta above 1.00, see appendix). With respect to father's affect on children's ability, the replication equilibrium reported sets b equal to .5. Simulations using the values .4 and .6 produce replication equilibria with no substantive differences in the key outputs. Smaller or larger values of b fail to produce replication equilibria suggesting that the ability transmission mechanism from father to children is somewhere in the 40 to 60 percent range.[13] Altering children's earnings remittances from parents leads to a failure to find a replication equilibrium. Further discussion of these robustness checks can be found in the appendix where we discuss the data and specification of the model in more detail.

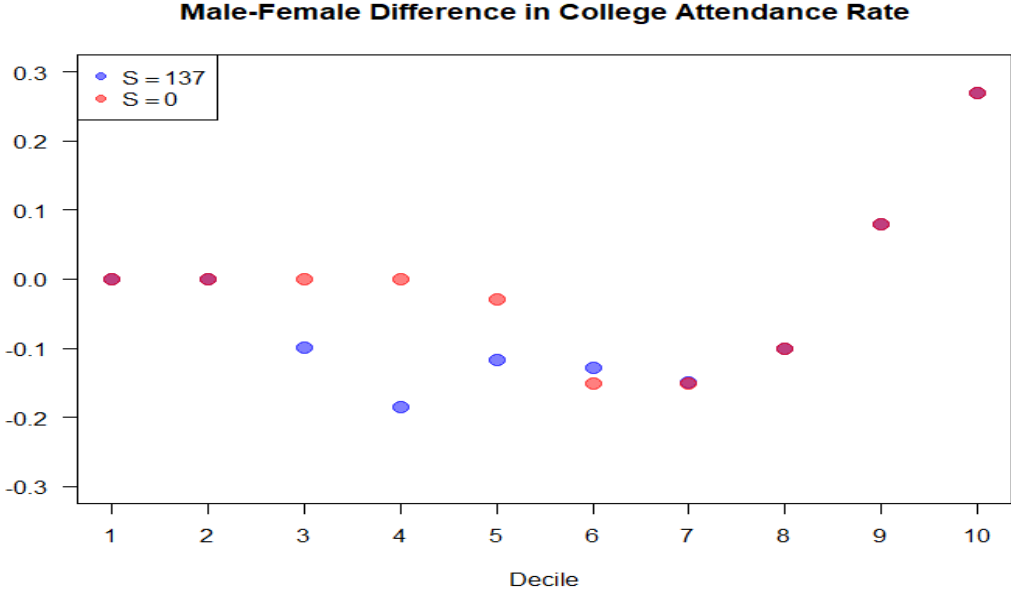
Male-Female Difference in College Attendance Rate

Figure 7 – Male-female difference in college attendance rate of high ability students by father's wage decile.

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[13] This range replicates research on heritability of IQ (Black et al., 2009; Bowles & Gintis, 2002).
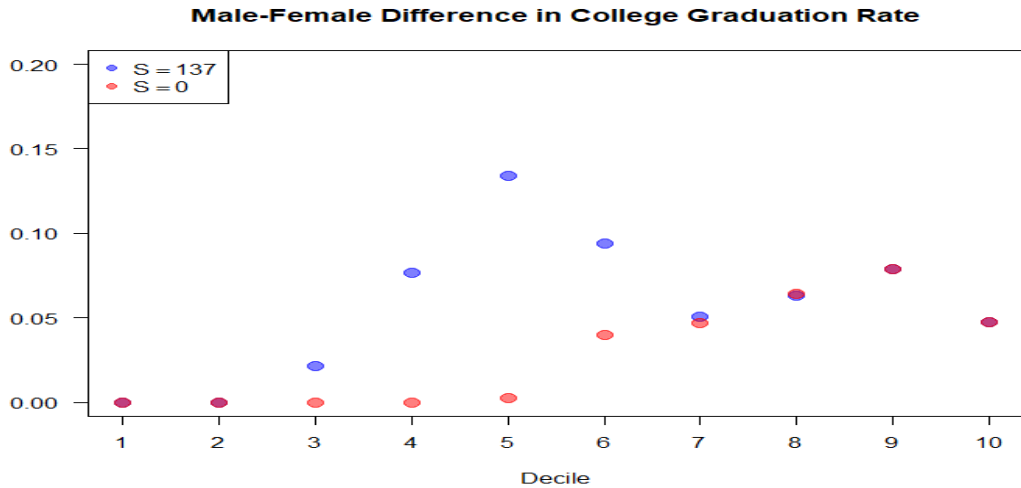
Figure 8 – Male-female difference in college graduation rate of high ability students by father's wage decile. The vertical height of the dots represents male college graduation proportions minus female graduation proportions within each decile.

Conclusions

Our findings show that the college subsidy program substantially increased college enrollment and graduation rates for the cohort of White college students most affected by the Great Depression. Moreover, stipend recipients on average were of higher academic ability than were college students without stipends. However, the emphasis on student ability likely decreased the number of students assisted to go to college, and relaxing the ability requirement would have resulted in only a small decrease in the mean ability of students. The subsidy program was confined to students from families in the middle earnings ranges. Virtually no high ability students from the lowest earnings deciles of the father's earnings distribution attended college, largely because stipend amounts were too small to make college affordable. This paper was restricted to the White population. A subsequent paper examines the college subsidy program's effects on Black students.

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Appendix

Proofs of Lemma 1 and Proposition 1

Lemma 1: Let H(a) be the conditional distribution of abilities over earnings eligible households. Assume the support of H(a) is a single connected interval of R_+. Then, $D(S, a)$ is strictly monotone decreasing in a.

Proof: Let d(S, a) equal the *aggregate* (mean) demand for stipends of need eligible households of type a when the stipend is S. The total demand when the minimum required ability equals zero is

$\int_0^\infty d(S, x) dH(x) = D(S, 0)$.[14] If the minimum ability equals a, $D(S, a) = \int_a^\infty D(S, 0) dH(x) = D(S, 0)[1 - H(a)]$ which is strictly decreasing in a.

Proposition 1. Suppose S* and a* are the optimal subsidy and minimum ability chosen by the government at an equilibrium. Then a* = a(S*).

Proof: Since S* and a* support an equilibrium, $D(S^*, a^*) = \frac{B}{S^*}$ which implies $a^* \in B(S^*)$. Moreover, since $S^* \cdot D(S^*, a^*) = B$ and $D(S^*, a)$ is strictly monotone decreasing in a, any other element of $B(S^*)$ must be greater than a^* showing a^* is a lower bound of $B(S^*)$. Because $a^* \in B(S^*)$, any value a greater than a^* is not a lower bound of $B(S^*)$. This shows a^* equals the infimum of $B(S^*)$.

Household Maximization and Simulations

In this appendix, we describe our computational approach to the household maximization problem defined by equation 1 on page 7, as well as the algorithm for producing simulated distributions of educational attainment. In section 1, we provide expressions for consumptions C_t^p, C_t^s, C_t^d, and C_{t+1}^p in equation 2 before

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[14] This proof takes advantage of the simplifying assumption that households did not anticipate the college subsidy program and therefore did not take it into account when making education decisions during the 1920s and early 1930s. This seems reasonable for the depression period and the emergency context of the program.

defining in section 2 a household's feasible set of educational investments, D. This set contains ordered integer pairs (e_{st}, e_{dt}) determined by minimum levels of education $\left(\underline{e_{st}}, \underline{e_{dt}}\right)$, maximum levels of education $(\overline{e_{st}}, \overline{e_{dt}})$, and egalitarian assumptions on the treatment of male and female children, namely that education investments may only differ when only one gender can be sent to college, in which case the other gender must complete high school. In section 3, we describe the algorithm used to simulate educational attainment distributions.

Consumption Equations

All children in a household are assigned ability a_t according to equation A, and ability indexes the number of grades completed in one calendar year; a child with education e_{xt} spends $\frac{e_{xt}}{a_t}$ years in school. Children begin school at age 6, complete schooling after $\frac{e_{xt}}{a_t}$ years, then enter the labor force and remain in the household until they marry. In the years prior to children entering the labor force or matriculating college, annual household earnings are divided such that each parent's consumption is twice that of each child.[15] Children who attend college receive one quarter of this annual basic consumption basket during the summer and during the remainder of the year consume C' which includes college tuition, room and board, and other costs of attendance. When children enter the labor force, they remit s_x percent of their annual earnings to parents until they marry and leave the household. Hence, first period consumption of children of gender x is:

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[15] According to a report from the Bureau of Labor Statistics which analyzed 100 years of family budgets in the United States, the budget of a family with one child and that of a family with three children are 0.82 and 1.16 times the budget of a family with two children, respectively (Johnson et al.: 34). We introduce the simplifying assumption that the consumption of an adult relative to a child is constant across family size, and thus a factor of two is a reasonable approximation based on these numbers from the BLS. As a result, if we let k be the portion of the family budget consumed by each child and there are two parents and n_t^a children, $2(2k) + n_t^a k = 1 \Rightarrow k = \frac{1}{n_t^a + 4}$.

$$C_t^x = \overbrace{\frac{w_t^p \cdot h_t^p}{n_t^a + 4}}^{Basic\ consumption\ basket} \cdot \overbrace{\left(6 + \frac{\min\{12, e_{xt}\}}{a_t}\right)}^{Years\ prior\ to\ college\ or\ working} + \overbrace{\left(C' + \frac{1}{4} \cdot \frac{w_t^p \cdot h_t^p}{(n_t^a + 4)}\right)}^{College\ consumption} \cdot \overbrace{\frac{\max\{e_{xt}, 12\} - 12}{a_t}}^{Years\ in\ college}$$

$$+ \overbrace{(1 - s_x) \cdot W_t(e_{xt}) \cdot h_t^x}^{Wages\ net\ remittance} \cdot \overbrace{\left(\max\left\{M_t^x - \left(6 + \frac{e_{xt}}{a_t}\right), 0\right\}\right)}^{Years\ working\ prior\ to\ first\ marriage}$$

where M_t^x is the age at first marriage of gender x in generation t. If children attend college, parents contribute the difference between the annual cost of college and the sum of wages and stipends earned by the student while attending. During the current generation, parents' consumption is thus:

$$C_t^p = \overbrace{w_t^p \cdot h_t^p \cdot l_t^p}^{2nd\ period\ earnings}$$

$$- \sum_{x=s,d} \Bigg[n_t^x$$

$$\cdot \left(\overbrace{\frac{w_t^p \cdot h_t^p}{n_t^a + 4}}^{consumption\ basket} \cdot \overbrace{\left(6 + \frac{\min\{12, e_{xt}\}}{a_t}\right)}^{Years\ prior\ to\ college\ or\ working}\right.$$

$$+ \overbrace{\left(C' + \frac{1}{4} \frac{w_t^p \cdot h_t^p}{(n_t^a + 4)} - \widetilde{w_t^x} \cdot \widetilde{h_t^x} - S \cdot A(I(v), \overline{a})\right)}^{Parenal\ contribution\ to\ college\ costs} \overbrace{\frac{\max\{e_{xt}, 12\} - 12}{a_t}}^{Years\ in\ college} - \overbrace{s_x \cdot W_t(e_{xt}) \cdot h_t^x}^{Remitted\ wages}$$

$$\left. \cdot \overbrace{\left(\max\left\{M_t^x - \left(6 + \frac{e_{xt}}{a_t}\right), 0\right\}\right)}^{Years\ working\ prior\ to\ first\ marriage} \right) \Bigg]$$

where l_t^p is the remaining life expectancy at first marriage for men at generation t, $\widetilde{w_t^x}$ is the wage earned by a college student of gender x, and $\widetilde{h_t^x}$ is the number of hours worked by college students of gender x.

The consumption of a parent of gender x in the following period C_{t+1}^{px}, is identical to current parental consumption, except the parental wage, w_t^p, is replaced with expected future wages as a function of educational investment,

$w^p_{t+1}(e_{xt})$. We also make the simplifying assumption that G1s believe their grandchildren will have the same educational attainment as their parents (G2s):

$$
\begin{aligned}
C^{px}_{t+1} &= \overbrace{w^p_{t+1}(e_{xt}) \cdot h^p_{t+1} \cdot l^p_{t+1}}^{\text{Second period earnings}} \\
&\quad - \sum_{x=s,d} \Bigg[n^x_{t+1} \\
&\quad \cdot \Bigg(\frac{\overbrace{w^p_{t+1}(e_{xt}) \cdot h^p_{t+1}}^{\text{Basic consumption basket}}}{n^a_{t+1} + 4} \\
&\quad \cdot \overbrace{\left(6 + \frac{\min\{12, e_{xt+1}\}}{a_{t+1}} \right)}^{\text{Years prior to college or working}} + \overbrace{\left(C' + \frac{1}{4}\frac{w^p_{t+1}(e_{xt}) \cdot h^p_{t+1}}{(n^a_{t+1} + 4)} - \widetilde{w^x_{t+1}} \cdot \widetilde{h^x_{t+1}} - S \cdot A(I(v), \overline{a}) \right)}^{\text{Parental contribution to college costs}} \overbrace{\frac{\max\{e_{xt+1}, 12\} - 12}{a_{t+1}}}^{\text{Years in college}} \\
&\quad - \overbrace{S_x \cdot W_t(e_{xt+1}) \cdot h^x_{t+1}}^{\text{Remitted wages}} \cdot \overbrace{\left(\max\left\{ M^x_{t+1} - \left(6 + \frac{e_{xt+1}}{a_{t+1}} \right), 0 \right\} \right)}^{\text{Years working prior to first marriage}} \Bigg) \Bigg]
\end{aligned}
$$

1. Feasible Education

Compulsory education laws constrain the minimum feasible level of education. The most common state laws in the 1920s required attending school either until age 16—equivalent to $\lceil 10a_t \rceil$ years of schooling[16]—or completing 8th grade (Goldin and Katz: 8). Hence, $\underline{e_{xt}} = \min\{8, \lceil 10a_t \rceil\}$. Maximum feasible education, $\overline{e_{xt}}$, which is either

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[16] We use $\lceil 10a_t \rceil$ since educational attainments must be integer values.

12 (high school graduation) or 16 (college graduation)[17], is determined by a college affordability condition described in the following subsection.

i.   College affordability condition

The "budget-per-child while children attend primary and secondary school", $\frac{w_t^p \cdot h_t^p}{n_t^a + 4}$, is allocated to each child's consumption annually. If the budget-per-child exceeds the required annual parental contribution to college expenses for a child, we conclude the household can afford to send all children to college. When the household cannot afford to send all children to college, there are several subcases: 1. If the household budget divided between parents and only children of one gender exceeds college costs, then the household can afford to send that gender to college. 2. If the household can afford to send either gender to college but not both, one gender is chosen to be eligible for college education according to the random variable $Y \sim Bernoulli(0.55)$, where sons are eligible if $y = 1$ and daughters are eligible if $y = 0$. Hence, let $\frac{w_t^p \cdot h_t^p}{n_t^x + 4}$ be the "budget-per-x", where $x = a, s, d$. We define the family budget criterion function, F, whose sign indicates whether the household's budget-per-x exceeds the parental contribution to college costs given stipend S:

$$F(v, S, x) = \frac{w_t^p \cdot h_t^p}{n_t^x + 4} - \left(C' + \frac{1}{4} \frac{w_t^p \cdot h_t^p}{n_t^a + 4} - \widetilde{w_t^x} \cdot \widetilde{h_t^x} - S \right)$$

where $x = a, s, d$.[18] Using the family budget criterion function, households can be assigned types which correspond with the household's ability to send all children to college, to send only sons, or to send only daughters, summarized in the following table:

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[17] We do not distinguish between college graduates and individuals who attended graduate or professional school whose educational attainment would be more than 16.

[18] We define $\widetilde{w_t^a} \cdot \widetilde{h_t^a} = \min\left\{\widetilde{w_t^s} \cdot \widetilde{h_t^s}, \widetilde{w_t^d} \cdot \widetilde{h_t^d}\right\}$.

Type	Description
I, Is, Id	Household can afford to send all children, only sons, or only daughters, respectively, to college when S = 0.
II, IIs, IId	Household can afford to send all children, only sons, or only daughters, respectively, to college when receiving stipend amount S per child.
III	Household cannot afford to send any children to college.

Observe the similarity between the functions $F(v, S, x)$ and $I(v)$. Specifically $I(v) < C'$ and $F(v, 0, x) < 0$ for $x = s, d$ are equivalent conditions. The two functions are distinct only in that $F(v, S, x)$ is from the household's perspective and $I(v)$ is from the government's—the government only considers whether any applicants from a household are stipend-eligible from a need-based criterion, whereas it is necessary for households to evaluate which children it can afford to send to college with and without a specific stipend amount, S.

We now describe the assignment of household types using the family budget criterion function. A household is type I if the budget-per-a exceeds the parental contribution to college expenses for every child when $S = 0$, i.e.:

$$type\ I: F(v, 0, a) \geq 0.$$

A household is type Is if 1. it is not type I, 2. the budget-per-s exceeds the parental contribution to college for each son when $S = 0$, and 3. either (i) the budget-per-d does not exceed the parental contribution for each daughter when $S = 0$ or (ii) $y = 1$:

$$type\ Is: \begin{cases} F(v, 0, a) < 0 \\ F(v, 0, s) \geq 0 \\ F(v, 0, d) < 0\ or\ y = 1 \end{cases}$$

A household is type Id if analogous conditions hold for daughters:

$$type\ Id: \begin{cases} F(v, 0, a) < 0 \\ F(v, 0, d) \geq 0 \\ F(v, 0, s) < 0\ or\ y = 0 \end{cases}$$

Types II, IIs, and IId are defined in the same manner, except $S > 0$ in the family budget criterion function: a household is type II if it is neither type I nor type Ix for $x = s, d$ and the budget-per-child exceeds the parental contribution to college expenses for every child if he or she were to receive a positive stipend[19]:

$$type\ II: \begin{cases} F(v, 0, x) < 0 \\ F(v, S, a) \geq 0 \end{cases}$$

A household is type IIs if:

$$type\ IIs: \begin{cases} F(v, S, a) < 0 \\ F(v, S, s) \geq 0 \\ F(v, S, d) < 0 \ or \ y = 1 \end{cases}$$

and type IId if:

$$type\ IId: \begin{cases} F(v, S, a) < 0 \\ F(v, S, d) \geq 0 \\ F(v, S, s) < 0 \ or \ y = 0 \end{cases}$$

Lastly, a household is type III if neither gender can attend college, even when receiving a stipend.

Maximum levels of education are then determined by a combination of a household's college affordability type and the subsidy allocation function $A(I(v), \overline{a})$:

$$(\overline{e_{st}}, \overline{e_{dt}}) = \begin{cases} (16,16) & [\text{type} = I] \ or \ [\text{type} = II \ and \ A(I(v), \overline{a}) = 1] \\ (16,12) & [\text{type} = Is] \ or \ [\text{type} = IIs \ and \ A(I(v), \overline{a}) = 1] \\ (12,16) & [\text{type} = Id] \ or \ [\text{type} = IId \ and \ A(I(v), \overline{a}) = 1] \\ (12,12) & otherwise \end{cases}$$

Combing both the maximum and minimum educational investments for each gender and assumptions that 1. education investments only differ when households are type $Is, Id, IIs,$ or IId and 2. when education investments differ, the gender that does not attend college must complete high school, the set of feasible education investments for a household, D, is:

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[19] There is no need to include the condition $F(v, 0, a) < 0$ because this is implied by $F(v, 0, d) < 0$ since $F(v, S, a) \leq F(v, S, d)$ for any S.

$$D = \left\{ (e_{st}, e_{dt}) : e_{st} \in \left\{ \underline{e_{st}}, \ldots, \overline{e_{st}} \right\}, e_{dt} \in \left\{ \underline{e_{dt}}, \ldots, \overline{e_{dt}} \right\}, e_{st} = e_{dt} \ if \ type \ \in \{I, II, III\}, \min\{e_{st}, 12\} \right.$$
$$\left. = \min\{e_{dt}, 12\} \ if \ type \ \in \{Is, Id, IIs, IId\} \right\}$$

2. Simulation Algorithm

The simulation takes place in two stages for types II, IIs, and IId. In the first stage, we impose the restriction that the maximum educational attainment for types II, IIs, and IId is 12 for both genders, and in the second stage, we re-simulate optimal attainments over the whole set D for type II's whose optimal educational investment is high school graduation in the first stage. The simulation algorithm is as follows:

1. Given a stipend amount S, assign college affordability types for each observation using the family budget criterion function. Determine the set of feasible educational investments, D, with $\overline{a} = 0$.

2. Maximize the objective in equation 2 over D for types I, Is, Id, III and over $D' = \{(e_{st}, e_{dt}) \in D : e_{st}, e_{dt} \le 12\}$ for type II, IIs, IId. Denote (e_{st}^*, e_{dt}^*) as the optimal investment for a household.[20]

3. For type II, IIs, IId households with $(e_{st}^*, e_{dt}^*) = (12,12)$, re-perform the maximization over D.

4. Solve for $a(S)$.

5. Impose $\overline{a} = a(S)$, i.e. assign $(e_{st}', e_{dt}') = (12,12)$ for all type II, IIs, IId households with $\max\{e_{st}^*, e_{dt}^*\} > 12$ and $a_t < a(S)$.

Determination of the Government's Budget

According to the NRA Final Report, the government spent about \$93 million on the college subsidy program during the academic years 1935 through 1943. Our estimates cover G2 college attendance between 1934 and 1940. Note that three semesters of funding (January 1934 – June 1935) are not included in the \$93 million. Moreover, the oldest cohort of G3 (born in 1917) began supplying 1st year college students in

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[20] Given that the maximization is performed over a small set of discrete values, we use brute force optimization.

substantial numbers during the academic year 1935-1936, so G3s would have competed with G2s for stipends during the period 1935 onwards. Thus, the entire $93 million could not have gone to G2 students, and additional funds for the eighteen months preceding September 1935 must be included. The oldest members of the G2 cohort (born 1912) began providing substantial college students during the academic year 1930-31 and would mostly have graduated during 1934. Thus, the majority of G2 students would have been eligible for subsidies from January 1934 through June 1938. We assume mean annual spending during the 1934 through 1940 period equaled mean annual spending of the $93 million during the seven-year period ending in 1942. Hence, the annual budget becomes $93 million/7 = $13.286 million per year. Noting G2 and G3 are about the same population size and assuming they attended college at similar rates during the 1930s, we calculate what proportion of the annual budget would be allocated to G3 students each year and subtract the sum from the total to estimate the budget for G2.[21] In 1934, the G3 cohort gets zero stipends. In 1935, G3 would be expected to get 100% of the stipends going to 1st year students = 25% of annual spending; in 1936 G3s get 100% of 1st year stipends and 100% of 2nd year stipends = 50% of annual spending; in 1937 G3s get 100% of year 1, 100% of year 2, 100% of year 3 =75% of annual spending; in 1938 - 1940 G3s get 100% of all stipends (assuming balanced numbers across the class years). Thus, G3s get $0 in 1934; .25*$13.286 million = $3.32 million in 1935; 2*$3.32 million= $6.64 million in 1936; $9.96 million in 1937; 1938 - 1940 G3 gets 3*$13.286 million = $39.85 million. The G3 cohort is estimated to have received $59.77 million leaving $33, 230,000 for the G2 cohort.

Determination of Model Parameter Values

Parameter values and explanations of their derivation are contained in Table 2 and its footnotes.

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[21] According to the US National Youth Administration, subsidy students who did not maintain grades were dropped from the program. Thus, recipients should have exhibited satisfactory progression toward graduation (US National Youth Administration: 52).

Table 2- Values of Parameters Used in Simulations

	Parameter	Value
Intertemporal Elasticity of Substitution		
	θ	0.75
Time Discount Rate		
	β	0.91
Altruism		
	β'	0.65
Ability Assignment		
	b	0.5
	d	0.2
College Costs		
	C'	$595
	p	0.55
Hours		
	h_t^p	3100
	h_t^s	1348
	h_t^d	1225
	h_{t+1}^p	1100
	$\widetilde{h_t^s}$	255
	$\widetilde{h_t^d}$	250
Remittances		
	s_s	0.8
	s_d	0.2
Life Expectancies		
	G1 men	63.83
	G2 men	66.92
	G2 women	69.16
Age at first marriage		
	G1 men	26
	G2 men	25.5
	G2 women	23.5
Number of Children		
	n_{t+1}^a	2.2

Intertemporal Elasticity of Substitution

Equilibrium occurs for the constant coefficient of relative risk aversion θ at a value of .75. Were

education a continuous variable with intertemporal maximization of generational utilities implying an

Euler condition and $\frac{1}{\theta}$ equaling the intertemporal elasticity of consumption (IEC), the implied 1.33 elasticity would exceed values commonly represented in the macroeconomics literature for the U.S., although well within the interval of elasticities estimated in a large literature (Havranek et al., 1015). We think there are several reasons for the small θ value. First, with households choosing among finite education possibilities there is no reason to believe the reciprocal of θ would equal the IEC. Moreover, the households whose behavior we simulate were making human capital investment decisions during the Great Depression when incomes, asset valuations, stock market participation rates, and expectations about the future were each near their lowest point of the 20th Century. Tellingly, we were unable to find a replication equilibrium for values of $\theta > 1$ where investments in education were much greater than the cohort's actual education levels and especially for college graduation rates. It appears at higher levels of θ households' desire to smooth consumption across time becomes so strong they would willingly sacrifice historically unreasonable amounts of current consumption by leaving children in school to increase future consumption despite current consumption's low values.

Parental Altruism and Time Discount

We initiated calibration with a time discount of .93 and a parental altruism rate of .69 which equaled the rates that calibrated Nishiyama's (2000) overlapping generation model with parental bequests to the U.S. economy. The rates that calibrated to a replication equilibrium were a time discount of .91 and a .65 rate of parental altruism. The multiplicative time discount and parental altruism rate of .59 obviously aligned well with Nishiyama's, and is also similar to the combined effect of .51 that calibrated Laibson et al's (2023) life-cycle model of consumption-savings behavior to the U.S. economy. The time discount of .91 corresponds to an interest rate of 9.89 percent slightly more than double the 4.49 rate on Aaa corporate bonds during 1933. The significance of this rate to our modelling assumption of no borrowing for college is suggested by the fact it would not be reached again until the mid-1960s during what is sometimes called

the credit-crunch of 1966 when similar to the depths of the Great Depression, reports of borrowers unable to obtain credit at any price were common (Owens and Schreft, 1995).[22]

Ability Assignment

Interestingly, our initial assignment of children's abilities was based on a random assignment about the father's percentile ranking in the G1 wage distribution (set b = 1 in equation A). There were no replication equilibria with this specification. One can find replication equilibria for b in the range .4 - .6, a range consistent with the empirical literature addressing the issue of IQ transmission rates between parents and children. The replication equilibria associated with these different values for b lead to virtually indiscernible changes in the simulated outcomes.

College Costs

The mean minimum average cost of attendance for *in-state students* across 50 public universities was $443.88 during 1938 (University of North Carolina, 1939), and the typical cost in coeducational public institutions during 1933-34 was $452 (Greenleaf, 1934). The cost at the private University of Pennsylvania in 1938 was $985 (Lloyd and Heavens, 2003). In computing C' which adds students' summer consumption to the cost of attendance, we assume stipend applicants were at the lower end of the cost range and we made small changes in to calibrate the equilibrium.

Hours Worked

The hours listed in Table 2 represent calibrated annual hours for the designated groups. Imputed annual hours were initially mean values based on unemployment rates and typical hours worked per day (US Census Bureau, 1949, Lebergott, 1957). G2 summer hours were based on mean values of college students calculated from the 1940 census. Beginning from these base rates, all hours were adjusted to calibrate the equilibrium.

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[22] Equilibrium results were not very sensitive to the discount rate.

Remittances

Historical sources report that early in the 20th century, working children living at home routinely remitted all their earnings to their parents and presumably received allowances. By the 1930s, this tradition was weakening and daughters especially were retaining larger amounts of their earnings (often to support purchasing clothing and other personal extra items), (Moehling, 2005, 417-21, 426; Ovington, 1911). The remittances reported in the table are the values that resulted in a replication equilibrium. It was not possible to reach equilibrium when the remittance percentages for sons and daughters were equal or if daughters' remittances were larger than the percentage reported in the table.

Life Expectancies

Life expectancies listed in Table 2 are mean values for the relevant cohorts and are taken from (Glover, 1921; Hill, 1936).

Age at first marriage

Median ages at first marriage are taken from Elliott, Krivickas, Brault, and Kreider (2012).

Number of Children

The number of children in G1 households are based on the number of children ever-born for the wife (the division between sons and daughters are based on children living at home or mean values if none at home. G2 and G3 children are based on median census values for the age cohort.

Wage Regressions and Earnings Imputations

To produce point estimates for expectations of future wages, we regressed hourly wages on education, experience, education-experience interaction, a south regional dummy, south-experience interaction, and occupation indicator variables on education, experience,[23] education-experience interaction, a south regional dummy, south-experience interaction, and occupation indicator variables (professional sales, foremen,

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[23] Since the Census does not report experience, we define $experience = age - (6 + education)$.

professional managers, professional elites, professional technical, and academic elites; see table 3 below) for

men and women (separately) with positive hours worked and positive hourly wage. Wages for all others are

then imputed using regression coefficients. Since w_t^p reflects the parent's average wage over the current period,

we remove fourteen years of experience from G1's wages using the regression coefficients and adjust to 1925

prices. We then calculate point estimates of G2 wages in both the first and second period: in the first period,

wage point estimates are education- and region-specific imputed values with experience equal to zero, and in

the second period, we average education- and region-specific point estimates for each value of experience from

0 to l_{t+1}^p.

Table 3 – Occupation Indicator Variables

Occupation Category	1950 Census Occupation Codes
Professional Managers	200, 210, 240, 250, 280, 290, 300
Foremen	523
Professional Sales	400, 450, 470, 480, 490
Professional Elites	000, 001, 032, 036, 055, 075
Professional Technical	002, 003, 007, 041, 042, 043, 044, 045, 046, 047, 049, 068, 073, 081, 083, 099
Academic Elites	012, 013, 015, 016, 018, 027, 029

Table 44 – Wage Regressions

	Men	Women
Education	0.020***	0.043***
	(0.006)	(0.003)
Experience	0.004**	0.003**
	(0.002)	(0.001)
Education*Experience	0.001***	0.0002**
	(0.0002)	(0.0001)
South	−0.003*	−0.002*
	(0.002)	(0.001)
Experience*South	−0.110**	−0.060***
	(0.044)	(0.021)
Professional Managers	0.333***	−0.187***
	(0.039)	(0.027)
Foremen	0.209***	0.075
	(0.067)	(0.083)
Professional Sales	0.009	−0.041**
	(0.037)	(0.019)
Professional Elites	0.377***	0.452***
	(0.117)	(0.090)
Professional Technical	0.395***	0.237***
	(0.071)	(0.076)
Academic Elites	0.746***	1.025***
	(0.215)	(0.117)
Constant	0.376***	−0.006
	(0.069)	(0.037)
Observations	201,634	86,513
R^2	0.003	0.011
Adjusted R^2	0.003	0.011
Residual Std. Error	4.439 (df = 201622)	1.529 (df = 86501)
F Statistic	53.562*** (df = 11; 201622)	87.111*** (df = 11; 86501)

Note: *p<0.1; **p<0.05; ***p<0.01