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The total return to higher education: Is there underinvestment for economic growth and development?

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ABSTRACT

The total return to higher education is the rate of return based on earnings plus non-monetary private and social benefits beyond earnings that captures higher education's contribution to development. A theory of endogenous development is a new scholarly contribution where firm and household production with education externalities and the endogeneity of new ideas leads to an optimal rate of development. This rate is higher than in an economy without these externalities. Since measures of private non-market and social benefit externalities are positive, externalities contribute to higher per capita development. The total return is estimated to be considerably higher than the opportunity cost of funds and the return on physical capital, the first major evidence of serious underinvestment in higher education in the US for optimal development. Policy-relevant treatment effects and policy options with implications for optimal development and for improving the worsening condition of the dissatisfied middle class are considered.

1. Introduction

It has long been known by economists that there has been underinvestment in higher education for growth. But with growing numbers of graduates and with rising private tuition costs and student debt is this still true? And beyond this, whether there is underinvestment for broader development has never been investigated. Central to the theme of this paper, there are important non-monetary private and social benefits above and beyond earnings that affect individual life chances as well as regional and national development that contribute to this but are poorly understood. In fact, the total returns, monetary and non-monetary, have never been comprehensively measured or measured without a lot of overlap. There are important implications for public funding policies, for academic policies, for rates of growth and development over time, and for institutions supporting democracy, human rights, and political stability that have not been systematically explored.

The total return to higher education includes earnings but also the value of these non-market outcomes beyond earnings, all in relation to their full social costs. This key measure of the contribution of higher education to development can be compared to the effectiveness of other types of investments. Non-monetary *private* benefits include higher education's contribution to better health, child development, longevity, household and asset management, and more. The non-monetary *social* benefits are externalities that include contributions to the evolution of civic institutions providing for democracy, human (or civil) rights, and political stability, to lower crime rates, environmental sustainability, higher tax revenues, and more new ideas. These are measured by regression methods although a few are not yet measured with much precision. The unfamiliarity with what these non-monetary outcomes are leads to them often being overlooked or de-emphasized, with implications for higher education's contribution to individual life chances, the quality of life, and overall development.

After offering a theory of endogenous development as a framework, this paper presents new estimates of the standard social rates of return to higher education (i.e., the narrow monetary rates) that focus on the 2 and 4 year college levels but computes these rates for

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all levels for comparison. These are deliberately measured to reflect the full longer run institutional and social costs of each increment. They are followed by estimates of the private and social nonmonetary benefits beyond earnings and their value, which leads to the total return. Comprehensive estimates have not existed previously, although there are several good surveys that contain overlapping and non-comparable outcomes and omit others.

This paper is not a survey, however. For the non-monetary outcomes in Section IV the existing literature is a data base from which the best that is known about each outcome is extracted, the only feasible way to estimate a total return. Only articles that contain the necessary coefficients and meet the scientific standards for the inference of causation are used. Methods are developed to standardize the coefficients that each study reports. Many studies are excluded because they deal with intermediate outcomes and therefore overlap when summing final outcomes or because they do not control for per capita income and therefore overlap the effects from the earnings benefits.

The scholarly contribution is in the development of a new theory of endogenous development leading to a solution for the optimal rate of per capita development. It also lies in presenting theoretical and empirical evidence that shows how higher education externalities raise that rate. This also results in the theory and evidence that enables a conclusion to be drawn for the first time about whether there is over or under investment in higher education for optimal per capita development. Other aspects that constitute potential scholarly contributions include the incorporation of the endogeneity of new ideas in a way that generates hypotheses about this endogeneity that can be tested further empirically. Further, the theory presented can be interpreted with minor modifications as a theory of higher education institutions that is more comprehensive than prior offerings in that it focuses on what higher educational institutions really produce, namely human capital skills embodied in graduates that have important outcomes, as their central role, (but for research universities, also direct R&D outcomes of course). Other potential scholarly contributions lie in new methods for standardization when one wishes to make use of results from diverse studies (as in Section V), a new practical method for valuing outcomes including social outcomes based on the cost of obtaining the same result by other methods, and new insights into the development of knowledge-based institutions necessary to democracy, human rights, and political stability that are shown to contribute to higher per capita growth and faster rates of broader economic development.

The policy significance of this paper lies in the potential for addressing two of the nation's biggest problems, the currently distressed condition of the middle class, and sharply rising inequality. With respect to the former, the 64% of the US population that has high school or less is deeply dissatisfied due to a flat or even 13% decline in their real incomes since 1980. They have not participated in the benefits of growth from freer trade and from new technology. Those who lost their manufacturing jobs have suffered even more than 13%. What is needed is not jobs, ---- we are now at full employment, but instead the capacity to access high paying higher skill jobs. Those with a college degree have seen a 49% increase in real earnings since 1980. If income from their higher savings is included, their total incomes have grown even faster. Tennessee, Oregon, New York, and now Rhode Island have recently made Community Colleges free. Most have made this available to only recent high school graduates, which leaves out many dissatisfied adults. But Tennessee is making all adults eligible who wish to study for an associate degree and the waiting rooms have filled up. The children of the depressed middle class also benefit, but they have virtually no chance of entering the ruling economic and political elite without a college degree so they will perpetuate rising inequality into the next generation. But is the return high enough to warrant the necessary investment? And is the public investment necessary to lower tuition and student loan debt consistent with economic efficiency and with optimal growth and development? This paper provides the framework and answers to these kinds of important policy questions.

2. The literature

Early origins of what is presented here lie in Becker (1960, 1964, 1965, 1967a, 1981) on human capital as it relates to earnings, but also to household production using the same human capital during non-labor market hours to benefit the family, and when used in the community, to benefit others as external social benefits. These final outcomes contribute to individual development and to economic development largely in the communities where the graduates live. Effects on development as used here mean education's effects on outcomes beyond earnings as measured, for example, in the World Bank (2017) *World Development Indicators*.

Early origins of the endogenous development model include Lucas (1988) work on endogenous growth and on new ideas (Lucas, 2009). The new endogenous development model offered here includes household production using human capital producing non-monetary outcomes, education externalities, and a deliberately simplified endogeneity of new ideas. Early origins of this will be found in McMahon (2002, 2007, 2009, 2017) and McMahon and Oketch (2013) where there are estimates of some of the non-monetary development outcomes but no formal model. Hu (2008) has a model that contains home production but it has no applications to development, no education externalities, no endogeneity of new ideas, and focusses on the transitional dynamics of three sector models.

With respect to empirical estimates of the non-monetary outcomes from education, Haveman and Wolfe (1984, 2007) pioneered the measurement of some of these and one method of valuation. However, they include none of the social benefits covered here. Theirs is a survey, which this paper is not, and therefore they include intermediate and final outcomes that overlap if one were to try to get a total return. Michael (1982) and Grossman (2006) surveys include important controls for per capita income. Other recent surveys help to identify relevant coefficients including Lochner (2011A, 2011, 2010A), Lochner and Moretti (2004), Oreopoulos and Petronijevic (2013), Oreopoulos and Salvanes (2011), Jacobson, LaLonde and Sullivan (2013A), Murnane Richard (1981A, 2013), Lochner and Moretti (2004), and Moretti (2004a, 2004b). None attempt to estimate a total return and all include many overlapping outcomes.

Finally, other early origins are in the author's prior work (McMahon, 2002, 2017, 2009). It has some of the preliminary work for Section V of this paper but all other parts of this paper are totally new. For Section V there were many years of work enabling identification and averaging of the education coefficients. McMahon (2012) is a 4 volume edited work reprinting a collection of background articles with introductions that serve as further references for this paper. Literature on various issues is cited in Appendix A on line at https://publish.illinois.edu/wmcmahon/. The literature on some of the higher education outcomes is cited later as these outcomes are considered.

3. The theory of endogenous development

Endogenous development builds on endogenous growth, so after a few definitions, endogenous growth will be briefly addressed first. The objective is not to specify equations to be estimated, but to explore the relevance of the social rates of return, to provide the basis for the main conclusions, and to discover the contribu-

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tion or the lack thereof made by higher education externalities and by the endogeneity of new ideas to optimal growth and optimal development.

There are two rates of return estimated later that are relevant to what follows in this section. The first is the standard social rate of return. It is based on monetary earnings only related to the full costs of the investment, private and public, and it is policy-relevant to pure economic growth. The second is the total rate of return relevant when the objective is endogenous development. It includes in addition to earnings the non-market development outcomes beyond earnings listed earlier.

Both are relevant to economic efficiency. Overall economic efficiency by definition includes internal efficiency within higher education institutions (i.e. production efficiency) but also the external efficiency (i.e. exchange efficiency) with which higher education outcomes serve the student's and society's well-being. The later includes social benefits which are externalities that benefit others and future generations. These externalities are significant in that they are the main rationale for taxpayer support of higher education on efficiency grounds. Equity will not be included here although it also is a part of social welfare and part of the rationale for public support. It is excluded because it is not part of the criteria for economic efficiency which is the focus.

3.1. Social rates of return and optimal growth

A brief summary of the endogenous growth model follows. It is new, however, in that it incorporates the endogeneity of new ideas, and further develops the role of externalities, and how they and public support relate to quality. This also provides key building blocks for the new model of endogenous development. For growth, and later for broader development, production by firms is:

$$Y_t = I_t[AK_t^{\beta}(\mu_t h_t N_t)^{1-\beta}]h_{at}^{\gamma}. \quad (1)$$

Here Y_t = output of goods and final services as measured by GDP, A = the level of technology, treated as constant in the absence of new ideas, and I_t = new ideas used to create and adapt new technologies. They are endogenous because they heavily depend below on human capital formation especially at Masters and PhD levels. K_t is physical capital, h_t is the average human capital or skill level per person which includes new technologies embodied in human capital by higher education, μ_t is the fraction of time spent on the job, and N_t is the number of persons. h_{at} is the average level of education in the community used to represent education externalities. I_t and h_{at} are shown outside the parentheses which emphasizes that when $\gamma > 0$ and/or $I_t > 1$ there are increasing returns to scale. This production function is similar to that in the Lucas (1988, 2011) endogenous growth model as well elements from his "ideas and growth" (2009). However, new ideas including significant adaptations, I, are here explicitly incorporated and are soon made endogenous.

If most externalities are to occur there must be public subsidies or, in the case of private institutions, large endowments because private incentives for investing in outcomes that benefit others are insufficient. Some liberal arts and humanities fields such as the philosophy of science dealing with scientific truth, literature with perspectives on ethics, the social sciences, and colleges of education that generate larger externalities depend more heavily on public or endowment support and this breadth adds to the quality of the higher education students get beyond more limited trade school benefits. These kinds of externalities foster altruism and benefits to others which are the focus of the Golden Rule. Public support allows for wider access as the result of lower tuition and financial aids, as well as disproportionate support for history and for research at both public and private research universities benefitting others and future generations. All of this contributes to the quality and diversity of higher education, and does public support sufficient to avoid excessive use of teaching assistants, academic professionals, and adjuncts in large classes and often, now even in the junior and senior level courses. More formally, the fraction of total time invested in human capital, $(1-\mu_t)$, is larger than it would otherwise be, as are both γ and I_t, both of which are >0. This assumes that government failure is negligible so that public augmentation of externalities and private incentives to invest is consistent with overall economic efficiency as well as with a a higher per capita growth rate than in a purely competitive economy as will be shown.

3.1.1. Optimal growth

For optimal growth over time, the objective function seeks to maximize the utility of the stream of real per capita consumption, c_t:

$$\int_0^{\infty} \frac{1}{1-\sigma} \boxed{[\, c_t^{1-\sigma} - 1\,] \quad e^{-\rho t}\, \partial t} \quad (2)$$

Here t = 0,..., ∞, an infinite time horizon, and the stream of per capita consumption is discounted at rate ρ. These preferences have a coefficient of risk aversion, σ, that is positive.

Assuming individual families and the government look ahead over the life cycle of the student when planning long term educational investments, *there is no significant difference to the rate of return between using a typical 45–65 year life span after graduation as a planning horizon vs an infinite time horizon.* See "Infinite Planning Horizons" in Lang and Merino (1993, pp.144–147).

3.1.2. The production of human Capital

Per capita consumption over time is maximized subject to the production of output by firms, (Eq. (1)), but also subject to the production of human capital by households:

$$\partial h/\partial t = G_t/Y_t \delta[1-\mu_t]h_t. \quad (3)$$

Here $\partial h/\partial t$ is gross investment in human capital formation, $1-\mu_t$ is the fraction of time devoted to human capital production, δ is the maximum rate of accumulation of human capital when

$(1-\mu_t) = 1$, G_t/Y_t is the fraction of GDP invested by government in education through direct support of colleges and universities and through student financial aids, most of which students pass to public and private educational institutions as they pay tuition, and h_t is the initial human capital of students, parents, and faculty. With lags this highlights the intergenerational transmission of human capital. There is a large literature on this that includes Carneiro, Meghir, and Parey (2013A) and others suggesting, among other things, that the market and non-market outcomes considered here largely determine not just the life chances of families but also of generations, differences that show up over time but also across individuals and families. Higher G_t/Y_t raises the *private* rates of return on human capital investment encouraging the average fraction of time invested in human capital formation to be increased that shows up through increased enrollments.

Human capital, therefore, is produced by households with the aid of colleges in a dynamic process using the human capital of the parents and the human capital of the faculty who, if quality is adequate, stimulate capacities for analysis and originality while accessing and contributing the newer ideas from worldwide sources in each field. There is also a contribution from the physical capital in universities such as labs and classrooms that is omitted here to simplify. Below the limit, δ, when all effort is devoted to human capital accumulation, there are no diminishing returns to the production of human capital. Lucas (1988) stresses that this is a social process that has no counterpart in the accumulation of physical capital. Each new family member begins with an amount of human capital that is proportional but lower than the level attained by older members of the family.

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The human capital production process in an optimal growth model would typically refer to all education, K-12- PhD, and not just to the contribution of higher education which is the focus here. In accord with this, empirically, the rates of return to all levels of education, K-12 through PhD, appear in Table 1 Section IV revealing among other things how the returns to education vary by levels of education. Re-focusing Eqs. (3) and (1) on only higher education makes it possible to interpret the model as a theory of higher education stressing that human capital is what is produced by higher education institutions in Eq. (3), not students. This leads to an important insight into what productivity in higher education really is, productivity in producing human capital skills and hence monetary and development outcomes, and not just instructional units (IU's) which is a very short term and incomplete measure of true productivity. This also looks at universities as sources of individual and social economic growth as well as of the broader development of families and societies. As such it is a more general theory of what Clotfelter (1999) refers to as "the familiar but curious economics of higher education". So interpreted, Eqs. (1)–(3) offer a more coherent and more general theoretical framework that focuses on what higher education really produces, namely human capital skills, and again, not students. The latter leads to distortion of academic policies and misallocation of faculty skills, such as separating research faculty from teaching faculty and the former from students, a policy often found that is implicitly based on the false assumption that it is students that are being 'produced'. This separation limits the embodiment in students of the newer and more advanced ideas and thereby probably reduces true 'productivity'.

The new ideas and adaptations, I_t, are largely dependent on the human capital that universities and households produce, h_t, via Eqs. (3) and (5):

$$I_t = \alpha h_t^{\eta}, \tag{4}$$

$$h_t = h_{t-1} + \partial h/\partial t - d h_{t-1} \tag{5}$$

Advanced graduates of research universities with MA's and PhD's typically spend all day every day working on creating and adapting new ideas and technologies for years after graduation and indeed most of their lives within firms, government and other universities. Most technological advancements nowadays require advanced education before one can even get started. Eq. (5) defines human capital stock accumulation as last period's stock plus the gross additions from Eq. (4) less depreciation and obsolescence at rate d. The gross additions include replacement investment in human capital replacing those who retire and die. *These new graduate replacements embody new knowledge and help to disseminate technologies just as much as the net new additions to the stock of graduates.* This important effect is overlooked by researchers that try to relate educational attainment (which is net of replacement investment) to growth and development rather than using gross investment in new human capital formation. The aggregate stock containing human capital of these newer vintages is[1]:

$$H_t = {}_{t=o}\Sigma^{\infty} N_t I_t h_t.$$

Additions of new human capital, $\partial h/\partial t$, embody the new technologies and are the key mechanism for the diffusion of technology in endogenous growth and in this endogenous development model. This responds to Parente's (2001A) critique that endogenous growth models fail because they contain no mechanism for the dissemination of technology. Beyond the dissemination through graduates, this model also has an endogenous explanation for the creation and adaptation of new ideas.

3.1.3. Optimal growth

To solve for the optimal growth of per capita consumption and per capita income, the current value Hamiltonian is:

$$H\left(K,h,\theta_1,\theta_2,c,\mu,t\right) = \frac{1}{1-\sigma}\left[c^{1-\sigma}-1\right] + \theta_1\left[(I[\,AK^{\beta}(\mu hN)^{1-\beta}\right]h_a^{\gamma} - Nc)/N\right] + \theta_2[G_t/Y_t\delta(1-\mu_t)h_t \tag{6}$$

Eq. (4) determining of the flow of new ideas next is substituted into the production function above for I. The Hamiltonian is then differentiated with respect to the endogenous variables to obtain the first order conditions. In this the two decision variables are per capita consumption, c_t, and the time devoted to production, μ_t, which in turn determines the fraction of time devoted to the production of goods vs human capital production (1- μ_t). Government investment, G_t, is exogenous. The values of the two endogenous variables are selected in solving to achieve the optimal path for investment in human and physical capital (the state variables). This also determines the optimal rate of growth of per capita consumption and hence of per capita income since the latter is defined as consumption plus investment plus government at each time, t, and since the two rates are equal in balanced growth This optimal rate of growth of per capita consumption (and income) which is given in Eq. (7) below uses the first two first order conditions, $\partial H/\partial c$ and $\partial H/\partial\theta_1$, which are conditions that must hold for per capita consumption over time to be maximized and the rate of growth to be optimal:

$$(\partial c/\partial t)/c_t = MPP_{Kt} - \rho \tag{7}$$

That is, the optimal rate of growth of per capita consumption[2] is equal to the marginal productivity of physical capital discounted at rate ρ.In a competitive economy, this discounted marginal productivity is the rate of return to physical capital, which in turn is equal to the rate of return to human capital in its two uses:

$$MPP_{Kt} - \rho = MPP_{Ht} - \rho = (\partial c/\partial t)/c_t \tag{8}$$

So if the social rate of return to higher education is higher than the rate of return to physical capital, increased investment in higher education will increase current output but also in balanced growth will lead to a higher sustained constant rate of growth of per capita consumption as in Eq. (8) and hence in per capita income *This determines a growth rate that is sustainable indefinitely without bounds!* That is, it is not limited by diminishing returns, an unsatisfactory feature of the Solow model.

3.1.4. Education externalities

For the role of externalities, totally differentiate Eq. (7) with respect to time which is of the form $F = f(K_t,h_t) = X$, where X is a constant. From this, the common growth rate of per capita consumption, $(\partial c/\partial t)/c_t$, physical capital, and per capita income, is related to the growth rate of human capital by:

$$(\partial c/\partial t)/c_t = \frac{[\,1-\beta+\eta+\gamma\,]}{1-\beta}(\partial h/\partial t)/h_t \tag{9}$$

This shows that on the balanced growth path, the common rate of growth of per capita consumption and per capita income is larger when the rate of growth of human capital investment, $(\partial h/\partial t)/h_t$, is

[1] This ignores the Cambridge controversies and problems with summation over different vintages of human capital. For a theory of higher education an additional term for physical capital inputs is needed.

[2] Strictly, *preferences* for per capita consumption using a coefficient for risk aversion, σ. There are also standard human and physical capital accumulation equations behind the scenes.

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larger. Furthermore, at any given rate of growth of investment in human capital, the growth rates of consumption and income are larger when either the creation of new ideas, η, and/or education externalities, γ, are larger. That is, *the optimal efficient rate of growth with $\eta > 0$ and $\gamma > 0$ is larger than a competitive economy equilibrium rate of growth where there are no education externalities (i.e. $\gamma = 0$).* Given insufficient private incentives to generate benefits that flow largely to others and future generations, and that quality and access are also related to resources per student, the flow of new ideas and of external benefits, the size of enrollments, and quality are all lower when the per student public support of universities is cut.

This result is also reflected in the real wage. It is the marginal product of labor at a given level of human capital skills. When human capital skills are augmented by the growth of per capita human capital skills due to education, $(\delta h/\delta t)/h_t$, the real wage, ω, grows as the workers average education level grows. This is in addition to the external spillover benefits from the higher education of others in the community.

3.2. Endogenous development

When policy makers and the public care about higher education outcomes that include the quality of life beyond earnings and jobs, then the objective function must be re-written to include the non-monetary outcomes. The constraints also must include human time used not just in production in firms and of more human capital, but must also include time used in household production during non-working hours.

3.2.1. The objective function

The objective function to be maximized now includes broader development outcomes. It is the sum of the per capita stream of discounted utilities for *total* consumption satisfactions, $\bar{c}_t$, over the entire life cycle of each individual. These include market goods, c_t, as before but now also non-monetary satisfactions, c_{nmt} :[3]

$$\int_0^{\infty} \frac{1}{1-\sigma} \boxed{[\,\bar{c}_t^{\,1-\sigma} - 1\,]\quad e^{-\rho t}\,\partial t} \qquad \text{where } \bar{c}_t = c_t^{\varepsilon} c_{nmt}^{\zeta} \quad (11)$$

If decision makers discount non-market outcomes, ζ is smaller.[4] This would occur if non-market outcomes are not well understood and/or are poorly perceived. This constitutes market failure due to poor information. An optimal solution based on true preferences will not be achieved.

3.2.2. Household production

Human capital is used on the job for production in firms for the fraction of time, μ_1, in the production of human capital, μ_2, or in household production, $(1 - \mu_1 - \mu_2)$. This means that the human capital is used during all waking hours each week either on the job, in school, or in household production and increases the productivity of time in all uses. Household production produces final satisfactions for private benefit of the family or produces social benefits largely during time spent in the community:

$$C_{nmt} = A \bullet I_t[C_t^{\beta}(1-\mu_{1t}-\mu_{2t})h_t N_t^{1-\beta}]h_{at}^{\gamma}. \quad (12)$$

These variables are as defined above under Eq. (1) where the production of market goods is determined since $C_t = N_t c_t = Y_t - I_t - G_t$.[5] Household production also is augmented by new ideas, I_t, and human capital in household production also generates externalities, h_{at}^{γ}.

Typically, a specific non-monetary consumption outcome such as better own-health is dependent on years of education, h_t, per capita income or market goods, c_t, the level of education in the community, h_{at}, and other controls which help to identify the effect of education on own health as causal. The data is typically in per capita terms and is micro data from household surveys. The exception is for some social benefit outcomes where micro data is insufficient.

3.2.3. Optimal development

For optimal development, the current value Hamiltonian is:

$$H\left(K, h, \theta_3, \theta_4, c, c_{nm}, \mu_1, \mu_2, t\right) = -\frac{1}{1-\sigma}[(c_t^{\varepsilon} c_{nmt}^{\zeta})^{1-\sigma} - 1\,]$$
$$+\theta_3\left[I\left[AK^{\beta}(\mu_1 hN)^{1-\beta}\right] h_a^{\gamma} - Nc\right] + \theta_4\left[G/Y\delta\mu_2 h\right] \quad (13)$$

where $I = \alpha h^{\eta}$, $\mu_3 = 1 - \mu_1 - \mu_2$, and δ is the maximum rate of human capital accumulation. The endogenous variables are c_t, which with ε exogenous determines c_{nmt}, μ_1, the fraction of time spent in production in firms, and μ_2, the fraction spent in human capital production, which together determine $1 - \mu_1 - \mu_2$, the fraction of time spent in household production at home or in the community. Maximizing by differentiating the Hamiltonian to obtain the first order conditions, and solving for the balanced path along which K, h, and c and thus market income y all grow at the same constant rates, the equilibrium rate of growth of the market economy in per capita terms, $(\partial c/\partial t)/c_t = (\partial y/\partial t)/y_t$, as in all standard endogenous growth models is determined by the rate of return and hence by the marginal productivity of physical capital:

$$(\partial c/\partial t)/c_t = (\partial y/\partial t)/y_t = MPP_{Kt} - \rho \quad (14)$$

If non-market outcomes are fully perceived so that ζ and ε are equal, for example, the equilibrium rate of growth of market consumption in (14) would also be the rate of growth of non-monetary development outcomes above and beyond earnings. The rate of return for development also would be the sum of the monetary and non-monetary rates of return.[6] If, however, the non-market outcomes are poorly perceived and there is market failure due to poor information, then ζ is smaller and there will be a smaller rate of investment in human capital and a slower rate of total development.

Finally, if education externalities are positive so that $\gamma < 0$ and if more new ideas are created and adapted so that $\eta < 0$, then just as in Eq. (9) investment in higher education is more powerful in generating higher rates of sustained per capita growth and development. An economy in which government supports the generation of these externalities and the creation of new ideas has optimum rates of development as well as of growth that are permanently higher than a competitive economy where private incentives to invest are insufficient to generate many externalities.[7]

[3] For a more general specification, see Benhabib, Rogerson, and Wright (1991) who uses a CES form.

[4] If $(\varepsilon + \zeta) = 1$ there are constant returns and in the absence of risk aversion the intertemporal elasticity of substitution is unity leading to explicit equilibrium paths here as in Lucas (1988) and Hu (2008). However, it is intuitively more realistic not to impose this gratuitous assumption with then a numerical solution for the more general specification

[5] The exponents are not necessarily the same as for production by firms. But this simplification does not affect anything.

[6] The institutional plus foregone earnings costs are the same whether the non-market outcomes are counted because the latter are produced using the same human capital but during non-working hours. So these rates can be added.

[7] Government failure also must be considered where subsidies are involved. But US higher education with all its flaws has a high rate of return and is often regarded as the best in the world. Therefore, on both counts it is relatively efficient. Government failure is probably smaller in the US than in authoritarian countries troubled with corruption.

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4. US social rates of return to education based on earnings

The standard "social rate of return" estimated in this section based on earnings before taxes and on the full social costs is not the private rate which uses only the private costs to the family. It does not include non-market outcomes and therefore is relevant to growth. The total return relevant to optimal development follows later.

It is well known and repeatedly found that a premium is earned by the college-educated in the job market over the high school graduate due to the advantage graduates have in using new technologies (e.g., Bartel & Lichtenberg, 1987). These increments to earnings over those of high school graduates trended upward sharply from 1982 to 1989 at a rate of 5.9% per year during that cyclical recovery as the economy went from 9.7% unemployment to 5.3% unemployment from Valletta (2016), Figures 3 and 4), with unemployment rates from the BLS (2017a). After this spurt, the secular trend of 1.35% per year for college graduate males and females has been constant, however, for the last 26 years from 1989 (when the unemployment rate was 5.3%) through 2015 (when the unemployment rate was also 5.3%). The secular trend in the graduate premium for Master's, PhD's, and Professional degrees has also been constant but larger at 1.65% per year during this same period (BLS, 2017a). Valletta (2016) suggests that the college premium has declined, lower since 2000 than before. But choosing beginning and ending points where the unemployment rate is the same, 5.3% in 1989 and 5.3% in 2015–6, eliminates transitory influences and reveals that the college premium trend is not "flattening" but is constant at 1.35% for bachelors and at 1.65% for advanced degrees.

4.1. The social rate of return to investment in higher education, 2007–2016

The conceptually appropriate social rate of return consistent with both endogenous growth and development models and relevant to policy is the social marginal net benefit of a marginal expansion of education at each different education level. Net benefit means net of marginal social costs which include public subsidies and per student institutional unit costs including those that must be covered in the longer run as institutions expand to accommodate increased enrollment. The policy-relevant margin is for the marginal level of education and not for one more year of education. This is both because financing policies usually address each level of education (e.g. Community Colleges) and not just one more year, and students also usually decide to enroll toward a 2 year Associate or 4 year Bachelor's Degree not for just one year except as a means to that end.

The policy-relevant margin is also not the margin for each student but an average across individuals at that level. Individuals are heterogeneous with different levels of ability and other characteristics, as well as across different fields of specialization and are at different institutions. There are numerous types of estimates reported in the literature because of this heterogeneity (ATE, TT, LATE, MTE, AMTE, etc.) many of which are relevant to private Mincer returns relevant to private investment decisions. But they are not the conceptually appropriate social rate marginal to each level of education relevant to the types of public policies that are the focus here. The marginal costs that correspond to this are at each level of education and are also an average across individuals who have different living costs and across institutions whose costs differ. The focus here is on the policy relevant treatment effect relevant to policy makers when they decide to finance expanded (or reduced) enrollments in Community Colleges or 4-year degree institutions. (With respect to completion rates, some students do drop out along the way. But the return to this can be seen in the College 1–3 row of Table 1 and compared to the rate for those who complete 2 or 4 year degrees, or compared to the rates adjusted for the risk of non-completion available in the on-line spreadsheets for each year.) In sum, the conceptually appropriate social rate of return is the policy-relevant treatment effect for the marginal degree level averaged over individual abilities and costs at each level. This can be and is calculated by the full method. It is not a private rate relevant to private decisions that ignores institutional unit costs, ignores the social costs of grants and subsidies, should measure returns after taxes, and is relevant to only one group of individuals with very specific individual characteristics that is typical of Mincer returns.

4.1.1. Causation

The desired result is policy-relevant causal effects, not simple correlations or crude estimates. There is a separate large literature on measuring marginal policy-relevant treatment effects (MPRTE) and average treatment effects (ATE), where the treatment effect is the *causal effect* as between those who attend college and those who do not. This literature includes Carneiro, Heckman, and Vytlacil (2011), Stearns (2014A), Cameron and Taber (2004A), Abel and Dietz (2014A), Autor (2014), Daly and Cao (2015A), Heckman, (2014, 2016) and others. It is useful in establishing causation, but less useful in measuring the size of the effects from human capital formation as will be developed in the next section. A Mincer return is typically estimated for one year of college, without taking the full institutional unit costs specific to each level of education into account. This has relevance to private decisions, but only has relevance to public policy where the interest is in what private decision makers are likely to do. It has been quite successful in establishing the causal connection between education and earnings as mentioned, between education and better health, and between education and some other non-monetary education outcomes. Heckman (2015), Grossman (2006), Card (1999) and others agree.

With respect to marginal vs average, Carneiro et al. (2011) compare marginal policy-relevant effects (MPRTE) to average treatment effects (ATE). Their estimates (Carneiro et al., 2011, Table 6, Part A) t control for dropouts and find a marginal policy relevant treatment effect (MPRTE) of .0988. This is smaller but remarkably similar to their average treatment effect (ATE) of .0995. In their baseline model without dropout controls their MPRTE of .0802 is again still very close to their ATE of .0815 (Carneiro et al., 2011). When they use the same instruments used by Cameron and Taber (2004A) their MPRTE = .0821 and ATE = .0851, again not identical but similar. That is, the causal effect *of inputs from formal educational institutions* at the margin between those who enroll and those who do not at the margin and on average is the same when rounded, or 9.9%, in Caneiro et al. and very similar or 8.2% for the MPRTE and 8.5% for the ATE in Cameron and Taber. So, although there is selection based on returns which reflects both parental income and unmeasured ability (the two are highly correlated) in Heckman (2015) and in Carneiro et al. (2011, p. 2778), it's effects are not large enough at the 2 and 4-year levels to cause much difference between the marginal and the average treatment effects.

There are 1 million high school graduates per year constituting one-third of all high school graduates who do not enroll in any college (NCES, 2015, 144) and who are admissible to a community college. So there is probably a very long way to go before the marginal return is very far below the average. Furthermore, and also important, there are several million older workers displaced by technical change and globalization who lack the necessary skills to adjust and could benefit from skill upgrading in the lifelong learning programs available in community colleges.

4.1.2. Appropriate rates of return to household production of human capital

Human capital in economic theory and in our model is produced by *household production* as in Eq. (3) and not just by schools or

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colleges. The 8.2%–12.5% Mincer return above can be viewed as a reasonable estimate of the causal effect produced by colleges when the focus is on the school, as it is in Heckman, Humphries, and Veramendi (2016) because parents' education and other household characteristics are among the controls. But this is not the return to investment in human capital produced by households. The latter includes some contribution by the parents' education and not just by the faculty's education; both are included in Eq. (3). Conceptually households combine inputs of their own time including the parents' and the student's time and the student's ability, to all of which there is a return, and acquire services from higher educational institutions in a dynamic process over time to produce new human capital skills. Because it is the results from human capital investment that arise as the result of household production of human capital that we seek to measure, and not just the component contributed by the school or college, controls for the parent's education which is one of the inputs will not be used.

However, there must be a control for net ability bias. To consider this, it is important to acknowledge, and then set aside, the fact that all returns include an implicit return on the innate ability of the typical student averaged over all those in college since with no ability whatsoever there is no benefit. But this contribution is a constant so it does not have to be taken into account. Instead, it is the selection bias as additional students enroll that have greater ability for which there must be controls. These also must be net of measurement error as discussed later. In sum, the estimates eliminate selection bias that is not a constant between those who enroll and those who do not, facilitating viewing the returns later as caused by the additional higher education, and furthermore as the returns to human capital produced by households and colleges involving students with given ability.

4.1.3. Marginal social costs

The conceptually appropriate marginal social costs relevant to public policies regarding expansion or contraction of education is at each marginal education level corresponding to the way earnings are measured. They include the full average institutional unit cost per student at each marginal educational level plus the foregone earnings costs which are costs to the family as well as to the society. The institutional costs are part of the long run marginal social costs that allow for building expansion and maintenance, and not the same as private marginal variable costs that include no institutional operating costs or short run fixed costs. That is, institutional and foregone earnings costs per FTE student at Community Colleges are related to Associate Degree earnings, and so forth. Since psychic costs are related to how outcomes are perceived or discounted they are discussed in Section VIII.

Institutional unit costs for public 2-year, public 4-year, and private not for profit 2 and 4-year degree granting institutions are from NCES (2014, 2015), *Digest of Education Statistics, Tables 334.10 and 334.30 respectively* and for K-12 from Table 236.15. Public institution costs are weighted by 69% and private institution costs by 31% corresponding to the numbers of graduates and to the earnings data. Foregone earnings costs are the earnings of graduates of the same age and sex at the next lower level of education who entered the job market and did not go. This as well as all earnings data is from the US Census/BLS Current Population Survey, CPS (2016). For reproducibility, earnings and costs are shown in the spreadsheets and discussed in Appendix A downloadable at https://publish.illinois.edu/wmcmahon/.

Misleading statements frequently appear about rising higher education "costs". It is true that *private* costs to families have risen sharply as tuitions and fees have gone up. This is largely due to the cut back in state financial support for public institutions and for need-based student grants at public and private institutions. But *institutional unit costs in real terms have remained unchanged at public 2-year and 4-year degree granting institutions from 2006 through 2014* (NCES, 2015, Table 334.10), the last year for which data was available on 7-10-17. At *private* not-for profit 4 year institutions costs per student in constant dollars rose over this period but only by 1.04%, while unit costs at private 2-year non-profit institutions during the same period fell significantly (NCES, 2014, Table 334.30). Foregone earnings costs have fallen in some years but generally also remained flat during this same period. The story about rising higher education costs is therefore not about rising institutional unit costs but instead about constant institutional unit costs, falling state support, and rising private costs to families.

4.1.4. Calculating social rates of return

Social rates of return marginal at each level of education are calculated by the standard full method (i.e. numerical methods) based on these mean earnings and mean per-FTE-student costs. They are the rate that discounts the stream of net earnings increments before taxes (i.e. increments above earnings at the next lower level) back to their present value and sets them equal to the full social costs. This is not a private rate of return which will usually be a bit higher because private costs are lower than the full social costs when there is a subsidy.

4.2. Empirical estimates of US social rates of return

Social rates of return for the US for 2015 as well as 2012 and 2014 adjusted for net ability bias and for technology trends are shown in the last 3 columns of Table 1 below. These can be compared to the unadjusted rates for 2007, 2010, 2012, 2014, and 2015 pre- and post-recession. The focus is on Associate and Bachelor's levels, but comparisons can be made to the returns for dropouts (College 1–3), high school diploma, and Master's, PhD, and Professional programs.

The unadjusted rates are based directly on the data to show consistent comparisons with no adjustments, as well as to show the small downward net effects of the adjustments. The adjustments remove ability bias net of measurement error from earnings, and add the effects from new technology and globalization as cross section age-earnings profiles of college graduates shift upward as graduates age. The effects of non-completion, see the rows for College 1–3 years and to see rates adjusted for the risk of non-completion see the discussion below and the last column of Table 3 on the rate of return spreadsheets for each of these years.

4.2.1. Size of the net ability bias correction

Some of the earnings increment is removed inappropriately when test scores are used as a control because test scores measure achievement (and hence parents' income) and not just innate IQ. Therefore, it is probably better to base this correction on more recent studies using large samples of identical twins because identical MZ same-egg twins have identical innate IQ's. This would be a perfect control except for the fact that the two individuals within each twin pair can also be subject to other external influences such as small differences in birth weight or fetal health that can become important. There also is sometimes little difference between the schooling levels within twin pairs. But recent studies do attempt to control for these. So the judgement call is that identical twin studies probably provide a better correction for ability bias than using test scores which measure achievement, or than unobserved effects that include motivation and other things, since both tend to overstate the appropriate correction.

Rouse (1999 p.152) and Behrman and Rosenzweig (1999, p. 166) both study large samples of identical twins. Rouse estimates the gross ability bias in earnings due to IQ differences to be about 17%, but when the 8–12% measurement error partially offsets this, the net ability bias is 6%. Behrman estimates gross ability bias to be about 18%, but when his smaller 6.9–7.5% measurement error

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is used as an offset, net ability bias is estimated to be 12%. The estimates of the gross ability bias in earnings are about the same. But Rouse' somewhat larger measurement error is consistent with other studies, so her 6% for net ability bias is used to reduce the net earnings differentials for the adjusted estimates for bachelors shown in Table 1. Associate Degree levels were reduced by 5% based on the fact that their English, math, and composite ACT test scores are 83% of the test scores of students entering 4-year programs (NCES 2014, Table 305.40). These adjustments are applied to both earnings and non-market outcomes.

Correcting both types of outcomes for net ability bias is part of assuring that the returns to higher education are causal, and not due to ability bias. The returns from the parents' education in human capital production is also causal. So this is truly a return to new human capital, and not to ability bias. It is not just a return to higher education institutions, but it is a treatment effect in the sense that it does not occur unless the student pursues higher education. Other controls in the estimates in Table 1 are the standard ones for education level, age, and sex. It is an average across races weighted the same way they are in the earnings data but this is what is policy relevant in the type of expansion or contraction policies we seek to explore.[8]

4.2.2. The screening hypothesis

This leaves the screening hypothesis. It argues that human capital is not causal and in its stronger version, is not productive. Instead outcomes are the result of screening that selects those who have high IQ and/or are well-adapted. The problem is that degree completion conveys information that the degree requirements have been met and that human capital has been produced. So yes, signaling occurs. But it overlaps the effects from human capital production by signaling that the skills needed, many of which can be very technical and quite inaccessible to even the brightest without rigorous higher education. The stronger version of this screening hypothesis that goes beyond this to suggest that human capital is not productive has been studied by Lange and Topel (2006). They reject its significance in this form in favor of the conclusion that it is the human capital skills created by the education process that are productive. Their analysis is convincing, and will be accepted here. However, that is not to say that the type of screening that essentially reports the creation of human capital skills signaled by degree completion does not occur, because it does.

4.2.3. Trends shifting cross section age earnings profiles

It is now well recognized that the age-earnings profiles of college graduates shift upward over time as technical change occurs giving advantages to those with the newer technical skills in the labor market. The size of the effects on rates of return were computed by Arias and McMahon (2001) who show rates of return computed from cross section data before and after these shifts. This is the 1.35% continuing annual growth in the college premium discussed earlier. Similar conclusions have been reached later by Heckman, Lochner, and Todd (2006, 2008) and Shierholz et al. (2013A). The constant 1.35% per year at the bachelor's level, is 1.9% for males and .8% for females based on Valletta (2016, Fig. 4) where the unemployment rate is the same 5.3% at the end points. These rates specific to each sex (t averaging 1.35%) are used to correct the college earnings premium given by current cross section data for trend, with the results included in the last three columns of Table 1. The graduate premiums have grown a bit faster, at 2.3% per year for males and 1.0% per year for females. Over the same period, K-12 earnings declined by .7%. The effects on the rates of return have been cross checked and are consistent with the difference between the static and 'dynamic 'rates in Arias and McMahon (2001, Table 3, 1990 and 1995). All assume that the longer term secular trend caused largely by technical change continues.

4.3. Empirical social rates of return in the US and economic efficiency

Conclusions can now be drawn based on the theory of optimal growth presented earlier and Table 1 below about whether the US higher education system at 2 and 4 year levels is economically efficient and about whether there is under- or over-investment for optimal growth.

4.3.1. The return to investing in community colleges

After correcting for net ability bias and for trends, the social rate of return in 2015 to public and family investment in Community College degrees is 13.0% for males, 12.8% for females, or 12.9% on average as shown in the last column of Table 1. After the risk of non-completion is considered it averages 10.9% (shown in online spreadsheet, Table 3) averaging in short certificate holders and dropouts in College 1–3 shown in Table 1 for whom it is a lower 6.4% but nevertheless positive. This is an important update because Community Colleges enroll over half of all first year students and over 30% of all FTE undergraduates. Neither Valletta (2016) nor Heckman et al. (2016) address this level because of their data limitations. In Table 1 this 12.9% average return can be compared to the much lower 1.4%% average for *high school* drop outs, lower11.8% for high school grads, 6.5% for 'some college', and, as mentioned, 10.9% including the risk of non- completion.

In comparison, Kane and Rouse (1995, p. 609) in their study of (Mincer) returns to 2-year college programs also corrected for net ability bias found returns for an earlier period (1990) for 'some college' averaging males and females to be 7.6% and to be a higher 21% return for Associate Degrees, although their results appear to not take institutional costs into account. With respect to the very low 1.4% return for high school dropouts in Table 1, others such as Heckman et al. (2008), Levin (2006) also find that returns to finishing 12th grade as compared to dropping out are enormous.

But the most important comparisons are that the 12.9% average return to investing in Community College degree programs and 10.9% adjusted for the risk of non-completion are both well above the 7.2% 10-year average return on an S&P 500 index fund, the opportunity cost of tax funds for the typical household. 7.2% is also above the return to physical capital in the model. This is new and strong evidence that there currently is underinvestment in 2-year community college programs for optimal growth. It is also evidence that Community Colleges despite their faults on average are more efficient than the 500 largest US corporations that average 7.2%. Because Community Colleges offer lifelong learning and because graduates tend to remain close to where they graduated, these institutions are well adapted to support regional and rural growth.[9]

[8] Other individual and environmental characteristics that can affect earnings and are included in Mincer regressions when seeking to distil pure causal effects. These variables include broken homes, number of siblings, family income (correlated with parent's education), region of residence, urban status, local unemployment, and local long run unemployment. These average out when considering national, state, and local education policies that deal with enrollment rates.

[9] Aghion et al. (2005) develop how 2-year graduates tend to remain near where they graduated and contribute to local development whereas bachelors graduates gravitate to larger cities where the jobs are.

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Table 1
US Social Rates of Return Based on Earnings, 2007, 2010, 2012, 2014, 2015.
Full Method Reflecting All Social Costs.
Returns and Costs Marginal to Each Level of Education.

Level of Education	Unadjusted					Adj. for Net Ability Bias and Trend[a]		
	2007	2010	2012	2014	2015	2012	2014[b]	2015
9th–12th Grade, M	4.5%	3.5%	1.1%	4.2%	1.8%	0.7%	3.8%	1.4%
9th–12th Grade, F	2.3%	3.0%	1.1%	1.3%	1.9%	0.7%	0.6%	1.4%
High School Grad, M	10.5%	9.4%	11.1%	7.1%	12.0%	13.1%	6.9%	11.9%
High School Grad, F	12.5%	9.2%	9.3%	10.5%	11.6%	11.1%	10.4%	11.5%
College 1–3 Years, M	5.8%	4.9%	5.5%	6.4%	5.8%	7.6%	8.8%	7.0%
College 1–3 Years, F	5.3%	4.0%	4.1%	4.2%	6.2%	5.4%	5.7%	5.9%
Associate Degree, M	13.3%	13.9%	12.0%	13.5%	13.5%	13.7%	15.0%	13.0%
Associate Degree, F	13.3%	16.5%	15.4%	15.3%	14.1%	15.6%	15.5%	12.8%
Bachelor's Degree, M	11.4%	12.0%	11.6%	11.8%	12.7%	11.8%	12.0%	12.0%
Bachelor's Degree, F	8.7%	10.0%	10.2%	11.4%	10.8%	10.0%	11.2%	9.9%
Master's Degree, M	9.3%	9.2%	12.6%	13.2%	9.0%	14.3%	15.1%	8.5%
Master's Degree, F	11.3%	10.9%	12.0%	6.3%	10.1%	12.7%	7.6%	8.4%
PhD, 5 Years, M	6.8%	9.9%	13.6%	9.8%	9.9%	14.2%	10.7%	9.5%
PhD, 5 Years, F	8.5%	15.9%	10.6%	9.5%	9.2%	10.7%	9.6%	8.4%
Professional, 4 Years, M	12.1%	14.1%	14.0%	15.6%	16.9%	14.1%	15.8%	17.8%
Professional, 4 Years, F	8.9%	9.9%	13.7%	12.9%	11.3%	13.4%	12.6%	10.4%

[a] Percentage corrections in this column for longitudinal effects are given in the text. They are based on Valletta (2016, Fig. 4) and cross checked against Arias and McMahon (2001, Table 3, 1990 and 1995).

[b] Standard errors for 2014 based on a sample size of 83,400 males and 74,594 females in the US Census Current Population Survey with the mean earnings for each cell shown in spreadsheet Table 1 at https://publish.illinois.edu/wmcmahon/. They can be approximated as +/- 0.39 percentage points for M&F at the BA level and +/- .43 percentage points for M&F at the Associate level based on the standard error of earnings in a typical cell as a percent of the mean earnings in that cell. The SE for each cell is given in CPS (2015, Table PINC-4). Costs are based on a census of institutions by NCES (2014). Sample sizes are larger and standard errors are lower at K-12 and college levels, and sample sizes are smaller at graduate levels.

4.3.2. The return to bachelor's degrees

The net return to investment in a typical bachelor's degree is 12% for males and 9.9% for females in Table 1 averaging 10.9%, all after corrections for net ability bias and trends. This is two percentage points below the 12.9% average return on an Associate Degree. The earnings of a bachelor's graduate are of course much higher, but the costs are also higher. Again, the return at the bachelor's level is well above the 7.2% 10 year average return on an S&P index fund, indicating that this is an efficient investment in contributing to earnings growth. It also indicates that the cuts by states in funding higher education over the last 15 years were not efficient and that there is underinvestment at the bachelor's level for optimal growth. The 12.0% for males compares to the 14.3% Mincer return for males obtained by Heckman (2015) using data from the National Longitudinal Sample of Youth (NLSY 79). This does not reflect institutional costs but has many controls designed to establish causation.

4.3.3. The return to graduate programs

The higher education earnings premium has grown even faster at the Masters, PhD, and Professional levels. The absolute earnings also are much higher as reported in CPS (2015 Table PINC-4). Even so, the earnings of these graduates seem unlikely to fully reflect the social benefit externalities given the research training PhD's receive and the generation of new ideas and adaptations throughout their careers as in the model above. Considering this, social rates of return for males and females corrected for net ability bias and trends average 8.45% for Master's, 9% for PhD's, and 13.9% for Professional programs as shown in Table 1. Private rates of return are higher than this due to subsidies. Nevertheless, these rates of return are all above the benchmark opportunity cost of funds of 7.2% for the S&P 500. The graduate premium continues to widen since 1989 at .79 percentage points per year relative to HS graduates compared to the .48 for bachelors based on Valletta (2016, Fig. 4). From experience, this follows a worldwide pattern where social rates of return to primary are highest in the very poorest countries, junior and senior secondary rates are highest at middle levels of development (e.g. Indonesia), 2 and 4 year rates are highest in advanced countries (e.g. US), but where now graduate-level rates are moving up the fastest.

4.3.4. Returns after correcting for drop outs

The rate of return for students who do not complete degrees are shown as College 1–3 years in Table 1. For bachelors' the probability of completion within 6 years is 69% for an enrollment-weighted average of public and private institutions (Toutkoushian et al., 2013A, p.84). Weighting the rates of return for bachelors' by .69 and for College 1–3 by .31, the social rates of return for 2015 corrected for net ability bias and trends are 10.3% for males and 7.7% for females available in Table 3 of "US Social Rates of Return 2015" spreadsheet at https://publish.illinois.edu/wmcmahon/.[10] For Associate Degrees, corrected for dropouts they are 10.9% for males and 10.4%% for females in 2015. Despite their focus on drop out problems, Bowen, Chingos, and McPherson (2009) do not compute rates of return. Although these rates are 2 percentage points lower than for those who finish, they all still above the 7.2% S&P 500 benchmark.[11] For comparison, for bachelors' in California, Benson et al. (2015a, Appendix Table A) find social rates of return in 2005–10 corrected for the risk of non-completion to be 8.1% for males and 10.2% for females, close to the 10.9 and 10.4% nationwide rates found here for 2015.

After taking dropouts into account by two different methods, there is still underinvestment in higher education at the Community College and bachelor's levels in the US for optimal growth.

[10] This considers students who transfer and graduate from other institutions. The probability of completion at public institutions within 6 years is 66.2% and at private not for profit institutions is 75.6%.

[11] It is true that S&P 500 index funds earned 18.35% over the last 5 years. But this reflects recovery from the 2008 recession. It was only 6.96% over the last 10 years up to 2/10/17.

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5. Non-monetary benefits beyond earnings

The total return relevant to broader development includes the value of the non-monetary private and social benefits beyond earnings. What follows is not a survey but instead uses what is known from prior studies as a data base to produce a standardized return without overlapping outcomes for each of 25 specific non-monetary outcomes, followed by a new method for valuation based on what it would cost to produce the same outcome by other means, and the first systematic estimate of the total return to higher education. Each of these is necessary to obtaining the result and is intended as a new scholarly contribution.

5.1. Distinguishing private from social benefits

Many higher education non-monetary outcomes of higher education are private benefits to the graduate and his or her family. But others are social benefits to those outside the family including future generations, and therefore are externalities. The family is regarded here as the basic decision unit at the undergraduate level since it is the household that produces human capital in theory and in our model, and since parents usually help significantly with the financing and are involved in the decision. This includes the parents usually bearing much of the foregone earnings costs, which are very roughly equivalent to the room, board, clothing, and transportation costs, as well as helping with tuition, all of which often includes cosigning student loans. This means that intra-family benefits such as health benefits to the spouse and children will be treated as private benefits to the family. If intra-family benefits were treated as "social" as in Wolfe and Haveman (2003), or in Gibson (2001), then the social benefits to higher education would be larger but the total return is unaffected. Non-monetary outcomes clearly are within the scope of economics as defined by Robbins (1932). His classic definition of economics is "the analysis of the allocation of scare resources among unlimited ends", and does not depend on either markets or money.[12]

Social benefits are usually but not entirely the result of time spent in the community using the human capital produced by higher education. Perhaps there are more than are commonly realized. They include monetary gifts to charitable institutions and higher taxes paid, but also non-monetary outcomes such as time given to public community boards and commissions and to private charitable organizations, or by simply getting involved in less civic crime. All the private non-monetary benefits and some of the social benefits are measured using multiple regression methods that control for other factors affecting the outcome in question and based on microeconomic data. But some social benefits involve public goods available to all, such as the operation and improvement of democratic and human rights institutions, actions conducive to political stability, and lower crime and state Medicaid costs as the result of wider access to higher education. For these community-wide levels, aggregate data for the communities or nations involved must be used. This is because public goods available to all are final outcomes very hard to measure with micro data, and because the processes in the long run evolution of these institutions are very slow. But with the proper controls the use of community or national averages with insignificant effects that average out and collected in the error term can reveal a lot. The alternative is to remain in the dark.

[12] The analysis of the allocation of time and of non-market outcomes has a long history in economics. 'Robinson Crusoe economics' involves no money and no markets and yet Robinson's use of his time involving saving, investment, consumption, income production, and human capital meets all the conditions of Robbins' (1932) definition of economics.

5.1.1. Standardization

The variables are often measured in different units and must be re-scaled to make them comparable. Measures of education are converted to years of schooling, measures of income are converted to annual income in 2016 dollars, and infrequently the dependent variable is in logs and must be re-scaled. This re-scales the coefficients but does not affect the t-statistics or R^2's. The detail is shown in the formulas underlying the cells on the spreadsheets cited for reproducibility. Once re-scaled there is considerable similarity among the results in different studies.

These rescaled education coefficients are averaged and reported in Tables 2 and 3. Averaging has the advantages of reducing the influence of outliers, and of resulting in a kind of consensus of the best that is known. Because the coefficients in the underlying studies all reach the .05 level of significance or higher their average also should lead to results that reach the .05 level of confidence. The author rejects the comment that not including studies where the coefficient does not reach the .05 level overestimates the effect of education since it would exclude studies where education's effects are small but significant. Studies are included where the regression slope coefficients for education are extremely small as will be seen and yet they reach the .05 and .01 levels. Significance is not the same as the size of the coefficient. Illustrations are offered in the spreadsheets on line of a few instances where the income coefficient does not reach the .05 level so that the reader can see that including these leads results in very wild outliers in the estimates of the values of the outcomes.

All coefficients included also are estimated under conditions that meet reasonable scientific standards for avoiding simultaneous bias, achieving identification by controlling for all other factors that are known to be significant, including the 6% correction for net ability bias mentioned earlier, and heteroscedascity. With respect to possible simultaneous bias, if any, it is very likely to be quite small since any specific non-monetary outcome will have a very small effect on income growth, which is explicit in the other equation in the model, and hence it will not lead to significant bias due to simultaneity. But if there should be some residual amount, it is further reduced by the 15 or 20 year lags between the education and education's effects. The resulting recursiveness does not eliminate all simultaneity since effects from ability can be correlated over time. But the lags reduce it. Thest lags also help to establish causality since the non-monetary outcome follows the education for each individual, not the other way around.

5.1.2. Effects specific to higher education

To identify the effects of higher education as distinguished from K-12, often the effect from one more year of education is linear extending into the college years. Where there is evidence supporting this it will be discussed. But for some outcomes there is evidence that the effects are non-linear in years of education, with the effects either increasing (as in the case of new ideas contributed by graduates), or decreasing (as for democratization) with years of education for which corrections are made. This will be discussed relating to each relevant outcome.

5.2. Private non-monetary benefits

The average annual *private* non-monetary outcomes from 1, 2, and 4 years of college are shown in Table 2 based on averages of the studies used as a data base. All studies that are known to exist that include the necessary coefficients are used if they meet reasonable scientific standards, but only if they relate to final outcomes and not to intermediate outcomes that would overlap if added in (e.g., intermediate outcomes like less smoking, and the final education outcome of better health overlap, as do monetary and non-monetary education outcomes which therefore requires a con-

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Table 2
Private Non-Monetary Benefits Beyond Earnings.

	1 Yr[a]	Assoc. Degree 2 Yrs[a]	B.A Degree 4 Yrs[a]	
Own Health	0.187	0.374	0.748	Units of health, 1–10
Better Child Health	0.195	0.390	0.780	Units of child health, 1–10
Better Spousal Health	0.180	0.360	0.720	Units of spousal health, 1–10
Greater Longevity	−0.117	−0.234	−0.468	Lower Mortality Rate; BA (Increases life 4.8 yrs.)
Child Educ., Cog. Dev.	−0.180	0.354	0.708	Reading and Math Scores
Smaller Family Size	–	−0.360	−0.720	Fewer live births/woman
Increased Happiness	–	–	+	Up to $80,000 HH income, family of 4
More Efficient HH Consumption	–	–	+	BA worth $4,016, Michael (1982)
More Saving, Better Asset Mgt.	–	–	+	BA worth $3,939, Solomon (1975)
Location & Work Amenities	–	–	+	
Lifelong Learning	–	–	+	No Coefficients Available

[a] Estimated *t*-statistics all at .05 to .01 level; See Text.

trol for per capita income.) The objective of getting to a total return results in the elimination of many studies whose outcomes overlap or in other ways are not relevant to the goal, further illustrating how this is not a survey. Table 2 shows the averages of the higher education contributions beyond earnings, (which are therefore a consensus of the studies that exist, albeit a mathematical consensus) to better own-health, better child health, better spousal health, greater longevity, more years of child education, better child cognitive development, smaller family size, more efficient household consumption, and better asset management.[13] There are positive contributions but of unknown size to happiness, to location amenities, to work amenities, and to lifelong learning because there are no known studies containing regression coefficients that meet the stated scientific standards, illustrating gaps in the research. The standardized and averaged coefficients are computed in the "Private NM Benefits" spreadsheet (Tables C1-A and C1B) at https://publish.illinois.edu/wmcmahon/. A typical case will be explained below, and others follow the same pattern.

5.2.1. Better own-health

There are 10 regressions for determinants of own-health that contain significant education and income coefficients and meet good scientific standards. After these coefficients are re-scaled and averaged the effect of one year of higher education is .187 in Table 2, or 1.87% per year over that of a high school graduate, since own health is measured on a scale of 1–10. From this it can be estimated that a 2-year Associate Degree contributes.374 or 3.74% in any given year to better own-health, and a Bachelor's Degree contributes.748 or 7.5% in any year, both above the health of a high school graduate.

Included in the averages are Eqs. (5) and (6) in Grossman (1975) which do not control for ability. Eq. (7) does control for general intelligence (reading comprehension, general information, arithmetic reasoning, and mathematics). But this control is insignificant. Grossman does control for parents' education suggesting that these are conservative estimates of the health return to household investment in higher education. The other seven equations whose coefficients are used are three from a different Grossman (1972) article, one from Erbsland, Reid, and Ulrich (1995), and three from Bolin et al. (2002A). Grossman (1972); Erbsland et al. (1995), and Bolin et al. (2002A) all control for income or wages which are standardized on the spreadsheets. All control for sex and age. Erbsland et al. (1995) also control for nationality and access to physicians resulting in a smaller education coefficient. Bolin et al. (2002A) include a self-health rating in a *later* year among the explanatory variables which is controversial and results in a zero effect of education on own-health when coefficients are averaged across income groups which is included in the average. All the original education coefficients in the published articles reach the .05 or .01 level of significance, so it is reasonable to infer that the average also reaches the .05 level.

A new study by Galama, van Kippersluis, and Lleras-Miney (2018) finds little evidence of education effects on smoking and obesity. But this conclusion is confined to experimental evidence and to these two health and mortality related outcomes and does not address many other effects on health. Its conclusions regarding mortality effects are more mixed, citing stronger effects in some contexts than in others, but with no coefficients reported that are relevant to measuring overall net effects of education on either health or mortality.

5.2.2. Child health

Currie and Stabile (2003A) and Case et al. (2002A) find that a mother's associate degree improves the health of her children ages 4–8 by 3.9% on average, and a bachelor's improves her children's health by 7.8% over the health of children of the same age whose mothers are high school graduates. Both control for income, and their education and income coefficients are all significant. Currie and Stabile (2003A) control for nothing else, and Case et al. (2002A) for the father's education. The latter may lead to a slight underestimate.

5.2.3. Spousal health

There is only one study of the effect of a woman's education on her husband's health, the one by Grossman (1975, p. 176, Eq. 6). Based on this, a wife's associate degree as shown in Table 2 improves the husband's health by 3.6% and a Bachelor's by 7.2% over what it would be if she had a high school education instead. Grossman (1975) estimates a three equation recursive system (Grossman, 1975, pp. 185–6) so it is not practical to list his many control variables. In the reduced form equation for the husband's health, the husband's own education and the wife's education are always both significant, with the wife's education always slightly more important than the husband's (Grossman, 1975 p. 176, Eqs. 4, 6, and 7). Health status in high school is always a control in all the structural equations, so the effect is clearly from higher education. Grossman points out that "schooling is the only predictor variable that has a significant effect on all three inputs (that are specified in the structural equations feeding into the husband's health)" (Grossman, 1975, p. 186).

5.2.4. Longevity

The three studies of mortality that meet the stated scientific standards yield coefficients that when standardized and averaged reveal that an associate degree reduces the mortality rate by .234 deaths per 1000 persons per year and that a bachelors reduces it by .468. Using the National Vital Statistics System life tables, a bach-

[13] 2 and 4 year FTE's for associate and bachelor's are used for cost calculations, although 4 has been creeping up to 4.5.

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Table 3
Direct External Social Benefits Beyond Earnings.

	1 Yr	Associate's Degree 2 Yrs	Bachelor's Degree 4 Yrs	
Democracy, Civil Institutions	.0008	.0016	.0032	Democracy Index, 1–7
Human Rights (Judicial)	.0012	.0024	.0054	Human Rights Index 1–7
Political Stability	.003	.006	.0135	Political Stab. Index 1–100
Longer US Life Expectancy	−.084	−.168	−.336	But Adverse Growth Effects
Less Inequality?				Only if Policies Support it
Poverty Reduction	.106	.212	.424	Poverty Index Increase
Lower Murder Rates	−1.13	−2.26	−4.52	Less Homicides per 100,000
Less Other Crimes	−78.9	−157.8	−315.6	Less Other Crimes per 100,000
Lower Prison Costs	$627	$1254	$2508	Muennig (2000) in 2016 $
[Additional Taxes Paid Annually, Present value]		[$989]	[$3824]	Not in total since in Table 1
Less Water Pollution (HE Only)	304	608	1,216	Lower Water Pollution Index
Less Air Pollution (HE Only)	.125	.250	.56	Air Pollution Index
Less Forest Destruction	.000005	.00001	.00002	Change in Forest Acres, %
Increased Social Capital	+	–	–	Helliwell (2005), No Coef.
Indirect Effects: Increased Wages of Others	.32	.64	1.28	Moretti (2004, p.28) & McMahon (2002)
New Ideas & Adaptations	+	+	+	

elor's degree therefore increases life expectancy at age 21 after controlling for income and other things by 4.8 years over that of a high school graduate (NVSS, 2012, Table 1, p.12). The uncontrolled life expectancy difference between college and high school graduates at age 21 is larger than this. Of the three studies, two are for OECD countries by McMahon (2009, p.367, Model i [HE] and Model ii [Sec]). Here, life expectancy is dependent and there are controls for all other levels of education. The third study by Grossman (1975, p.202) based on the longitudinal Thorndike sample consists of three equations explaining the survival rate. All control for income, job satisfaction, and 5 measures of different aspects of 'ability'. The schooling coefficient in all three equations is highly significant, and the education effect it finds based on micro data is about twice as large as that in the OECD regressions. This suggests that the estimate of a bachelor's lowering the mortality rate by 4.68% and raising life expectancy by 4.8 years is conservative.

5.2.5. Child education and cognitive development

There are two studies of the effect of the graduates' college education on their children's years of schooling (quantity) by Emisch (2000) and by Blau (1999A), and nine regressions on the effect of the parents' education on cognitive development (quality). Because these measures of quantity and quality overlap, the value of the effects of the mother's education on the number of years the child is in school and on the cognitive development of the child within each year are not added but are averaged over the eleven regressions. The nine regressions estimating the effect of parent's education on the child's cognitive development find that reading and math scores are raised if the mother has a bachelor's degree rather than a high school education an average of .708 points, and by an average of .304 points if the mother has an associate degree. The nine regressions for cognitive development are one by Angrist and Levy (1996A), three by Murnane (1981A, p.249) which includes one involving a one parent family, one by Edwards and Grossman (1979A), three by Shakotko et al. (1980A, p. 18), and one reported by Haveman and Wolfe (2007). All control for household income in one way or another, estimate the effect of the years of schooling of the mother, and all find both education and income coefficients to be significant. The average of this rather large number of studies reveals that a bachelor's held by the mother raises the child's cognitive development by .708, an effect commonly seen in local primary schools.

5.2.6. Smaller family size

No, children are not a negative benefit. But the number of children, especially when large, does have a bearing on the poverty status of the family. Therefore, the effect of increased years of female education beyond about ninth grade on lowering fertility rates has important implications for per capita development in the poor countries and poor neighborhoods that are frequently overlooked. This effect from increased female education continues to lower fertility rates up through the undergraduate and graduate college years. Smaller family size contributes to the reduction of poverty and frees resources that contribute to the health and education of the other children. Based on Michael and Willis' (1976, p. 68, footnote 38) regressions, which is the basis for their tables, Table 2 shows that a wife with an associate degree chooses to have .36 fewer children than a wife who is a high school graduate, and that a wife with a bachelors has .72 fewer children in her child bearing years. They control for the husband's income, the wife's age, urban/rural residence, the duration of the current marriage, and a multiplicative interaction term between the wife's education and the husband's income. Since increased education is known to delay the age of marriage and thereby reduce the number of child-bearing years, the control for age suggests that the effect of the woman's education in lowering fertility is understated.

5.2.7. Happiness

Psychologists can now measure happiness in cardinal terms by measuring brain waves, and obtain cardinal measures have been shown to coincide with the responses to questions about the degree of happiness. Economists find that as income increases, happiness increases up to about $80,000 for a family of four, after which the marginal utility of income for generating happiness falls to zero (Layard, 2006 and 2005, p. 32). It is apparent that education contributes to increased income and hence indirectly through income to happiness. But there are no studies with non-linear controls for income for the effect of higher education on happiness beyond these income effects. There also may be minor negative effects. So the net effects above and beyond earnings are left at zero.

5.2.8. Household consumption efficiency

The effects of education in increasing the efficiency of consumer purchasing was first analyzed by Robert Michael who concluded after controlling for per capita income that it "has a profound effect on real consumption" (Michael, 1982, p. 131). Averaging his estimate and Haveman and Wolfe (2007), the value of a bachelor's over a high school education in improving consumption efficiency and household management after controlling for income is $1,004 in 2016 dollars.[14] There are no education coefficients to be averaged

[14] This assumes that Haveman and Wolfe's estimate is in 2007 dollars.

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so the value of this education outcome is included with consumption and asset management benefits in Table 4.

5.2.9. Saving and better asset management

The savings rates by college graduates are higher than those of high school graduates. But savings are a part of earnings so this is not a benefit beyond higher earnings. However, it leads to additional earnings from assets, as well as better asset management. Solomon (1975, p. 288) found that after controlling for income, college graduates are more likely to invest in stocks and mutual funds (t = 6.39) and to avoid low interest bank CD's and savings accounts (t= – 5.41). Lee (1982A) also studies the value of better asset management, estimating that the average annual value of this contribution of a bachelor's is $3,550 in 2016 dollars. Again, there are no coefficients so Lee's estimate is used directly in Table 4. An important implication for rising inequality is that higher education also contributes by this route to interest, rent, and profit income. As state support continues to be withdrawn, and tuitions therefore rise, students from low income families are increasingly excluded from 2 and 4 year higher education, inequality rises, and many of the social benefits from higher education to faster per capita development proved analytically in Section II are lost.

5.2.10. Amenities, and lifelong learning

Higher education is associated with better access to and utilization of lifelong learning (Mincer, 1962). Chambers (1996A) shows that higher education after controls contributes to more desirable job locations, Duncan (1976) to better working conditions, Pascarella and Terenzini (2007) to "psychic" net benefits while in college, Becker (1981, Ch.4) to selective mating and marriage benefits, Feinstein and Sabates (2008) to more lifelong learning, and Nelson and Phelps (1966) and Rosen (1975A) to less obsolescence of human capital. But these are research gaps since there are no usable education coefficients.

5.3. Social benefit externalities

The external social benefits of higher education are those outcomes that benefit others including future generations. They include the direct social benefits from each social benefit outcome that will be the focus here, but also the indirect effects though intervening variables that build up over time. The external benefits from research and new ideas that are endogenous here based on the production of PhD and Masters degree graduates are widely acknowledged by economists to generate externalities. Butt the social benefits from higher education degrees are dismissed by some with the unsupported argument that these benefits are included in the earnings of graduates and therefore are private. However, even apart from the new ideas and technologies generated by PhD's and Masters graduates, some private earnings are really social benefits such as the taxes paid on higher earnings that finance public goods that benefit others. The proximity to graduates also increases wages paid to wage earners by about 28% according to Moretti (2004a, 2004b) estimates. Some social benefits such as those from democratic institutions are small on a per capita basis but large in the aggregate. The problem is that households where there are externalities have insufficient incentive to invest in human capital involving benefits that go to others and hence underinvest without public support. If external social benefits are not measured and clearly understood, then this public support is not forthcoming.

It is the *direct effects* and the *indirect effects* of higher education on non-monetary outcomes that are above and beyond the effects on GDP that are not addressed elsewhere. The direct effects are estimated in Table 3. They include improvements to civic institutions basic to democratization, to human rights (i.e., the rule of law), and to political stability. But they also include the effects on lower crime rates, lower public welfare, public health, and prison costs, the public good benefits financed by increased tax revenue, increased social cohesion (social capital), and increased generation and adaptation of new ideas. The education coefficients reported in Table 3 are the averages of the education coefficients standardized as before from the original studies. They can be interpreted as a disaggregation of the 'average level of education in the community' that Lucas (1988) and the endogenous development model in Section III above use to simplify education externalities except that here they focus on effects beyond those on GDP. The computations are shown in the 'Social Benefits of Education' coefficients spreadsheet at https://publish.illinois.edu/wmcmahon/.

5.3.1. Democratization

The belief that education contributes to the establishment and operation of essential civic institutions supporting democracy (and human rights) has been important to the support for public education since the emphasis on it by Thomas Jefferson. This and other contributions to economic development were central to the rationale for the Land Grant Act in 1964 signed by Lincoln, the GI Bill after WWII, the expansion of the Community College System in the 1960′s, and the Robbins (1961A) report leading to the large expansion of higher education in Britain.

To estimate the contribution of higher education to democratization, the degree of democracy is measured by Freedom House (2016) in an index on a scale of 1 through 7 for 210 countries or territories. The index reflects an evaluation made for each country of the effectiveness of voting for the president and legislative leaders, of the presence of viable opposition candidates, competing political parties, their access to the media, the presence of functioning legislative and judicial branches, limitations to authoritarian rule such as civilian control of the military, a degree of decentralization to provincial and local levels, and institutions at those local levels led by freely elected officials. Similar indices are now published by the Economist Intelligence Unit (2016A) and the World Bank (2016). There are erratic upward and downward shocks, but the trend reveals democratization to be a very slow long run process. Studies based on micro data and macro regressions that seek significant changes in short periods are likely doomed to failure. However Dee (2004, 2010) has done a great deal of work on the effects of contributions of education to components of democracy, as have Milligan et al. (2004). It is only because there are contributions to intermediate inputs that would overlap contributions of education to final outcomes that they cannot be included.

A typical bachelor's degree is estimated to contribute .0032 per year to the democratization index or .046% of the scale that runs through 7 in Table 3. This average is based on the standardized education coefficients shown in Column G of the Social Benefits of Education spreadsheet (op.cit). All the underlying studies control for per capita income, military expenditure as a percent of the government budget (a negative effect), human rights, and political stability. No other determinants could be found, including religion, that are significant at the .05 level. The three regressions averaged are McMahon (2002, p. 98, Model 1) and McMahon (2009, p.367, models i and ii). This is an under-researched field and more studies are needed. Education's effects on democratization and human rights are lagged 12 years and on political stability are lagged 20 years. The lags are consistent with the logic of the average time lag of effects over the life cycle and also make the relation recursive which reduces but does not totally eliminate potential simultaneous equation bias. A correction for net ability bias is made later in Table 4. Two of the coefficients find that four years of secondary and of higher education have approximately the same effect which is consistent with a test for each measure of education separately using OECD panel data and controlling for per

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capita income. The latter yields coefficients of .011 for secondary and .010 for higher education which is essentially also the same (McMahon 2009, p.367).

Keller (2006a) estimates education's effect on democratic institutions based on higher education enrollment rates after standardization and with a similar specification is essentially the same as the average shown in Table 3, or .00087 per year. The income coefficient is significant at the .10 level but not at the .05 level so under the stated criteria it just barely could not be included in the average (although it is shown on the Social Benefits spreadsheet, op. cit.). In her study, higher education investment is highly significant and the most significant determinant of democratization!

5.3.2. Human rights

In view of the apparent upsurge in human rights abusers in Syria, Turkey, Egypt, China, N. Korea, the Philippines, and elsewhere, it is worth noting that democratization is statistically a highly significant determinant of improved human rights that reflect the effectiveness of judicial institutions. Much of higher education's effects on human rights comes indirectly through its effect on democracy (McMahon, 2002, p.103). However there are some additional residual effects suggesting that a bachelor's degree increases human rights by about .005 or .007% on the Freedom House human rights index (i.e., civil rights measured on a scale of 1–7) averaging Keller (2006a) and McMahon (2002, p.103). These results are consistent with Glaeser, La Porta, Lopez-de-Silanes, and Shleifer (2004) who find that education has a causal effect on institutions key to development. Glaser's result is challenged by Acemoglu, Johnson, Robinson, and Yared (2005) who again introduce time dummies and fixed effects after which education again becomes insignificant. However, there is a long history of dissatisfaction with the use of time dummies (and hence presumably also fixed effects that assume that the initial conditions do not change over time) that goes back to Griliches who complained vigorously about using determinants which themselves are unexplained to 'explain' the (unexplained) technical change in the 'residual'. In view of this situation, the Glaeser et al. (2004) result seems reasonable.

5.3.3. Political stability

The degree of political stability as measured by *the International Country Risk Guide* (Coplin, O'Leary, & Sealy, 2016) depends on democratization after a lag, and in turn is positively related to growth even though democratization directly is not (McMahon, 2002; Barro & Sala-I-Martin, 2007). The per capita direct effects of increased higher education on democratization, human rights, and political stability in Table 3, the latter by about .013% on that index (measured on a scale of 1 to 100), are small but nevertheless positive and significant. Small effects can be expected due to the slowness of the process and the fact that they are measured on a per capita basis. For a community however, the effects of higher education on political stability and democratization can be substantial. China, for example, has had political stability and rapid per capita growth in recent years as has Singapore, but the effects on democratization, although apparent at local levels in China, have been slow. With more time things may change.

5.3.4. Life expectancy

Increased life expectancy is a social and not just a private benefit as the human capital that is preserved yields benefits to the society for more years. But in the US and other OECD nations more live beyond retirement age which also increases public social insurance costs. The latter has been shown to slow growth by Barro and Sala-I-Martin (2007, p.434) and McMahon (2009, p. 364). When these negative externalities are netted out, the net purely social benefit is negligible, although the private benefit (above) was positive. See Appendix A on line for details.

5.3.5. Inequality

Whether higher education reduces inequality is indeterminate because it depends heavily on the current financing policies pursued. Increased access to Community Colleges is very likely to reduce inequality, but this is another research gap. See Appendix A for further discussion.

5.3.6. Poverty

Growth reduces poverty, and higher education contributes to growth. But higher education's effects on poverty after controlling for its effects on growth depend on policies supporting access for children from poor families,which differ over time. This is another research gap.

5.3.7. Crime rates

With the US incarceration rate the highest in the world it is important to consider additional approaches such as Community College attendance to lowering crime. But it is not just basic education but also college attendance that reduces crime among attendees and reduces lifetime criminal activity as concluded by Lochner (2010A, p.95). Based on Lochner's (2004A, 2010A, 2011A, 2011b) extensive literature survey, few studies specifically estimate the effects of an additional year of college on different types of crime. But Lochner and Moretti (2004A) do estimate the percentage effects of one more year of education on reducing crime using the FBI's Crime Reports for 1960-90 inter-state data linked to US Census data (FBI, 2013A). They control for race, state-specific crime effects, variation in arrest policies across states, and crime and age specific trends common to all states. Their OLS and IV estimates are not statistically different. They find that a 1-year increase in average years of schooling reduces murder and assault rates by about 30%, car theft by 20%, arson by 13%, burglary and larceny by 6%, robbery by 0%, and increases the rate for rape. With respect to white collar crimes such as forgery, counterfeiting, fraud, and embezzlement, there is a positive but statistically insignificant affect from education per Lochner (2004A). For homicide, the 30% reduction for each 1-year increase in average education levels times the US murder rate of 4.7 per 100,000 in the US in 2012 (FBI, 2013A) leads to an -1.41 reduction in the homicide and assault rate for each 1-year of additional education (See the spreadsheet cited). The Lochner and Moretti estimate does not control for per capita income which would reduce the size of their coefficient somewhat. When averaged with the −.859 coefficient independently estimated by McMahon (2002,p.144, model 6) who does control for income, this leads to the -1.13 coefficient shown on Table 3 for the effect of each additional year of education on the homicide and assault rate. Community College students and employed graduates are less likely to be involved in street crime and what evidence exists suggests that the effect of one more year of education at these levels is linear in years of education.

For crimes other than homicide and assault, the weighted average of the effects of 1 additional year of education for reducing car theft (20%), arson (13%), burglary (6%), larceny (6%), and robbery (0%) from Lochner and Moretti (2004A) is 6.92%. The average of the number of crimes other than homicide is much larger than the number of homicides, or 1,521 per 100,000 which is an average dominated by the number of arrests for larceny and burglary. From these, or −78.91, is the estimated effect of one more year of higher education on the crime rate as shown in Table 3. This does include the positive but insignificant effects of HE on white collar crime, a negative externality.

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5.3.8. Lower prison and welfare costs

Reduced crime rates below what they would otherwise be mean reduced state and local criminal justice system and prison costs. Also, as more graduates are employed, education reduces state welfare and Medicaid costs. Legislators tend overlook these effects as well as the larger tax revenue from more graduates and higher earnings when they focus on short term education budgeting. The only comprehensive estimates known of the size of these effects on state prison and welfare costs and revenue loss are those by McMahon (2015A) which are for Illinois. Muennig (2005A, p.28), however, estimates the discounted present value for the saving in prison costs for the US using a discount rate of 3% to be $2,508 (converted to apply to a bachelor's in 2016 dollars) per college graduate per year which is shown in Table 3.

5.3.9. Additional tax revenue

A college education generates earnings above those of a high school graduate and hence significant additional state and federal tax revenue. Although a few may not like particular public goods, taxes to finance them are supported by the votes of legislative majorities. These include schools, judicial systems, highways, and defense that provide social benefit externalities to others. They are included in earnings before taxes used to calculate the social rates of return in Table 1. So this social benefit is monetary and not included as in the totals for non-monetary benefits. It is shown in Tables 3 and 4 in brackets as an exhibit and will be discussed briefly since it is appropriately discussed as a social benefit and was not discussed under monetary returns.

Community College graduates earn an average of $7,647 per year (in 2016 dollars) over their life cycles more than a comparable high school graduate. Those with bachelor's degrees earn on average $24,873 more per year.[15] The typical Community College graduate earns $44,208 in 2016 dollars and pays 13.9% in Federal taxes and 11.3% in state and local taxes based on the Institute of Taxation and Economic Policy (2014A) or 25.2% of the earnings increment which is $1,927 more in Federal, state and local taxes per year. Similarly, a bachelor's graduate earns $63,097 on average and pays a total of 28.3% in Federal, state, and local taxes on the increment of $24,740, which is $7,001 more per year in taxes than the typical high school graduate. Public goods financed with new tax revenues due to increased education are largely education externalities because they benefit others and future generations and not just the taxpayer directly. On the tax side, higher education creates incentives to become employed, to work longer hours, and to work longer in life as well as to save and invest a larger percentage of income, as well as to better manage household investments, some of which have been documented above. All of these offset any adverse effects from education taxes on supply side incentives to work, save, and invest, and some of the excess burden of other taxes as well. Using a 3.5% discount rate, the discounted present value of this additional tax revenue is $989 per year in 2016 dollars for each Community College graduate and $3,824 for each Bachelor's graduate as shown in Tables 3 and 4 (but again, not included in the totals).[16] This additional tax revenue is lost from each graduate when states cut back their support.

5.3.10. Environmental sustainability

Most economic studies concerned with the environment deal with regulation and virtually none address the effects of education on forest and wildlife sustainability, water pollution, and air pollution. What little there is suggests that many of the effects are indirect (e.g. from education's effects in slowing population growth). But it also suggests a detectable direct effect from more higher education on less water and air pollution after a lag of 20 years after controlling for current GDP per capita, initial GDP per capita, growth of GDP/cap., other levels of education, urban poverty, and democratization in McMahon (2002), p.134 model 1 and, for air pollution, model 4). The recursive relation reduces simultaneity and the higher education coefficients shown in Table 3 are robust over several specifications.

5.3.11. Indirect effects

Indirect effects are important. But studies of them have usually been limited to the indirect effects of higher education through other variables on wages such as by Moretti (2004a) or on total income later by McMahon (2002, p. 240), Hermannsson, Lisenkova, Lecca, McGregor, and Kim Swales (2016), and others. But indirect effects include the effects on non-monetary outcomes, the only known estimates of which are by McMahon (2002, p. 240-1). Specifically, indirect effects are the cross partial derivatives of education's effect through intermediate variables on final growth or development outcomes. In a dynamic model, they interact and cumulate over time as in Hermannsson et al. (2016) and McMahon (2002) and their size is therefore a function of time.

As shown in Table 3, Moretti (2004a, p.28) estimates the effect of a 1% increase in the percentage of college graduates in the population on the level of wages in a city based on U.S. Census data to raise local wages by 1.32% after controlling for the unemployment rate and other city effects. This 32% over a unitary elasticity based on Moretti is shown in Table 3. But this estimate is not carried over to Table 4 because the scaling is problematical, and because Tables 3 and 4 are focused on direct effects on non-monetary outcomes beyond earnings. For further discussion see Appendix A (op.cit.).

Since indirect effects cannot be ignored, from the work cited it can be concluded that:

1) indirect effects from higher education are larger if the non-monetary outcomes are included,
2) direct and indirect effects interact and build up to eventually be much larger than the initial impact,
3) therefore, their size is a function of time, and
4) the indirect effects are substantial and positive. An educated guess as to the size of the indirect effects on both monetary and non-monetary outcomes based on Moretti (2004a), Hermannsson et al. (2016), and McMahon (2002, p.240) is that they are 37% of the total benefits of education in the US after 40 years. This is an educated approximation that does not include higher education externalities due to an endogenous larger flow of new ideas and adaptations.

5.3.12. New ideas

Finally, the endogeneity of new ideas in the endogenous development model in Part III specifies that more Masters and PhD graduates from research universities lead to a larger flow of new ideas and technologies and their adaptation and therefore are a source of higher education externalities. The counter-argument is that these graduates are paid, not to speak of many failed experiments. Of course, this is true. But many important contributions such as those by William Shakespeare, Charles Dickens, Alfred Marshall, John Maynard Keynes, or John Bardeen, the latter who died while on the faculty of my University and the recipient of 3 Nobel Prizes for the invention of the transistor that made possible the computer revolution have had massive impacts on future generations worldwide far beyond anything they were paid. This

[15] Calculated in Column R, Rows 41 and 56, converted to 2016 dollars using the CPI of the "US Social Rate of Return 2014" spreadsheet from BLS/Census CPS (2016) at https://publish.illinois.edu/wmcmahon/.

[16] As calculated in Table 2, Cols AA and AB of the spreadsheet cited in the preceding endnote.

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is a testable hypothesis. There is some research in Glasgow by Hermannsson et al. (2016) on the relation of the number of Masters and PhD's in firms to firm productivity. It finds the positive effects just cited above. This connection is more specific than the one measured by Moretti (2004a), and goes beyond the large body of research on the returns to university-based R&D which is a separate output. None of this offers the necessary education coefficients to estimate of the size of the effect. But Hermannsson et al. (2016) do find that the effect from an increased proportion of graduates in the labor force raises labor productivity 11.5% within 30 years in their base scenario. To carry this further, the numbers of Masters and PhD's are broken down by field in McMahon (2009, p.264) and could be related to productivity in each field in firms, universities, and government where these graduates work. This effect is reminiscent of Romer (1990) growth model that stresses R&D personnel in firms created by higher education.[17] It is not just research within universities, but ideas generated after graduates are employed that makes endogenous idea generation important.

6. Valuing the non-monetary outcomes

To obtain a total return to higher education, an estimate of the monetary value of each non-monetary higher education outcomes in Tables 2 and 3 is a separate step.

6.1. Valuation methods

The basis for these valuations is *what it would cost to produce each higher education outcome by other means.* This can be done by using the income coefficient that is included in every equation because it is required on theoretical grounds. As a control, the income variable measures the non-monetary outcome above the effects on income of higher education and thereby avoids double counting this effect on income when monetary and non-monetary outcomes are added. So then next, using the education coefficient it is possible to ask, 'how much of the non-monetary outcome does one more year of higher education produce?' Then, using the income coefficient, ask 'how much income (i.e. other means) does it take to produce that education outcome?' This method also works for valuing the higher education social benefit externalities in a way that the Haveman and Wolfe (1984) method does not. However, both can be shown to produce approximately the same result.

The details for estimating the value of the non-monetary outcomes using the above methods are explained in the Technical Appendix available on line at https://publish.illinois.edu/wmcmahon/.

To describe one example very briefly, for "own health", the coefficients α and β are first shown in the on-line spreadsheet from the original published study. To standardize them to comparable units from different studies the coefficients are then re-scaled. Then, using first the Haveman-Wolfe method, it is assumed that a few doctor's visits and related drugs would have cost about $1,000 to produce one unit of better health (scale of 1–10). This is remarkably close to the amount of income it would take based on the income coefficient (with the amount of education held constant) to produce the same outcome. Using the education coefficient, which is normalized by being divided by the income coefficient, it is possible to multiply this by $1,000 to ask how much would cost to produce this own-health education outcome by other means? Multiplying this by 4 years of college for a bachelor's degree gives an estimate of the value of what a bachelor's would produce. Converting this to 2016 dollars and correcting for net ability bias and longitudinal trend gives the estimated value of the better own health produced by a bachelor's degree that is shown in Table 4. This value is $15,887 in 2016 dollars (for Grossman, 1975, Eq. 5). The separate estimates for all 8 regressions for own health range from the low of $5,058 (Bolin, 2002A, medium category) to the high of $42,022 (Grossman, 1972) with a mean of $16,122. To avoid double counting, longevity/mortality effects that average $4,902 for a bachelor's are subtracted before arriving at the final estimate. Valuation outcomes are generally not far from the average reported except when the income coefficient is not significant.

Valuations of the other non-monetary higher education outcomes estimated in the same fashion then are all corrected for net ability bias (i.e. IQ net of measurement error) by being reduced by 6% as was done with the monetary outcomes. They are also corrected for longitudinal trends due primarily to technical change and globalization. As was done for the monetary outcomes, these returns are not corrected for the risk of non-completion in order to show the returns for those who complete 2 and 4 year degrees that are comparable to the earnings benefits. The reader can see in Table 1 the return for those who drop out after 1–3 years, which is lower by about half as opposed to graduates.

With respect to the return to higher as opposed to secondary education, the evidence suggests that linearity is a reasonable approximation for own health effects but not for education's effects on democratization, human rights, or political stability institutions, or on new ideas. For own-health, Grossman (1975) estimates that control for health status in high school are the same as estimates in other studies that do not have this control, indicating linearity. Where there is known to be non-linearity, the effects on democratization, human rights, and political stability also are corrected by reducing them by 10%, an approximation based on the scatter diagrams for each of these in McMahon (2002, Ch.7). There is some, but weaker, evidence of non-linearity with diminishing fertility and longevity effects, and evidence for increasing returns in the production of new ideas and adaptations. Further research is needed on these for refinements to be made. But this effects from these non-linearity's does not appear to be large (e.g. 10%) and is unlikely to change the outcomes reported by very much.

With respect to net ability bias, as those with higher IQ self-select to go farther in college, some of the regressions such as Grossman's Eq. (7) already control for ability as approximated by achievement test scores. So the correction of -6% for net ability bias included in all estimates in Table 4 result in conservative estimates of the causal effect of higher education on these outcomes.

6.2. Total private and social non-monetary benefits

6.2.1. Total private benefits

The total estimated value of the non-monetary private benefits beyond earnings from a bachelor's degree sum to $50,176 per year, and of an associate degree to $17,688 in Table 4. These are each 156% of the averages of male and female earnings at each degree level. Although private non-monetary benefits as well as earnings contribute to broader development in the community, they are not externalities because they are enjoyed privately by the graduate and his family. They can be financed privately. There is some evidence that there is low awareness of the scope and size of non-monetary private outcomes beyond earnings in McMahon (1984, p.85), low significance of expected non-monetary returns), and in Cunha (2005). If there was greater awareness it would add to the private incentives to invest.

6.2.2. Total value of the social benefits

The total estimated value of the non-monetary direct social benefits beyond earnings in Table 4 are estimated to be $30,697 for a

[17] It differs, however, in its relation to the role of human capital in diffusing knowledge that is more central in Lucas' (1988) model as compared to R&D alone. Romer's has more limited application beyond the advanced countries.

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Table 4
Value of Non-Monetary Benefits of US Bachelors and Associate Degreesss. Benefits are for each year after graduation, beyond earnings, and in 2016 dollars[a].

Non-Monetary Benefits	Estimated Value	
	Bachelor's	Associate
Private Non-Monetary Benefits		
Better Own Health	$16,122	$5,683
Better Child Health	$7882	$2779
Better Spousal Health	$2,141	$755
Greater Longevity	$5354	$1887
Child Education & Cognitive Development	$13,395	$4,722
Poverty Reduction due to Smaller Families	$1,732	$611
Evidence for Increased Happiness, beyond $80K Family Income	0	0
More Efficient Consumption & Asset Management	$3550	$1251
Job and Location Amenities	+$	+$
Lifelong Learning	+$	+$
Total Private Non-Market Benefits	**$50,176**	**$17,688**
Private NM Benefits as a % of Earnings Increment	**156%**	**156%**
External Social Benefits		
Democracy (Better Civic Institutions	$2,274	$801
Human Rights (Judicial Institutions)	$1,209	$426
Political Stability	$3,769	$1,329
Longer Life Expectancy (Private Benefit)	$0	$0
Less Inequality (Depends on policies)	?	?
Poverty Reduction (Mostly private benefit)	$0	$0
Lower Homicide Rates	$3823	$1348
Less Other Crime	$8037	$2833
Lower Public Welfare and Prison Costs	$2,630	$927
[Taxes Paid, Present Value, not in total]	[$3,824]	[$989]
Forest Maintenance & Wildlife Habitats	$3922	$1382
Clean Water	$378	$133
Reduced Air Pollution	$4655	$1641
Social Capital (Social Cohesion) (Overlaps)	$0	$0
New Ideas	?	?
Total Direct Social Non-Monetary Benefits	**$30,697**	**$10, 820**
Direct Social NM Benefits as a % of Earnings Increment	**96%**	**96%**
TOTAL PRIVATE & SOCIAL NON-MON. BENEFITS	***$80,873***[b]	***$28,508***[b]
Average Earnings Increment over HS, M/F Avg:	*$32,102*	*$11,316*

[a] All values above are at the mid-point of the life cycle since they are averages over the life cycle and therefore future values. It is the ratios to the average monetary return shown that also is not discounted that are used to convert the monetary rate which is discounted to a discounted total return.
[b] These totals reflect the reduction for non-linearity to Democracy, Human Rights, and Political Stability.

bachelor's and $10,820 for an associate degree. These are future values at about the mid-point in each graduate's life cycle not discounted back to their present values because it is the ratios to comparable mean earnings increments and not absolute values that are used to convert monetary rates of return to a total return.

Given questions about the applicability of the Haveman-Wolfe method for use in valuing public goods, all the social benefits are valued using the direct method by asking *what would it cost to produce the same social benefit by other means?* The limited applicability of the other related method is because the individual cannot purchase market goods to produce an indivisible public good such as a one unit improvement in the index for democracy, or his/her share of one program on PBS, and in the process, equate the ratio of their marginal products to their prices. This is a difference that applies to all public goods; namely, all citizens are involved, and each contributes a little through taxes. It is possible, however, to look at the income coefficient which is available in all regressions used and ask "What is the average annual cost in dollars in per capita income (with education and other factors held constant) to produce one additional unit of improvement in the dependent variable?

If this method is to be used, the income coefficient is not computable for the US alone because there are too few years for which data exists. 5-year increments must be used to avoid short term noise and hence the sample is too small. Data for the 50 US states alone involves endogeneity when focusing on democratic, human rights, and political stability institutions because mobility of people and institutional patterns among states, a single US Constitution, and Federal laws universally applicable lead to relatively homogeneous political and judicial institutions. However, a panel of the 28 independent OECD countries (including the US) for which there is data increases the sample size. For a few social benefits such as effects of higher education in lowering crime rates there is sufficient data specific to the US, more variation among jurisdictions, and crime rates are probably less slow moving. But for other public goods the OECD sample must be used. The income coefficient can then be used to price out the number of units in the Freedom House democracy index that are the result of each additional year of higher education on average in the OECD when other contributing factors are held constant. This was done choosing the 45 year period from 1960 to 2005 (to avoid the 2008 recession) to estimate P(Y) and hence **P(E)** in the Technical Appendix. The details for valuing this and all other social benefits are shown there for those interested discussing the "Social Benefit Calculations, Coefficients" based on "OECD Data" from OECD (2016). There are three exceptions to this procedure. 1.) Muennig's (2010 A) estimates for net effects on prison costs are updated and used directly, 2.) additional taxes paid are shown as a social benefit but not included in the total in Table 4 because they are included in the monetary social rate of return calculations in Table 1, and 3.) indirect effects which are social benefits since they are neither anticipated nor enjoyed by individuals as they invest are not included in Table 4 which focuses on direct effects.

With respect to indirect effects on GDP only, Moretti (2010) estimatesthe indirect effects of higher education of a 32% increase in money wages is somewhat analogous and similar in size to McMahon (2002, p.240) estimate of indirect effects leading to a 37% increase in GDP after 40 years based on cross country data as mentioned earlier. There are differences, however, since Moretti

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estimates that city-wide wages in the US are increased by 1.32% for every 1% increase in the number of college graduates and McMahon's simulations are for an increase in all levels of education. Hermannsson et al.'s (2016) micro-to-macro based estimates for higher education impacts only on GDP in Scotland are a smaller 11.8% increase in GDP also after 40 years in their base scenario. Their indirect effects are modest in the short run but build up as do mine as the intermediate variables interact and as graduates move through their life cycles. They are also larger when the indirect effects in the form of non-monetary private and social benefits are added. This all makes it easier to see how a higher per capita rate of development is predicted by solutions to the endogenous development model when positive social benefit externalities and/or positive externalities from the endogeneity of new ideas are present. It also helps seeing how this rate rises as it reaches the steady state, how this rate is permanently higher than that in a competitive economy, and how it is sustainable without bounds.[18] Although the range is apparent, precise estimates are not yet possible. But it can be concluded that higher education's social benefits are positive, and significant in the short run along the lines of Table 2, but also clearly build up with indirect benefits over time and become even more important determinants of the development of families, regions, and nations over a longer 30–40 year period. The pieces are now in place, with research gaps and qualifications noted, for the first systematic estimate of the total return.

7. The total return to higher education

The total return to higher education is the standard earnings-based social rate of return in Table 1 plus the rate of return due to non-monetary private and direct social benefits above and beyond earnings based on Table 4. They can be added because the per student costs are the same. The non-monetary benefits arise through use of the same human capital on the job later at home or in the community. Adding indirect benefits would make the total return a function of time.

7.1. The total return to bachelor's degrees

The private non-monetary benefits are estimated to be 156% of earnings increments in Table 4 and the *direct social* benefits to be 96% of earnings. It is assumed that these non-monetary benefits are spread over the life cycle proportionate to earnings, but the non-monetary estimates are conservative because they are the primary benefits from higher education after retirement. Using these percentages implies a total return averaging males and females of 38.5% on a Bachelor's Degree in 2016. This is based on the monetary plus non-monetary returns, or 3.52 times the 10.9% average return for males and females at the bachelor's level. All returns are corrected for ability bias net of measurement error and for longitudinal trends due primarily to continuing technical change.

7.2. The total return to associate degrees

For associate degrees, the total return is 13% monetary return for males and 12.8% for females averaging 12.9% in Table 1 to which 156% of this is added representing non-monetary private benefits and 96% of this for social benefits. This leads to a 45% total return on investment in Associate Degrees. This also is corrected for net ability bias and trend. For students who do not complete, based on the 6.4% average return for College 1–3 years, the total return is 22.5%. This lower return for dropouts is consistently lower than for those that do complete, but still higher than the 7.2% benchmark return on the S&P 500. So, completion of a degree is clearly the best option and policies designed to encourage that are warranted. But for a contribution to development, even for drop outs, the total return indicates that some college is better than none.

The 156% + 96% for private plus social non-monetary benefits as a percent of earnings implies that each hour human capital is used at work is still more valuable than hours using the human capital in home production. Of the total hours available to each individual each week, if 40 are spent at work and the remaining 128 (including about 56 sleeping) are spent using one's human capital at home or in the community, this means that 320% of the time spent working is spent at home producing non-monetary returns that are equal to only 252% of earnings. It could help to explain why some spend less time sleeping, and why most with college work more years before retirement and work more hours during retirement. However, if the indirect effects in the form of non-market outcomes which may not be fully perceived are included, the non-monetary outcomes are a larger percentage of the total than above and close to the typical 320% of time spent in household production. If the total return seems high, it must be remembered that it is a return (for the same cost) to the larger outcome of development which includes private benefits and social benefits to GDP plus to development beyond GDP.

7.3. Error margins

The margins of error for the *monetary* rates of return are approximately +/- 0.39 percentage points at the bachelor's level and +/- .43 percentage points at the associate level. These are small because the standard errors of mean earnings for the very large nationwide samples published by the BLS (for each sex/age/education-level cell) on which they are based are small.

The significance levels for the non-monetary quantitative outcomes in Tables 2 and 3 should all be at or above the .05 level since the estimates in the underlying studies are all at the 95% level of confidence or better. The error margins for the *values* of the non-monetary outcomes in Table 4 are less certain since although the education and income coefficients used all reach the .05 level, the final value estimates depend on the assumption these values are equal to what it would cost to produce the higher education outcome by other means. However, omissions that lead to underestimation of outcomes and hence their value are almost certainly the major source of error. Omissions include the value of the indirect effects (about 37% of the total benefits), job and location amenities, contributions from additional lifelong learning, contributions due to better asset management, and perhaps the most important of all, contributions from an increased flow of ideas and their value. A potential new contribution of this article is the more specific identification of areas like these that are under-researched. For example, more research is badly needed on the endogeneity of new ideas and on the size of the indirect effects on non-monetary outcomes, whereas own-health effects are relatively well understood.

Another potential source of error is flaws in the econometric methods. Simultaneous bias is not likely to be a major source of error because individual non-market outcomes have only small effects on income growth that in our model does feed-back increasing the non-monetary outcomes in question. There is also a control for income in every equation used, and most articles take steps to reduce simultaneity by using IV or 2SLS methods. Other OLS regressions are recursive since they contain lags of 15 or 20 years which reduce but do not totally eliminate simultaneity, as mentioned. Studies that specify dynamic treatment effects to identify the causal effects of educational *institutions* overcorrect with too many controls to be appropriate when estimating the total return on investment in human capital, not just the return to institutional

[18] That is, it is not limited by diminishing returns.

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involvement. Finally, the 'full method' is not 'back of the envelope' but instead is thoughtfully chosen to calculate a pure internal rate of return rather than the more familiar Mincer return because the objective is not to estimate a private return, using private costs, but instead a to estimate a household treatment effect marginal to each level of education that reflects the full social costs. To be policy relevant to the type of policies at issue here it must average over races, number of siblings, urban vs rural status, and other individual characteristics as well as over institutional unit costs at each education level. The result is a total return that applies to a nationally representative group with individual characteristics and costs appropriately weighted.

8. Conclusions and policy implications

Brief remarks about economic growth about which there are major policy concerns follow before returning to my main theme, broader economic development.

8.1. Economic growth

From the solution to the endogenous growth model in Section III and the updated empirical estimates of earnings-based social rates of return it is concluded that there is underinvestment in higher education for there to be economically efficient optimal growth. This updates earlier findings. Separate results for Community College and 4-year levels with and without dropouts are new. Examining Table 1, we find no evidence that there has been a decline in the monetary rates of return to higher education in the US, as is sometimes claimed in the popular press (Economist, international, Feb. 3, 2018), at least since 2007. In fact there seems to be a modest upward trend in the rates of return to Masters and PhD's.

8.1.1. Investment in community colleges

For Associate degrees, the average 12.9% rate of return for males and females is well above the benchmark 7.2% average 10-year return on a S&P 500 index fund. The latter can be interpreted as the opportunity cost of tax funds to families and a bit above the average return on physical capital. The solution for optimal growth says that these rates must be equal, so this higher rate of return to human capital formation indicates that there is underinvestment at the community college level. Although some community colleges are more cost effective than others (see Grosz 2017A), this comparison indicates that community colleges are more efficient in yielding returns than the average of the nation's 500 largest corporations. *Since the 7.22% S&P return is also the opportunity cost of tax funds, the higher rate of return to investment in human capital in community colleges implies that state governments who are cutting back state support are doing so to the detriment of their own states. The same is gtrue in the UK, the estimates for which based on UK data re reported by* McMahon and Oketch (2013). It also has implications for lagging Federal support of Pell Grants discussed later. Over half of all US undergraduates are in community colleges, the places best positioned to also upgrade the skills and benefit older workers, who are the Trump voters who have spoken out in protest as they have been displaced by technical change and globalization. A very high percentage of Community College students are older. Community College graduates are known to mostly remain near the communities where they attended school and to contribute to growth there (e.g., Aghion, Boustan, Hoxby, & Vandenbussche, 2005). It can be concluded from these results that State cuts to Community College support such as in Illinois further retard economic development in the rural areas and may even encourage emigration.

8.1.2. Bachelor's level

With a 10.9% average social rate of return based on earnings it can be concluded that the underinvestment from the point of view of efficient growth extends to 4-year colleges and universities as well. With a 7.2% opportunity cost of funds, states are not wise to be cutting back on their investment in human resource development if there is to be efficiency and optimal growth. This is very strong evidence and overshadows the argumentt that some graduates are unemployed. For one thing, unemployment shortly after graduation is very misleading, so it is necessary to wait a year or so until graduates find work and to consider their whole life cycle. For another, the unemployment rate of college graduates (2.4% in June 2017, lower in 2018) is well below the unemployment rate of high school graduates (4.6%, BLS, 2017b), and even farther below in recessions. The argument that it would be efficient if young people should stop with vocational courses in high school does not hold up.

8.2. Economic development

The total return to higher education for development of 45% for Associate, 38% for Bachelors' Degrees, and 22% for college dropouts, all corrected for net ability bias and trends, are far above the 7.22% opportunity cost of funds and the return on physical capital. It can be concluded from this there is even more serious underinvestment in the US in higher education at the bachelor's level for efficient development, a totally unique and new finding.

8.2.1. Education externalities

A third conclusion is that the per capita rate of optimal development is larger and sustainable indefinitely with higher education externalities that are positive. This is based on the analytic proof in Section III and the empirical evidence in Tables 3 and 4 that higher education externalities are positive for 16 direct social benefits beyond earnings. It does not depend on indirect effects for which there is evidence not based on macro growth equations that they are also positive and likely substantial. The value of the direct external benefits alone with omissions is estimated to be 96% of the earnings benefits (Table 4). The evidence is that indirect effects which are all externalities increase with time, and are 11.8% of GDP or about 37% including non-monetary outcomes after 40 years. Based on the theory of endogenous development and this empirical evidence it is concluded that sustainable per capita development is larger in the presence of these externalities than it would otherwise be. And that when public support is cut, these externalities and the rate of economic development are smaller.

8.3. Policy options

8.3.1. Market failure

If there is poor information about the non-monetary private and social benefits of higher education, there is classic market failure that can lead to underinvestment in human capital formation in colleges. There is evidence of this failure, albeit weak, that poorly perceived non-monetary outcomes lead to less investment by students and their families in McMahon (1984, p.85). There the few measures of non-monetary benefits tested (N_1 and N_2) have low significance and explanatory power in explaining decisions to invest relative to the significance of expected earnings. If the information was better about the private non-monetary benefits from college, such as the benefits of greater longevity or better asset management, then the parameter ζ in Eq. (11) reflecting the satisfactions perceived from non-monetary benefits would be larger and private investment would be greater. Similarly, if there were better information about social benefits there would be larger public

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investment. Market failure could also help to explain why productivity growth and rural development remain low.

Psychic costs are another closely related way of explaining the discounting of future non-monetary outcomes as in Cunha (2005). In Eq. (11) above, holding the utility of market consumption and of monetary benefits constant, and decreasing the exponent ζ on non-market outcomes is tantamount to increasing the uncertainty about the future by inserting and discounting expected non-monetary benefits by a larger σ. For further discussion of psychic costs see Appendix A (op.cit.,on line).

The common policy response to market failure (and/or to psychic costs) is for the government to make markets work better by providing for better information. There are many examples such as truth in labeling for food and drugs, truth in lending by banks, and statistics provided free by government. A policy option in this case is for the US Department of Education to provide more comprehensive information on more specific private and social non-monetary outcomes together with the earnings benefits of 2 and 4 year degrees for the typical student directly to high school students and their families, to older displaced workers directly, and to state Boards of Higher Education and legislators.

8.3.2. Rising private costs to families

Financial problems and concern about high student loan debt are the major reasons that students drop out or do not go to college (e.g. McMahon, 1984). The exclusion of admissible students from middle class and poor families by rising tuition as private costs to families have risen in response to falling state support per student at public institutions is the main policy problem that urgently needs to be addressed. Per student institutional costs in real terms have remained constant from 2006 through 2016 at public 2 and 4-year degree granting institutions as indicated earlier (NCES 2016, Table 334.10). Costs at private non-profit colleges and universities have risen but only by 3.6% (NCES 2016, Table 334.30). Tuition and student debt have skyrocketed as state support has fallen. There have been proposals to lower tuition through increased federal support (conditional on states not cutting their support) that would increase enrollment rates and help address the underinvestment.

8.3.3. Community colleges

State support that has fallen 30% over the last 10 years has forced community colleges to depend much more heavily on local property taxes. This has resulted in great inequality in expenditure per student as between property rich and property poor districts and declines in public expenditure per student and in enrollments that are larger in the poorer districts. Enrollment declines have averaged 3.9% per year from 2011 to 2016 with faculty layoffs and adverse effects on development, effects that are much more serious in some states such as Illinois. See Juszkiewicz (2016A, Table 1) and McMahon (2015A). The percentage declines also have been greatest in the older age groups that expressed the greatest dissatisfaction in the recent election. The two policies that have been proposed to reverse these are increased Federal funding of Pell Grants and the proposal for zero tuition for Community Colleges, the latter through federal grants to public community colleges that would include incentives to states to maintain or increase their funding.

Policies that increase enrollment for Associate Degrees as in Tennessee, New York, Oregon, and Rhode Island are efficient for growth with an average US rate of return based on earnings of 12.9% and also for development with a total return of 45%. The total return to drop outs is a lower 22% but still quite worthwhile for development. There are refinements to this for Pell Grant recipients, but both Pell grants and lower tuition automatically induce additional private saving and investment in human capital as students enroll. This is in the form of student expenditures on living costs which are really private investment in human resource development that otherwise would not be made. If states would offer free tuition not just to recent high school graduates but also to older workers, the additional skills could be helpful to the 64% of the US population with a high school education or less whose incomes continue to fall since 1980 and who rose up and spoke at the last election. This kind of investment is especially helpful to regional development; no requirements are necessary; students tend to stay close to where they graduated and contribute to development there as shown by Aghion et al. (2005).

8.3.4. Bachelor's level policy options

At the bachelor's level, the need is to reverse the decline in state support in real terms per student to lower tuition and student loan debt. This probably requires increased Federal support to institutions and expanded Pell Grants. Zero tuition is less realistic than at the 2-year level, and also less desirable because it would eliminate the resource recovery from wealthier families that results in more resources per student that allows US higher education to excel worldwide. However, tuition at public institutions that is too high is eroding political support from wealthier families and driving the middle class out. Although quality has fallen with the cuts, enrollment in public 4-year institutions has not decreased as much as it has in 2-year institutions since 2008. After 2011 it increased slowly at 1.5% per year. Higher investment and enrollment rates are efficient for growth, and even more dramatically efficient for economic development given the high social rates of return to each.

8.3.5. Any deadweight loss?

Higher education subsidies that apply to those who would go to college anyway are sometimes said to result in some deadweight loss. But this does not apply to Pell Grants since they go to students from low income families who are otherwise unlikely to attend. And there is an element of fairness in lowering tuition for students from higher income families who pay most of the taxes. They withdraw political support when they receive no benefits, so efficiency goals may require them to be included. There is even less excess burden that occurs when taxes adversely affect supply-side incentives to work, save, and invest. This is because education is an investment and also higher education *increases* incentives to save, invest, participate in the labor force, and to work later in life.

9. Conclusion

New scholarly contributions are offered including a new theory of endogenous development with a solution that yields an optimum rate of per capita development that is larger due to positive higher education externalities and the endogeneity of new ideas. Both of the latter are heavily dependent on public support. This higher rate of development is sustainable within the framework of the model and can continue without bounds (i.e. is not limited by diminishing returns). Empirical evidence in Tables 3 and 4 show many higher education externalities to be positive, and to be substantial, with the non-market direct social benefits beyond earnings about 96% of the earnings benefits. This estimate does not include indirect social benefits or benefits from more new ideas which would raise the value of the non-monetary social benefits over time. None of this rests on the results from macro growth equations, the findings from which are judged to be inconclusive. Several of these social benefits of higher education are major sources of the evolution of institutions, institutions that include those that are vital to democracy, human rights (i.e.civil liberties), political stability, and, in turn, development.

The total return to higher education estimated here for the first time is another potential scholarly contribution. It is not intended to be an estimate with high precision, but instead a first and serious estimate that seeks to also identify the missing pieces. From this it

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can be concluded that with total returns of 45% for Associate and 38% for Bachelor's Degrees there is even more substantial underinvestment in higher education when the full returns are considered.

Economic growth is a component of endogenous development. The logic of the model supports the conclusion that the 12.9% 2-year and 10.9% 4 year social rates of return with a 7.22% opportunity cost of funds is strong evidence that there is underinvestment at both of these levels for efficient growth. Evidence is also presented that there are positive external social benefits which the model developed earlier implies that growth is higher than it will be as these external benefits are cut.

The estimates of impacts of higher education on broader development are larger, but conservative because the impacts of generation of new ideas and from other gaps are put at zero. But enough is known to conclude that there is a continuing skill deficit, that it generates a rising premium for more advanced education, that higher education externalities do exist, and that they also both theoretically and empirically contribute to higher rates of per capita growth and development.

Beyond this, rising inequality can be addressed not just by fixing the tax laws but also by expanding 2 and 4-year enrollments and lifelong learning which lead to higher earnings and higher saving rates for more in the population. Finally, the policy options discussed are economically efficient for addressing serious economic plight and high and rising dissatisfaction in the large majority with a high school education or less, many of whom voted for Trump in the US. Brexit in the UK, and similar populist causes elsewhere who have not shared in either growth or development and whose life-chances are being seriously limited.

Appendix A. Supplementary explanations

Supplementary material related to this article much of which was cut to shorten it can be found, in the online version, at doi: https://doi.org/10.1016/j.qref.2018.05.005.

[19]

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