A Rational Theory of the Growth of Government and the Distribution of Income

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Abstract

This paper builds on our earlier work, Meltzer and Richard (1981), on the size of government. How does the distribution of income change as an economy grows? To answer this question we build a model of a labor economy in which consumers have diverse productivity. The government imposes a linear income tax which funds equal per capita redistribution. The tax rate is set in a single issue election in which the median productivity individual is decisive. Economic growth is the result of using a learning by doing technology, so higher taxes discourage labor causing the growth rate of the economy to fall. We consider two economic scenarios. First, in a developing economy the median voter chooses increasing taxes and increasing redistribution which causes the growth rate of the economy to recede from a high level as the economy matures. The increasing tax rate discourages labor and growth causing the distribution of pre-tax income to widen. Second, in a mature economy, the distribution of productivity can widen due to increased technological specialization. This causes voters to raise the equilibrium tax rate and reduce growth. The distribution of pre-tax income widens. We estimate the model using U.S. data from 1967 - 2011 with excellent results.

1 Introduction

Starting with Kuznets (1955) economists and others have studied the relation of income distribution and economic growth. Kuznets summarized his work on the relation in the famous Kuznets Curve. Economic growth at first increases the spread in the income distribution as the unskilled enter the labor force. Income

growth narrows the spread because the workers acquire skills and increase their productivity.

The Kuznets Curve has remained contentious. Concern for the relation, and for what is called "distributive justice" or redistribution has generated a very large literature. At one end, Okun (1975) discussed society's decision to trade off efficiency or growth for equality achieved by taxing higher incomes to increase redistribution. Okun described the process as a "leaky bucket" because not all the tax revenue financed transfers.

At about the same time, the very popular philosophical conjecture by Rawls (1971) proposed a minimax strategy to set redistribution in a constitution chosen before anyone knew his or her position in the income or wealth distribution.

Our earlier work Meltzer and Richard (1981) departs from these ideas. In a functioning democratic system, voters make the choice repeatedly not once and for all times. They know their position but are uncertain about their and their children's future. The political choice of redistribution is like economic decisions that optimizing consumer's make repeatedly. They vote either to increase current consumption by voting for a higher tax rate or they vote for growth and increased future consumption by lowering tax rates and spending. Although our earlier model is static, it is consistent with voter's decisions. Sometimes they vote for higher tax rates and spending and sometimes they do the opposite. No society chooses once for all future time.

In this paper, we extend our earlier results to incorporate growth. We address the question of how should the distribution of income and consumption change in a growing economy in general equilibrium. We can now show how the choice of tax rate affects growth of output, so we learn why voters may shift their choices to favor more redistribution and higher tax rates or the opposite.

These issues have received greatly increased attention following publication of Piketty (2014) and the work greatly augmenting Kuznets' data set by Piketty and his coauthors. Unlike Piketty and many others, in our model optimizing voters choose the tax rate in single issue elections. Their choice changes as the factors influencing their choices change. Also Piketty's concern is almost entirely on the return to capital. A main point of his book is that the return to capital changes little and is less than the growth rate in mature economies. Like Marx, capital will be saturated eventually Piketty (2014, 228)

We accept that the return to capital changes very little over time. What Piketty neglects is the return to labor. Labor income increased over 20 fold over the 200 or so years of capitalist development. Recent research summarized in shows that the "education wage premium explains about 60 to 70% of the rise in dispersion of U.S. wages between 1980 and 2005". In our model, labor income rises with worker productivity, so the income distribution changes over time as described by the Kuznets Curve.

2 A Selective Literature Survey

There are several branches of the large literature on redistribution. One branch analyzes the share received by the top one percent of earners. After surveying recent work, Kaplan and Rauh (2013, 52) wrote: "In many of these theories, top earners obtain rents in the sense that they distort the economic system to extract resources in excess of their marginal products."

Treatment of high incomes as rent permits increased taxation to finance redistribution without reducing productive activity. A special use of rents is the claims that most high incomes result from inheritance of wealth produced by an earlier generation and passed on. Evidence does not support this claim both in the U.S. and other developed countries. Kaplan and Rauh, (2013, 46, 48); Becker and Tomes (1979, 1158). Some work suggests that culture and educational attainment of parents has more important influence on later generations than financial inheritance. Becker and Tomes (1979, 1191), Corak (2013, 80)

Another problem with treating high incomes, those of the top one percent as rent is that the population is not fixed but changes. Piketty (2014, 115-16) writes that capital transforms "itself into rents as it accumulates in large enough amounts." Saez (2013, 24) concludes that "high top tax rates reduce the pre-tax income gap without visible effect on economic growth." Corak (2013) shows that intergenerational mobility remains large in developed countries like the U.S. and Canada. The main exception in the U.S. is the "least advantaged." In this paper we address the issue of why some of the least advantaged have stagnant incomes. The least productive choose not to work, so their incomes are all redistribution. Hence they do not acquire productive skills.

Much of the discussion of the top one percent makes no mention of the other 99 percent. A very different explanation of the rising share of income earned by the top one percent builds on work on superstars by Rosen (1981). Rosen argued that technological change increases the relative productivity of individuals with exceptional talent in using and developing the new technology. Rosen's work brings in relative productivity as an explanation of the rising share of the top one percent. Developing new software, like Steve Jobs and others, that create entire markets brings high rewards. Successfully managing a bank or corporation with branches in 50 or 100 countries is an order of magnitude more difficult than managing in a single country or state. Ten years is a long tenure in such jobs, so there is turnover not inheritance of high income positions. Highly skilled surgeons adept at operating new technologies should be included.

Major league sport stars in football, baseball, soccer, basketball and hockey no longer perform before audiences restricted to a stadium. Television increased their productivity. Kaplan and Rauh (2013, 42, Figure 3) show the substantial increase in their incomes. Turnover is high; careers at the top are brief. And there is little evidence that the super stars cede their places to their offspring. Rock musicians and entertainment stars often have similar careers with high incomes for short duration. Income of super stars may explain some of the increase in the relative earnings of the top one percent. We doubt that it is

Before Tax (%)				
Year	**1979**	**1989**	**2007**	**2010**
Lowest 20%	6.2	4.9	4.8	5.1
Middle 20%	15.8	15	13.4	14.2
Highest 20%	44.9	49.3	54.6	51.9
Highest 1%	8.9	12.2	18.7	14.9
After Tax (%)				
Lowest 20%	7.4	5.7	5.6	6.2
Middle 20%	16.5	15.7	14.3	15.4
Highest 20%	42	47.3	51.4	48.1
Highest 1%	7.4	11.8	16.7	12.8

Source: CBO (2014)

Table 1: Selected Income Shares 1979-2010 (2010 Dollars)

a full explanation because the data after 1980 show that the rise in the pre-tax share of the top one percent can be seen in data for the United States, the United Kingdoms, Canada and Sweden but data for France and the Netherlands do not show a similar increase. Roine and Waldenstrom (2006)

The share of pre-tax incomes received by the top one percent includes income from reported capital gains. That makes it more volatile, rising in periods when owners of shares choose to report gains in excess of losses. Also there are substantial differences in the relative shares of different income quintiles when before and after tax and transfers are included. Most economic theory considers consumption, based on permanent not current income, to be a better measure of the economic component of well-being. Table 1 shows data on pre- and post-tax incomes for the United States. The data for 1979 to 2010 are available on the Congressional Budget Office website.[1]

The range of data in Table 1 is the range given by CBO. We chose 1989 because it was the end of the Reagan growth years. We chose 2007 because it is the peak year for the income share going to the top one percent. That year is also the peak year for the after tax share of the top one percent.

The table makes clear that it matters considerably whether analysis uses before or after tax income shares. Conceptually, income after tax and transfer is closer to consumption. By 2010 the share of after tax income received by the lowest 20 percent (6.2 percent) is the same as the before tax share received in

[1] http://www.cbo.gov/publication/44604

1979. Income shares for the lowest and middle 20% fall until 2007, then rise; the share of top one percent and 20 percent rise to 2007, then fall. Most of the rise occurs during the period of relatively high growth in the 1990s. The change is not likely to reflect changes in the return to capital. The data seems more consistent with productivity growth during the boom years.

Of interest in relation to recent discussion, the share of the upper income groups declined from 2007 to 2010. These are years of relatively slow growth combined with increased returns to equity capital and a recovery in many house prices. Again, this suggests that productivity growth is more important than return to capital in explaining income shares.

A main theme of Piketty's (2014 and elsewhere) work is that the tax rates on income and wealth should be raised even though, at some points, he recognizes that the higher rates would lower top incomes but not provide much revenue. Few of the many discussions of his work point out that the choice of tax rate should be an implication of a utility maximizing model, preferably a general equilibrium model, such as in this paper.

Long before the Piketty book stimulated renewed interest in income distribution and the choice of tax rate, Becker and Tomes (1979, 1986) developed general equilibrium models of income distribution across family generations. Becker and Tomes (1979)1175 choose a linear tax structure and use revenues for redistribution. They find that "even a progressive tax and public expenditure system may widen the inequality of disposable income." Becker and Tomes (1986, 533-4) note that some empirical work by Arthur Goldberger found that the widening of inequality does not occur for several generations.

Alesina and Rodick (1994) use a growth model. As in Meltzer and Richard (1981) voters differ in their endowments, some prefer more, some less, taxation and government spending. The authors show that, in general, voters will not maximize economic growth. Instead, they vote to tax capital to finance redistribution. As in all general equilibrium models, the budget is balanced.

Alesina and Rodrik use the Gini coefficient to measure income inequality. They show empirically that income inequality is negatively related to future economic growth. The reason is that as income inequality rises, voters choose more redistribution, reducing the growth rate.

May increased government spending and taxation increase both growth and redistribution? Of course, it may, but the empirical data in Alesina and Rodrik and elsewhere shows that, in developed economies, the reverse is true. Government spending is mainly for redistribution to augment consumption.

Our contribution to this research builds on the findings in Alesina and Rodrik but incorporates some of the principal ideas offered by Simon Kuznets in his insightful discussions. Kuznets (1979) contains several of his essays. In particular we incorporate technological change Kuznets (1979, 45) as a major source of income growth with substantial effects on income distribution that are not explicitly considered in much of the literature. And, like Kuznets (ibid., 17-18) we relate growth to immigration from abroad as well as from agriculture to industrial activity. The role of population movements is an essential part of Kuznets' historical studies.

Our approach incorporates these and other elements in a maximizing general equilibrium model. In the United States, immigration from abroad, supplemented by movements of labor from agriculture to industry gave a major surge over time to wages and changed income distribution. In other countries, foreigners had less or no significance but movements from agriculture to industry are a major influence in China, Japan, Korea, Europe and elsewhere. We capture these effects using "learning by doing" to generate increased labor productivity.

Here is Kuznets (1979, 17-18) discussion of immigrants. "Beginning with the late 1830s, the income distribution among the population outside the South ... was complicated by the incidence of mass migration. The latter, with the typical lower incomes of the foreign-born, meant an addition of weight to the lower tail of income distribution – even though to the immigrant himself, the income in his earlier years in the country, may have meant a marked advance over what he was earning in his country of origin. ... But the same factor also made for higher mobility up the income ladder."

In our model, unlike Piketty (2014), growth of labor productivity and labor income – learning by doing – is a large factor, the largest, in explaining growth of output and living standards. We do not challenge the role of capital or the implication that the return to capital changes very little. The return to labor changes much more. We do not impose our ideas of the desirable extent of income distribution. The workers in our model are voters who choose their preferred tax rate and redistribution. They are aware that an increased tax rate to finance redistribution lowers investment in productivity enhancing investments that add to their future consumption.

Our analysis fits the contours of growth experience. As workers learn, their skills, productivity and incomes increase. They save more, acquire real assets especially housing. They spend to educate their offspring, and they vote for or against redistribution and taxation.

Kuznets early studies of growth and income distribution, that Piketty praises, do not omit the importance of productivity growth. Piketty prefers market gloom to Kuznets' optimism, but like Marx he cannot explain why capital accumulation has accompanied growth instead of destroying it.

In our earlier work,Meltzer and Richard (1981), we showed that rational voters choose a tax rate consistent with the most basic economic theory. They decide whether they want increased taxes to finance more redistribution (consumption today), or lower tax rates to spur investment and future consumption. In the growth model here, the same choice remains central.

3 The Economic Model

Consumers are endowed with different relative levels of productivity, indexed by n, and one unit of time. A consumer with relative productivity n maximizes his lifetime utility of consumption and leisure:

$$V^n(c^n, \ell^n) = \int_0^\infty e^{-\delta t} \left[\lambda \ln(c_t^n) + (1-\lambda)\ln(1-\ell_t^n)\right] dt, \tag{1}$$

where $c^n = \{c_t^n\}_0^\infty$ is his consumption stream, $\ell^n = \{\ell_t^n\}_0^\infty$ is his labor stream, and δ is the discount rate. There is a government which levies a linear tax on income at rate τ_t at time t and uses the proceeds for redistribution, equally per capita. The budget constraint for a consumer with productivity n is

$$c_t^n = \rho_t w_t + (1-\tau_t) w_t n \ell_t^n, \tag{2}$$

where nw_t is the wage per unit of labor at time t and $\rho_t w_t$ is redistribution at time t. Each individual is a price taker in the labor market, takes the processes $\{\rho_t\}, \{w_t\}$, and $\{\tau_t\}$ as given and chooses $\{c_t^n\}$ and $\{\ell_t^n\}$ to maximize utility. The standard Bellman equation for optimal control is[2]

$$0 = \max \left[\lambda \ln(c_t^n) + (1-\lambda)\ln(1-\ell_t^n) - \delta J^n + J_w^n \dot{w}_t + J_\rho^n \dot{\rho}_t + J_\tau^n \dot{\tau}_t \right], \tag{3}$$

where $J^n(w_t, \rho_t, \tau_t)$ is the value function for a consumer with relative productivity n. The standard first-order conditions for equation (3) yield

$$\ell_t^n = \lambda - \frac{\rho_t(1-\lambda)}{n(1-\tau_t)}. \tag{4}$$

The maximum fraction of time devoted to working is λ, as can be seen by setting $\rho_t = 0$ in equation (4). Since labor must be positive there is a minimum level of relative productivity, ν_t, below which consumers are *voluntarily* unemployed, living on their redistribution:

$$\nu_t = \frac{\rho_t(1-\lambda)}{\lambda(1-\tau_t)}. \tag{5}$$

We call ν_t the voluntary unemployment productivity. Optimal consumption is

$$c_t^n = \rho_t w_t, \ for\ n < \nu_t. \tag{6a}$$

$$= \lambda(\rho_t + (1-\tau_t)n) w_t, \ for\ n \geq \nu_t. \tag{6b}$$

Notice that consumption is increasing and ordered by relative productivity for all choices of ρ_t and τ_t.

Relative productivity is distributed lognormally, $\ln n \sim N(0, \sigma)$, so that the median relative productivity is $m = 1$ and the mean relative productivity is $\overline{n} = e^{\frac{1}{2}\sigma} > 1$. Mean productivity normalized hours worked at time t, Ψ_t, is:

$$\Psi_t = \int_{\nu_t}^{\infty} \frac{n\ell_t^n \exp(-\frac{1}{2}(\frac{\ln n}{\sigma})^2)}{n\sigma\sqrt{2\pi}} dn \tag{7}$$

$$= \int_{\nu_t}^{\infty} \frac{\lambda(n-\nu_t)\exp(-\frac{1}{2}(\frac{\ln n}{\sigma})^2)}{n\sigma\sqrt{2\pi}} dn \tag{8}$$

$$= \lambda \left[\overline{n} N(-\frac{\ln \nu_t}{\sigma} + \sigma) - \nu_t N(-\frac{\ln \nu_t}{\sigma}) \right]. \tag{9}$$

[2] The super dot indicates the time derivative.

The government's budget is balanced in that the per capita spending on redistribution, $w_t\rho_t$, equals the tax revenues, $w_t\Psi_t\tau_t$:

$$w_t\tau_t\Psi_t = w_t\rho_t. \tag{10}$$

Since the median consumer has productivity $m = 1$, w_t is the absolute productivity of the median consumer. Hence nw_t is the absolute productivity of a consumer with relative productivity n.

Everything in this economy is a function of ν_t and w_t. It is obvious from equation (9) that Ψ_t is a function of ν_t. Substituting equation (5) into equation (4) we find that

$$\ell_t^n = \lambda(1 - \frac{\nu_t}{n}). \tag{11}$$

Solving equation (10) for ρ_t, substituting the result into equation (5) and then solving for τ_t gives:

$$\tau_t = \frac{\nu_t}{\nu_t + (1-\lambda)\psi_t} \tag{12}$$

where

$$\psi_t = \Psi_t/\lambda = \overline{n}N(-\frac{\ln\nu_t}{\sigma} + \sigma) - \nu_t N(-\frac{\ln\nu_t}{\sigma}) \tag{13}$$

is the number of full-time equivalent productivity-adjusted units worked. Substituting equation (12) into equation (10) gives:

$$\rho_t = \frac{\lambda\nu_t\psi_t}{\nu_t + (1-\lambda)\psi_t}. \tag{14}$$

Finally, substituting equations (11), (12), and (14) into equation (6) gives:

$$c_t^n = \lambda w_t\psi_t\frac{\nu_t}{\nu_t + (1-\lambda)\psi_t}, \ for\ n < \nu_t. \tag{15a}$$

$$= \lambda w_t\psi_t\frac{\lambda\nu_t + (1-\lambda)n}{\nu_t + (1-\lambda)\psi_t}, \ for\ n \geq \nu_t. \tag{15b}$$

In preparation for determining the size of government we show that selecting ν_t is an equivalent to selecting τ_t. This can be seen by showing that τ_t is a strictly increasing function of ν_t :

$$\frac{d\tau_t}{d\nu_t} = \frac{(1-\lambda)\overline{n}N(-\frac{\ln\nu_t}{\sigma} + \sigma)}{(\nu_t + (1-\lambda)\psi_t)^2} > 0. \tag{16}$$

Hence the mapping from ν_t to τ_t is continuous and strictly increasing, so that setting ν_t is equivalent to setting τ_t. Furthermore, increasing (decreasing) ν_t is equivalent to increasing (decreasing) τ_t.

We can now show that regardless of how tax rates are determined, the distribution of pre-tax income widens as taxes rise. This widening has nothing to do with technological change or the privileges of the rich. The widening of the distribution of income is the direct consequence of the incentives created by

increasing taxes and redistribution. The income of a consumer with relative productivity n at time t is

$$\begin{aligned} I_t^n &= 0 \; for \; n < \nu_t, & (17a) \\ &= w_t n \ell_t^n \; for \; n \geq \nu_t. & (17b) \end{aligned}$$

Substituting equation (11) into equation (17) gives

$$\begin{aligned} I_t^n &= 0 \; for \; n < \nu_t, & (18a) \\ &= w_t \lambda (n - \nu_t) \; for \; n \geq \nu_t. & (18b) \end{aligned}$$

Assuming that he works, the median consumer's income is

$$I_t^m = w_t \lambda (1 - \nu_t) \; . \tag{19}$$

The average income of all consumers, both those who work and those who live on redistribution, is

$$\overline{I}_t = w_t \lambda \psi_t. \tag{20}$$

A commonly used measure of the dispersion of income is the ratio of mean to median income:

$$r = \frac{\psi_t}{1 - \nu_t}. \tag{21}$$

Differentiating we get

$$\frac{dr}{d\nu_t} = \frac{\overline{n} N(-\frac{\ln \nu_t}{\sigma} + \sigma) - m N(-\frac{\ln \nu_t}{\sigma})}{(1 - \nu_t)^2} > 0. \tag{22}$$

so that the ratio of mean to median income rises as tax rates increase. In fact all consumers with productivity above (below) median increase (reduce) their income relative to median income as taxes rise:

$$\begin{aligned} \frac{d(I_t^n / I_t^m)}{d\nu_t} &= 0 \; for \; n < \nu_t, & (23a) \\ &= \frac{n - 1}{(1 - \nu_t)^2} \; for \; n \geq \nu_t. & (23b) \end{aligned}$$

What happens to the relative income of the much discussed upper 1%? The upper 1% begins with relative productivity n^*, where $N(-\frac{\ln n^*}{\sigma}) = 0.01$, or $n^* \approx e^{2.33\sigma}$. The income of the upper 1% is

$$\begin{aligned} I_t^* &= \lambda w_t \int_{n^*}^{\infty} (n - \nu_t) \frac{\exp(-\frac{1}{2}(\frac{\ln n}{\sigma})^2)}{\sqrt{2\pi} n \sigma`} dn \\ &= \lambda w_t \left[\overline{n} N(-\frac{\ln n^*}{\sigma} + \sigma) - \nu_t N(-\frac{\ln n^*}{\sigma}) \right]. & (24) \end{aligned}$$

The ratio of upper to median pre-tax income rises with increasing taxes:

$$\frac{d(I_t^* / I_t^m)}{d\nu_t} = \frac{\overline{n} N(-\frac{\ln n^*}{\sigma} + \sigma) - m N(-\frac{\ln n^*}{\sigma})}{(1 - \nu_t)^2} > 0. \tag{25}$$

Again, "the rich get richer" relative to the median as taxes rise. Again, this is an inevitable consequence of taxation and redistribution.

There is much discussion in the media, and unfortunately among academics, of how rising income dispersion is evidence of a more "unequal" society. This is, of course, very misleading because funds collected in taxes are redistributed so that the distribution of consumption actually *narrows* with increased taxes. The welfare implication of increased taxation is a more equal, "fair" society, despite an increase in the dispersion of incomes. In fact all consumers with productivity above (below) median reduce (increase) their consumption relative to median consumption as taxes rise:

$$\frac{d(c_t^n/c_t^m)}{d\nu_t} = \frac{(1-\lambda)}{(\lambda\nu_t+(1-\lambda))^2} > 0 \; for \; n < \nu_t, \tag{26a}$$

$$= \frac{\lambda(1-\lambda)(1-n)}{(\lambda\nu_t+(1-\lambda))^2} \; for \; n \geq \nu_t. \tag{26b}$$

What about the 1%? The consumption of the top 1% is

$$c_t^* = \lambda w_t \psi_t \frac{\lambda\nu_t N(-\frac{\ln n^*}{\sigma}) + (1-\lambda)\overline{n}N(-\frac{\ln n^*}{\sigma}+\sigma)}{\nu_t + (1-\lambda)\psi_t} \tag{27}$$

The consumption of the top 1% falls relative to median consumption as taxes increase:

$$\frac{d(c_t^{n^*}/c_t^m)}{d\nu_t} = -\frac{\lambda(1-\lambda)(\overline{n}N(-\frac{\ln n^*}{\sigma}+\sigma) - N(-\frac{\ln n^*}{\sigma}))}{(\lambda\nu_t+(1-\lambda))^2} < 0 \tag{28}$$

Since the consumption of those below the median increases and those above decrease relative to the median, the effect of rising taxes on average consumption relative to median consumption is ambiguous. With all budgets balanced, average consumption must equal average income

$$\overline{c}_t = \overline{I}_t = w_t \lambda \psi_t \tag{29}$$

The derivative of the ratio of average to median consumption with respect to ν_t is:

$$\frac{d(\overline{c}_t/c_t^m)}{d\nu_t} = \frac{(1-\lambda)K(\nu_t)}{(\lambda\nu_t+(1-\lambda))^2}, \tag{30}$$

where

$$K(\nu_t) = 1-(1-\lambda)N(-\frac{\ln\nu_t}{\sigma}) - \lambda\overline{n}N(-\frac{\ln\nu_t}{\sigma}+\sigma). \tag{31}$$

We calculate that $K(0) = -\lambda(\overline{n}-1) < 0$, $K(\infty) = 1$, and

$$\frac{dK(\nu_t)}{d\nu_t} = \frac{(\lambda\nu_t+(1-\lambda))}{\nu_t\sigma}\widetilde{n}(-\frac{\ln\nu_t}{\sigma}) > 0, \tag{32}$$

where $\widetilde{n}(x) = \exp(-\frac{1}{2}x^2)/\sqrt{2\pi}$, the standard normal density. Hence as tax rates rise from zero, the ratio of average to median consumption first falls, reaches

a minimum and then rises for large enough tax rates. In the next section we show how the median voter chooses the tax rate.

Finally, we determine the mean number of labor units worked, $\overline{\ell}_t$:

$$\begin{aligned}
\overline{\ell}_t &= \int_{\nu_t}^{\infty} \frac{\ell_t^n \exp(-\frac{1}{2}(\frac{\ln n}{\sigma})^2)}{n\sigma\sqrt{2\pi}} dn && (33)\\
&= \int_{\nu_t}^{\infty} \frac{\lambda(1-\nu_t/n)\exp(-\frac{1}{2}(\frac{\ln n}{\sigma})^2)}{n\sigma\sqrt{2\pi}} dn && (34)\\
&= \lambda\left[N(-\frac{\ln \nu_t}{\sigma}) - \nu_t \overline{n} N(-\frac{\ln \nu_t}{\sigma} - \sigma)\right]. && (35)
\end{aligned}$$

The fraction of full time labor worked at time t, L_t, is

$$L_t = \overline{\ell}_t/\lambda = N(-\frac{\ln \nu_t}{\sigma}) - \nu_t \overline{n} N(-\frac{\ln \nu_t}{\sigma} - \sigma). \tag{36}$$

4 The Median Voter

Until now all consumer have been price takers who have no influence over government tax policy. Roberts (1977) shows that if the ordering of individual consumption is independent of the choice of ρ_t and τ_t, the median voter is decisive in a majority rule election to set the tax rate. So the median voter is continuously decisive in elections for $\{\tau_t\}$.

We now turn to analyzing how the median voter would prefer to set tax rates. The choice of tax rates depends on how taxes effect the growth rate of wages. We assume that the growth of wages is due to learning by doing or on the job training. Time spent working contributes to the growth rate of wages. The amount of learning by doing at time t is proportional to ψ_t, the full-time equivalent units of productivity adjusted labor worked at time t; there is no contribution to learning by doing from those who do not work. We assume that the growth rate of wages (or median productivity) is

$$\frac{\dot{w}_t}{w_t} = g_t \psi_t, \tag{37}$$

where g_t is a technological productivity multiplier which determines how much each full-time equivalent of productivity normalized labor increases wages.

The growth rate of the economy is decreasing in the tax rate. The growth rate of the economy at time t, γ_t, equals the growth rate of aggregate consump-

tion:

$$\begin{aligned}\gamma_t &= \frac{d\ln \overline{c}_t}{dt} \\ &= \frac{\dot{w}_t}{w_t} + \frac{1}{\psi_t}\frac{d\psi_t}{d\nu_t}\dot{\nu}_t \\ &= g_t\psi_t - \frac{N_t}{\psi_t}\dot{\nu}_t, \end{aligned} \tag{38}$$

where $N_t = N(-\frac{\ln \nu_t}{\sigma})$. There are two effects on economic growth captured in equation (38). The first term, $g_t\psi_t/\overline{n}$, is the growth rate due to current learning by doing, which is smaller the higher are taxes since $\frac{d\psi_t}{d\nu_t} < 0$. The second term captures the direct reduction in the current growth rate caused by consumers experiencing increasing taxes. Whenever taxes are increasing, so is the level of voluntary unemployment, implying the growth rate of the economy falls.

5 Long-Term Growth: Developing Economies

In developing economies the productivity multiplier, g_t, falls as time passes. A given amount of productivity normalized labor, ψ_t, is less effective at increasing aggregate productivity as the "low-hanging fruit" is picked. Economies earlier in their industrialization, such as Korea and China, can grow very fast by copying productivity enhancing technology from developed economies, such as the U.S. or Western Europe. Mature economies must invent their own productivity enhancements so they grow more slowly per unit of normalized labor. Hence we model g_t as beginning at a high level, g_0, and gradually decreasing to an asymptotic lower level, $g_\infty < g_0$:

$$g_t = g_0 e^{-\theta t} + g_\infty(1 - e^{-\theta t}). \tag{39}$$

Differentiating equation (39) gives

$$\dot{g}_t = (g_\infty - g_t)\theta. \tag{40}$$

The state of the economy is summarized by the state variables, w_t and g_t. The median voter chooses the tax rate τ_t to maximize his lifetime utility $J^m(w_t, g_t)$ which satisfies the Bellman equation

$$0 = \max_{\nu_t}\left\{\lambda\ln(c_t^m) + (1-\lambda)\ln(1-\ell_t^m) - \delta J^m + J_w^m\dot{w}_t + J_g^m\dot{g}_t\right\}. \tag{41}$$

We conjecture that

$$J^m(w_t, g_t) = \frac{\lambda}{\delta}\ln w_t + j^m(g_t). \tag{42}$$

Substituting equations (6), (11), and (42) into equation (41) we find

$$\begin{aligned} 0 &= \max_{\nu_t}\{\lambda\ln\lambda + \lambda\ln\psi_t - \lambda\ln(\nu_t + (1-\lambda)\psi_t) + \ln(\lambda\nu_t + (1-\lambda)) \\ &\quad -\delta j^m(g_t) + \frac{\lambda\psi_t g_t}{\delta} + j^{m\prime}(g_t)\theta(g_\infty - g_t)\}. \end{aligned} \tag{43}$$

The derivative of equation (43) with respect to ν_t is:

$$h^m(\nu_t, g_t) = \frac{-\lambda N_t}{\psi_t} - \frac{\lambda(1-(1-\lambda)N_t)}{\nu_t + (1-\lambda)\psi_t} + \frac{\lambda}{\lambda\nu_t + (1-\lambda)} - \frac{\lambda N_t g_t}{\delta}, \tag{44}$$

Denote the optimal choice of voluntary unemployment by ν_t^m. The standard conditions for a maximum are

$$h^m(\nu_t^m, g_t) = 0 \tag{45}$$

and

$$h_\nu^m(\nu_t^m, g_t) < 0. \tag{46}$$

Equation (45) is an implicit equation which can be solved (numerically) for ν_t^m as a function of g_t, which is equivalent to the optimal tax rate $\tau_t^m(g_t)$. Substituting $\nu_t^m(g_t)$ into equation (43) yields an ordinary differential equation for $j^m(g_t)$.

$$\begin{aligned} 0 &= \lambda \ln \lambda + \lambda \ln \psi_t^m - \lambda \ln(\nu_t^m + (1-\lambda)\psi_t^m) + \ln(\lambda\nu_t^m + (1-\lambda)) \\ &\quad -\delta j^m(g_t) + \frac{\lambda g_t \psi_t^m}{\delta} + \frac{dj^m(g_t)}{dg_t}\theta(g_\infty - g_t), \end{aligned} \tag{47}$$

where $\psi_t^m = \psi_t(\nu_t^m)$. This confirms that our conjectured form of $J^m(w_t, g_t)$ given by equation(42) is correct.

In equilibrium the government grows. Differentiating equation (45) with respect to time gives

$$0 = h_\nu^m(\nu_t^m, g_t)\dot{\nu}_t^m - \frac{\lambda N_t}{\delta}\dot{g}_t, \tag{48}$$

which implies that

$$\dot{\nu}_t^m = \frac{\lambda N_t}{\delta h_\nu^m(\nu_t^m, g_t)}\dot{g}_t > 0. \tag{49}$$

Increasing $\dot{\nu}_t^m$ implies an increasing tax rate so the government grows taking an ever larger share of output. There is, however, a limit to government growth. The tax rate reaches a maximum, τ_∞, at the minimum level of the productivity multiplier, g_∞.

The growth rate of the economy falls as the government grows as shown by equation (38). So our model shows that developing economies are characterized by rapid early economic growth, followed by slowing economic growth and increasing government growth caused by a fall in the productivity multiplier. As the economy matures, the growth of government and fall in the economic growth rate eventually slow as the tax rate asymptotically approaches its maximum rate. As government growth increases, income inequality also increases, but consumption inequality decreases.

6 The Size of Government in a Mature Economy

In a developing economy, analyzed in the last section, secular changes to absolute productivity, w_t, and to the growth rate of technology, g_t, determine the

long-term growth of government. In a mature economy such as the U.S. or western Europe, we need to consider change in relative productivity, σ, as well as change in absolute productivity. Learning-by-doing raises the wage earned by all workers, regardless of their level of productivity. An increase in σ is meant to capture the effect of technological change with disparate effects, such as the computerization of production the U.S. experienced in the past 40 years. Accordingly, we now allow σ_t to be time dependent.

In a mature economy changes to g_t are mainly due to business cycle effects rather than copying technology, so equation (40) is no longer appropriate. Instead we assume that

$$\dot{g}_t = \mu_t^g, \tag{50}$$

where μ_t^g is an arbitrary well-behaved function of g_t. The exact form of μ_t^g is irrelevant as long it is independent of ν_t. The process for σ_t is

$$\dot{\sigma}_t = \mu_t^\sigma \tag{51}$$

Again, as long as μ_t^σ is independent of ν_t, its exact specification is irrelevant.

The reason that we do not need to specify the exact form of μ_t^g or μ_t^σ is the myopic decision making resulting from logarithmic utility. The Bellman equation for the median voter is

$$0 = \max_{\nu_t} \left\{ \lambda \ln(c_t) + (1-\lambda)\ln(1-\ell_t) - \delta J + J_w w_t \psi_t g_t + J_g \mu_t^g + J_\sigma \mu_t^\sigma \right\}, \tag{52}$$

where we have suppressed the superscript m. Again, we conjecture that

$$J(w_t, g_t) = \frac{\lambda}{\delta} \ln w_t + j(g_t, \sigma_t). \tag{53}$$

Substituting equations (6), (11), and (53) into equation (52) we find

$$0 = \max_{\nu_t} \{ \lambda \ln \lambda + \lambda \ln \psi_t - \lambda \ln(\nu_t + (1-\lambda)\psi_t) + \ln(\lambda \nu_t + (1-\lambda)) - \delta j + \frac{\lambda \psi_t g_t}{\delta} + j_g \mu_t^g + j_\sigma \mu_t^\sigma \}. \tag{54}$$

The derivative of equation (54) with respect to ν_t is:

$$H(\nu_t, g_t, \sigma_t) = \frac{-\lambda N(-\frac{\ln \nu_t}{\sigma_t})}{\psi_t} - \frac{\lambda(1-(1-\lambda)N(-\frac{\ln \nu_t}{\sigma_t}))}{\nu_t + (1-\lambda)\psi_t} + \frac{\lambda}{\lambda \nu_t + (1-\lambda)} - \frac{\lambda}{\delta} N(-\frac{\ln \nu_t}{\sigma_t}) g_t, \tag{55}$$

The standard conditions for an optimal ν_t are

$$H(\nu_t, g_t, \sigma_t) = 0 \tag{56}$$

and

$$H_\nu(\nu_t, g_t, \sigma_t) < 0. \tag{57}$$

Increases in σ_t, *ceteris paribus*, causes the government to grow. To see this we need some preliminary calculations. First we need the partial derivative of ψ_t with respect to σ_t :

$$\frac{\partial \psi_t}{\partial \sigma_t} = \sigma_t \overline{n} N(-\frac{\ln \nu_t}{\sigma} + \sigma) + \nu_t \widetilde{n}(-\frac{\ln \nu_t}{\sigma}) > 0, \tag{58}$$

where $\widetilde{n}$ is the unit normal probability density function. We also need the partial derivative of H with respect to σ_t :

$$H_\sigma = \lambda \left[\frac{N_t}{\psi_t^2} + \frac{(1-\lambda)(1-(1-\lambda)N_t)}{(\nu_t + (1-\lambda)\psi_t)^2} \right] \frac{\partial \psi_t}{\partial \sigma_t} - \frac{\lambda \widetilde{n}(-\frac{\ln \nu_t}{\sigma}) \ln \nu_t}{\sigma_t^2} \left[\frac{\nu_t}{\psi_t(\nu_t + (1-\lambda)\psi_t)} + \frac{g_t}{\delta} \right] > 0. \tag{59}$$

Assuming the median voter works, $\nu_t < 1$ so that $\ln \nu_t < 0$, implying that $H_\sigma > 0$. Taking the total derivative of equation (56) with respect to t, we get

$$\dot{\nu}_t = -\frac{H_g}{H_\nu} \dot{g}_t - \frac{H_\sigma}{H_\nu} \dot{\sigma}_t, \tag{60}$$

where

$$H_g = -\frac{\lambda}{\delta} N(-\frac{\ln \nu_t}{\sigma_t}) < 0. \tag{61}$$

Because $\frac{H_\sigma}{H_\nu} < 0$, positive $\dot{\sigma}_t$ causes $\dot{\nu}_t$ to increase. Increasing dispersion in relative productivity causes higher tax rates and increased government growth. As before, $\dot{g}_t > 0$ causes the government to shrink because $\frac{H_g}{H_\nu} > 0$. This result is consistent with long-term data for many countries.

The effect of increasing σ_t on economic growth is ambiguous:

$$\begin{aligned} \gamma_t &= \frac{d \ln \overline{c}_t}{dt} \\ &= \frac{\dot{w}_t}{w_t} + \frac{1}{\psi_t} \frac{d\psi_t}{d\nu_t} \dot{\nu}_t + \frac{1}{\psi_t} \frac{d\psi_t}{d\sigma_t} \dot{\sigma}_t \\ &= g_t \psi_t - \frac{N_t}{\psi_t} \dot{\nu}_t + \frac{1}{\psi_t} \frac{d\psi_t}{d\sigma_t} \dot{\sigma}_t. \end{aligned} \tag{62}$$

Substituting equation (60) into equation (62) yields

$$\gamma_t = g_t \psi_t - \frac{\lambda N_t^2}{\delta \psi_t H_\nu} \dot{g}_t + \frac{1}{\psi_t} \left[\frac{N_t H_\sigma}{H_\nu} + \frac{d\psi_t}{d\sigma_t} \right] \dot{\sigma}_t. \tag{63}$$

The coefficient of $\dot{\sigma}_t$ in equation (63) is ambiguous because the first term, $\frac{N_t H_\sigma}{H_\nu} < 0$, and the second term, $\frac{d\psi_t}{d\sigma_t} > 0$. The coefficient of $\dot{g}_t$ is positive so an increasing productivity multiplier spurs economic growth.

7 Estimation

We now estimate the model using U.S. economic data from 1967 through 2011, the first and last dates, respectively, when the data are available. Our sources are the Census Bureau and the St. Louis FED's FRED database. The Census Bureau supplies annually Real Mean Household Income, Real Median Household Income, and the Number of Households. We calculate MM, the ratio of Real Mean to Median Household Income from these data. FRED supplies Average

Annual Hours Worked by Persons Engaged for United States, Total Government Expenditures, GDP and Non-Farm Business Output per Hour Worked. There are 10 Federal Holidays annually, so we use 40 hours a week for 50 weeks or at total of 2000 hours as full time labor. We calculate $\overline{L}$, the fraction of full time equivalent annual hours worked, to be equal to Average Annual Hours Worked by Persons Engaged for United States/2000. Finally, following the argument of Milton Friedman, we measure the real annual tax rate, T , as Total Government Expenditures/GDP.[3] Finally we set the real discount rate $\delta = 0.01$.

We estimate two of the unknown model states $\{g_t, \sigma_t\}$ and the parameter λ using a search to maximize the log-likelihood (omitting extraneous constants):

$$\mathcal{L} = -\frac{3T}{2} \ln \left(\frac{1}{3T} \sum_{t=1}^{T} \left[(MM_t - mm_t)^2 + \left(\overline{L}_t - L_t\right)^2 + (T_t - \tau_t)^2 \right] \right), \quad (64)$$

where

$$mm_t = \frac{\overline{I}_t}{I_t^m}, \quad (65)$$

and $\overline{I}_t$, I_t^m, L_t, and τ_t are given by equations (20), (19), (36), and (12), respectively. Notice that maximizing the log-likelihood, equation (64) is equivalent to minimizing the sum of squared errors.

The search steps are:

(0) Make a starting guess for the states $\{g_t, \sigma_t\}$ and λ.

(1) For each t, solve equation (56) for ν_t using a numerical search.

(2) Compute $\overline{I}_t$, I_t^m, L_t, and τ_t using equations (20), (19), (36), and (12), respectively.

(3) Compute log-likelihood using equation (64).

(4) Update the states and λ using a Nelder-Mead algorithm

(5) Repeat steps (1) - (4) until convergence.

The results of the estimation are in Table 2 and shown in the figures below. The estimated $\lambda = 0.8124$, (T-statistic[4] $= 430$), meaning that if there is no redistribution people choose to work 81.24% of the available time. Since we have assumed that full time labor is 2000 hours per year, the available total time for labor or leisure is $2000/0.8124 = 2462$ hours or about 49.2 hours per week.

Figure 1 shows the optimal states, $\{g_t, \sigma_t, w_t\}$, and the optimal full-time equivalent labor, both productivity-adjusted and not. The productivity multiplier, shown in Panel 1, increased from 1967, reached a peak in 2000, and declined afterward. The dispersion of relative productivity, shown in Panel 2, increased steadily from 1967 through 2000, but has leveled off since then.

The average and median productivity indexes are shown in Panel 3. The average output per hour worked, P_t, is reported by the BLS on the FRED

[3] Our data is available in an Excel spreadsheet at https://fnce.wharton.upenn.edu/profile/972/. Also available is Matlab code for the calibration.

[4] The T-statisics are calculated using the outer product. We have not corrected for serial correlation in the residuals.

	G	T-statistic	Sigma	T-statistic
Dec-67	0.004%	0.07	0.453	12.61
Dec-68	0.028%	0.43	0.476	11.42
Dec-69	0.048%	0.58	0.488	9.47
Dec-70	0.035%	0.24	0.498	5.25
Dec-71	0.042%	0.11	0.506	1.85
Dec-72	0.074%	0.76	0.526	8.75
Dec-73	0.077%	0.60	0.518	7.54
Dec-74	0.085%	1.62	0.539	23.60
Dec-75	0.031%	0.39	0.532	12.72
Dec-76	0.075%	2.16	0.547	29.72
Dec-77	0.109%	2.20	0.560	20.38
Dec-78	0.102%	4.36	0.551	41.73
Dec-79	0.127%	4.55	0.565	36.77
Dec-80	0.095%	4.06	0.566	43.96
Dec-81	0.097%	4.62	0.573	49.14
Dec-82	0.082%	3.12	0.584	42.30
Dec-83	0.104%	0.77	0.594	8.34
Dec-84	0.145%	0.64	0.606	4.77
Dec-85	0.145%	0.72	0.612	7.08
Dec-86	0.141%	0.71	0.617	5.73
Dec-87	0.162%	0.69	0.627	4.74
Dec-88	0.193%	1.53	0.636	9.96
Dec-89	0.218%	0.51	0.651	2.50
Dec-90	0.173%	1.19	0.634	8.66
Dec-91	0.170%	2.50	0.644	17.12
Dec-92	0.174%	1.44	0.651	15.92
Dec-93	0.285%	7.50	0.710	42.06
Dec-94	0.336%	8.17	0.723	35.01
Dec-95	0.303%	6.55	0.705	34.80
Dec-96	0.331%	2.83	0.716	12.06
Dec-97	0.378%	5.00	0.731	25.62
Dec-98	0.383%	1.22	0.724	4.52
Dec-99	0.416%	3.91	0.735	17.73
Dec-00	0.448%	0.66	0.750	8.01
Dec-01	0.440%	2.26	0.764	7.81
Dec-02	0.401%	1.89	0.750	5.94
Dec-03	0.382%	0.77	0.749	2.49
Dec-04	0.389%	1.77	0.750	14.61
Dec-05	0.394%	3.42	0.753	16.10
Dec-06	0.414%	0.56	0.764	2.55
Dec-07	0.348%	1.59	0.733	9.74
Dec-08	0.321%	5.06	0.742	25.92
Dec-09	0.240%	10.86	0.739	71.53
Dec-10	0.256%	15.65	0.741	99.68
Dec-11	0.321%	20.84	0.763	114.58

Table 2: State Variables and their T-statistics.

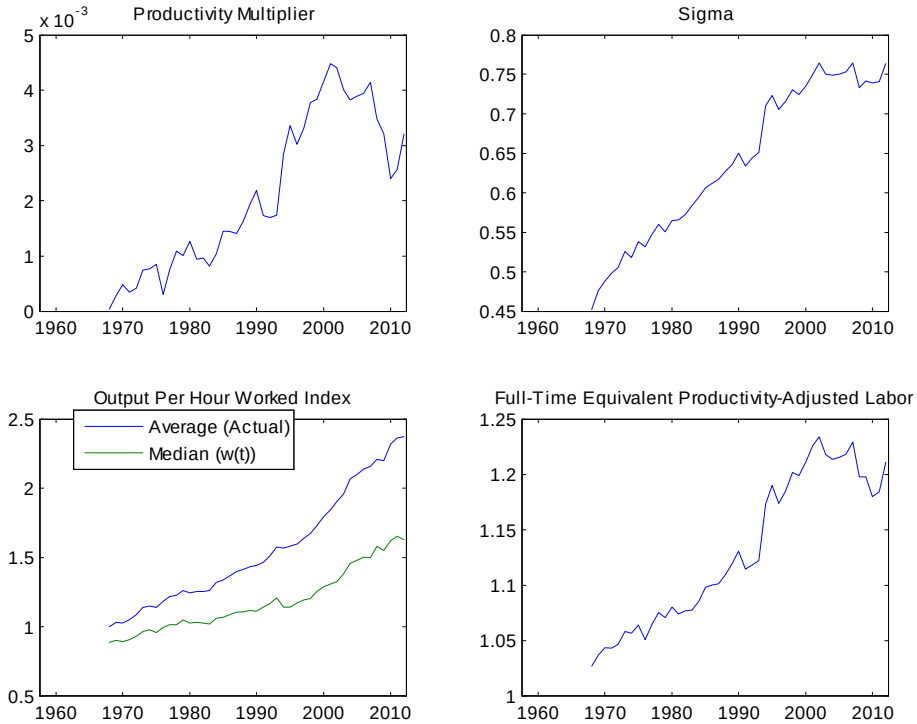

Figure 1: Optimal states (Panels 1 and 2), output per hour, both average and median, (Panel 3) and optimal full-time equivalent productivity-adjusted labor (Panel 4).

database. The median productivity is the state variable, w_t. We equate average total output calculated by using productivity-adjusted labor, equation (20), with average total output calculated using unadjusted labor:

$$\overline{I}_t = w_t \lambda \psi_t = P_t \lambda L_t \tag{66}$$

Solving equation (66) we get

$$w_t = \frac{P_t L_t}{\psi_t}. \tag{67}$$

In contrast to the other state variables, w_t grows throughout the sample, but this result is driven by the BLS measurement of average productivity. Finally, Panel 4 shows full-time equivalent productivity-adjusted labor, ψ_t, which increases until 2000 and then declines.

In Panels 1-3 of Figure 2, we compare the actual data to the model estimates. Obviously, the fits to actual data are excellent with $r^2 = 75.26\%$, 99.96%, and 94.56%, respectively, so the model captures most of the aspect of the ebb and flow of

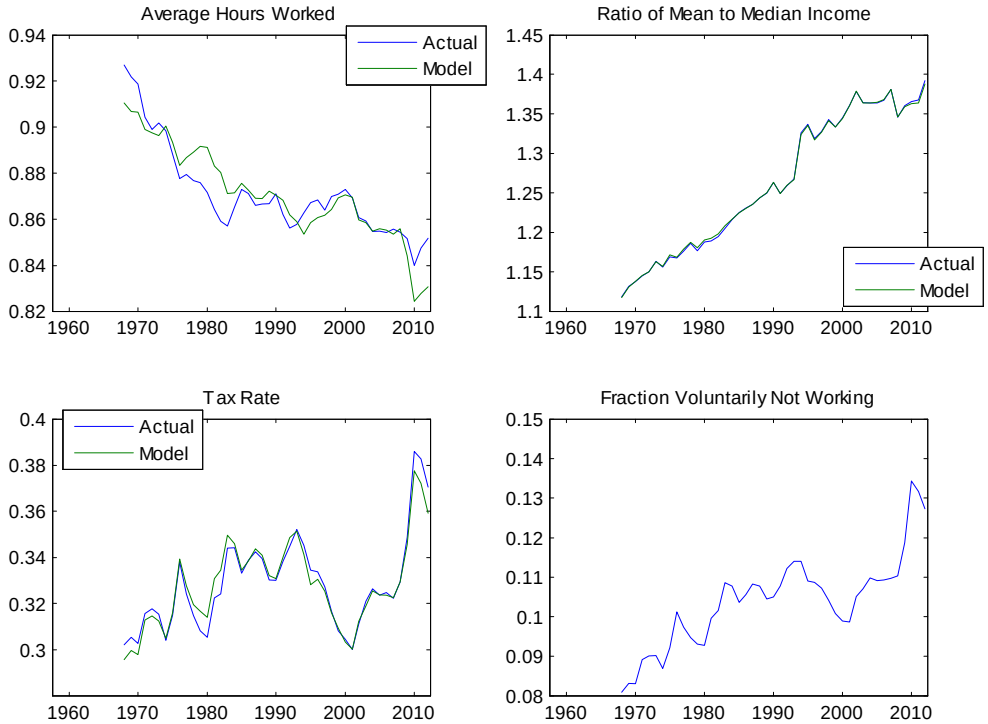

Figure 2: Actual and model average annual hours worked (FTE) (Panel 1), ratio of real mean to median income (Panel 2), and tax rate (Panel 3), and voluntary unemployment rate(Panel 4).

the size of government over the past 45 years. Panel 4 shows the fraction of the potential workforce which is voluntarily unemployed, preferring to live on redistribution.

8 Changes to Productivity: Specialization and Immigration

Two possible causes for the change in the distribution of productivity are technological specialization and immigration. New technologies can result in divergent growth in productivity, which increase σ_t. Immigration can change both the dispersion of relative productivity, σ_t, and the median level of absolute productivity, σ_t.

Increased returns to specialization can cause the distribution of relative productivity to widen. Evidently, as shown in Panel 2 of Figure 1, there has been a significant widening in the dispersion of relative productivity, σ_t, in the

U.S. This dispersion has been attributed to the growth of computer technology.[5] Those who are able to lever their skills through technology have become relatively more productive in comparison with the median consumer. This technological change has increased the growth rate of the economy and the dispersion of pre-tax income. We are concerned, however, that this technological driven growth has evidently run its course since σ_t has leveled-off since 2000.

Immigration can change both the median productivity and the dispersion of relative productivity. If immigrants are unskilled and have low productivity relative to the domestic median, they lower w_t. Conversely, if the government institutes policies which encourage the immigration of high skill individuals, then w_t will increase. Immigration can also change σ_t. If government policy admits immigrants with a similar dispersion of relative productivity as the domestic population, then, of course, σ_t will be unchanged, even though w_t may fall or rise. Conversely, if government policy favors the admission of either low skill or high skill individuals, σ_t will increase, and w_t will fall or rise, respectively.

9 Conclusion

Our contribution to the large and very diverse literature on growth and income distribution takes the form of a general equilibrium model of growth in labor income and consumption. The tax rate and the amount spent on redistribution are endogenous variables. In developed, democratic countries voters chose the tax rate in single issue elections. The budget is balanced, so spending and tax collections are equal. By assumption, all spending is for redistribution.

The model extends our earlier work on a static economy, Meltzer and Richard (1981), to a growing economy. Consumers are endowed with different initial levels of productivity. Output and labor income change, as does productivity and, with it, the distribution of income among income groups. The principal reason, conjectured by Kuznets (1955,) is known as the Kuznets Curve. In developing economies, immigration from abroad or from rural regions domestically bring mainly low-skilled workers with low productivity into the labor force. In our model, labor productivity changes as workers learn new more productive skills. This changes relative and absolute incomes and the spread between the top and the bottom (or other aspects) of the income distribution. Our general equilibrium model generates the Kuznets Curve over time as worker productivity increases. The history of the past 200 hundred years in the United States, the past 30 years in China, and in many other countries is consistent with these findings. Labor income has increased as much as 200 fold over the years of United States economic development.

The model answers the puzzling result emphasized by Piketty (2014). As did Karl Marx, Piketty concludes that because the return on capital repeatedly exceeds the growth rate of developed economies and does not change much

[5] See Gordon (2002). More recently Gordon and Mokyr have joined in a lively debate over whether continued technological change will fuel future productivity growth Aeppel (2014).

over time, developed economies will face ever-increasing capital stocks. Since returns to capital go mainly to the highest income groups, the distribution of income widens over time and will continue to do so. Another possibility, of course, is that capital owners either consume or donate to charity the capital output in excess of the economic growth rate, so that capital does not accumulate faster than the economy grows. The puzzle for Piketty's conjecture is why there is no evidence anywhere that the capital stock has approached saturation. That fact opens the way for an alternative explanation of the relative constancy of the return to capital. Unlike Piketty who bases his conclusion on a comparison of the before tax income of the top 1 or .01 percent to before redistribution to the lowest income groups, we compare incomes available for consumption by the different income classes. Piketty's choice greatly overstates what has happened in developed countries. Our measure is more closely related to income after tax and after redistribution. And it changes with productivity growth, thereby increasing at times the relative shares of those in the working classes while reducing their relative share in periods of low growth.

Our model analyzes consumption over time. Consumption is an endogenous variable that depends, *inter alia*, on taxation. Voters choose the tax rate in periodic elections. Sometimes they choose to increase current consumption by increasing tax rates and redistribution. Since higher tax rates reduce investment in learning by doing, the growth rate falls. Voters can vote to increase growth by subsequently voting to reduce tax rates to increase future consumption. The spread between top and bottom of the income distribution declines. Estimation of the model shows good correspondence to the historical data for the tax rate, average hours worked, and mean to median income, which means the model captures the main facts about redistribution and economic growth.

As in our earlier work, and in fact, the median voter has less than the mean income. Hence government redistribution rises over time, as it has in all developed countries. However, higher tax rates lower the growth of wages, so sometimes voters prefer to improve their future and their children's future by reducing the tax rate. They know that they can increase future consumption by reducing tax rates.

Developing economies face different choices. They can increase productivity by copying productive technologies developed by the more advanced economies. To grow, mature economies must develop new technologies and teach them to their workers. As productivity increases on average, so does redistribution and the relative size of government. This is consistent with observed changes over time

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