

Supplement to “On financing retirement with an aging population”: Technical appendix

(*Quantitative Economics*, Vol. 8, No. 1, March 2017, 75–115)

ELLEN R. MCGRATTAN

Department of Economics, University of Minnesota and Federal Reserve Bank of Minneapolis

EDWARD C. PRESCOTT

Department of Economics, Arizona State University and Federal Reserve Bank of Minneapolis

1. INTRODUCTION

This supplementary appendix provides additional details for the main paper. Specifically, we provide more details on our data sources and construction of the model’s national accounts and fixed asset tables, some balance sheet items, distributions of incomes and transfers, and sources underlying the demographic variables. We discuss in more detail the baseline parameterization and the methods used in computing the model equilibria. And, finally, we provide predictions for the transition paths and further details underlying the sensitivity analysis of Section 5 in the main text. For those interested in trying their own experiments, we have also made the codes available in another supplementary file on the journal website, http://qeconomics.org/supp/648/code_and_data.zip.

2. U.S. MACRO DATA

Here, we describe the main sources of our data: the U.S. national income and product accounts, the fixed asset tables, several balance sheet items from the flow of funds, population statistics and projections, and employment and hours.

2.1 *National accounts and fixed assets*

The primary source of data used in our model accounts is the *U.S. National Income and Product Accounts* (NIPA) and *Fixed Asset Tables* compiled by the Bureau of Economic Analysis. These data are published in their *Survey of Current Business* (and online at www.bea.gov). We use estimates prior to the 2013 comprehensive revision (which is still ongoing). For certain imputations that we make, we also rely on data from the *Flow of*

Ellen R. McGrattan: erm@umn.edu

Edward C. Prescott: Edward.Prescott@asu.edu

The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

Copyright © 2017 The Federal Reserve Bank of Minneapolis. Licensed under the [Creative Commons Attribution-NonCommercial License 3.0](https://creativecommons.org/licenses/by-nc/3.0/). Available at <http://www.qeconomics.org>.

DOI: 10.3982/QE648

TABLE A1. Revised national income and product accounts: Averages relative to adjusted GNP, 2000–2010.

TOTAL ADJUSTED INCOME	1.000
Labor Income	0.585
Compensation of employees (NIPA 1.10)	0.531
Wages and salary accruals (NIPA 1.10)	0.433
Supplements to wages and salaries (NIPA 1.10)	0.099
70% of proprietors' income with IVA, CCadj (NIPA 1.10)	0.053
Capital Income	0.415
Corporate profits with IVA and CCadj (NIPA 1.10)	0.073
30% of proprietors' income with IVA, CCadj (NIPA 1.10)	0.023
Rental income of persons with CCadj (NIPA 1.10)	0.017
Surplus on government enterprises (NIPA 1.10)	0.000
Net income, rest of world (NIPA 1.13)	0.007
Indirect business taxes	0.072
Taxes on production and imports (NIPA 1.10)	0.068
Less: Subsidies (NIPA 1.10)	0.004
Business current transfer payments (NIPA 1.10)	0.008
Less: Sales tax	0.042
Federal excise taxes (NIPA 3.5)	0.005
Federal customs duties (NIPA 3.5)	0.002
State and local sales taxes (NIPA 3.5)	0.029
Motor vehicle licenses (NIPA 3.5)	0.001
Severance taxes (NIPA 3.5)	0.001
Special assessments (NIPA 3.5)	0.001
Other taxes on production and imports (NIPA 3.5)	0.004
Consumption of fixed capital (NIPA 1.10)	0.117
Consumer durable depreciation (FOF E10)	0.060
Statistical discrepancy (NIPA 1.10)	−0.004
Imputed capital services ^a	0.037
Consumer durable services	0.013
Government capital services	0.025

(Continues)

Funds Accounts of the United States compiled by the Federal Reserve Board of Governors and the *Statistics of Income* compiled by the Internal Revenue Service (IRS). The source is noted in the tables. (See Board of Governors (1945–2016), U.S. Department of Commerce, Bureau of Economic Analysis (1929–2016), and U.S. Department of the Treasury, Internal Revenue Service (1918–2016).)

In Table A1—which is an expanded version of Table 1 in the main text—we provide all of the details of how we revise the NIPA to conform with theory. The main source of the domestic income data is the NIPA, Table 1.10. With labor income we include compensation of employees and 70 percent of proprietors' income. All other income is categorized as capital income, which is adjusted in two ways. First, we subtract taxes other than property tax from the NIPA measure of taxes on production and imports. Second, we impute capital services for consumer durables—which we treat as investment—and government capital. The imputed services are estimated to be 4 percent times the current-cost net stock of consumer durable goods and government fixed assets. These

TABLE A1. *Continued.*

TOTAL ADJUSTED PRODUCT	1.000
Consumption	0.745
Personal consumption expenditures (NIPA 1.1.5)	0.655
<i>Less:</i> Consumer durable goods (NIPA 1.1.5)	0.081
<i>Less:</i> Imputed sales tax, nondurables and services	0.037
<i>Plus:</i> Imputed capital services, durables ^a	0.013
Government consumption expenditures, nondefense (NIPA 3.9.5)	0.111
<i>Plus:</i> Imputed capital services, government capital ^a	0.025
Consumer durable depreciation (FOF E.10)	0.060
Tangible investment	0.211
Gross private domestic investment ^b (NIPA 1.1.5)	0.145
Schedule C corporations	0.069
Other private business	0.076
Consumer durable goods (NIPA 1.1.5)	0.081
<i>Less:</i> Imputed sales tax, durables	0.005
Government gross investment, nondefense (NIPA 3.9.5)	0.025
Net exports of goods and services (NIPA 1.1.5)	-0.042
Net income rest of world (NIPA 1.13)	0.007
Defense spending	0.044
Government expenditures, national defense (NIPA 3.9.5)	0.044

Note: IVA, inventory valuation adjustment; CCadj, capital consumption adjustment; NIPA, national income and product accounts; FA, fixed assets; FOF, flow of funds. Expressions in parentheses are the data sources and table numbers.

^aImputed capital services are equal to 4 percent times the current cost net stock of government fixed assets and consumer durable goods.

^bThe corporate share of gross private domestic investment is 56.5 percent. To determine the share of Schedule C corporations, we assume that the ratio of investments for these corporations and all other corporations is the same as the ratio of their depreciable assets. Based on balance sheet data from the IRS corporate tax returns, this would imply that 83.5 percent of corporate investment is made by Schedule C corporations.

stocks are reported in the BEA's fixed asset tables. In addition, we need to include depreciation of consumer durables, which is reported in the flow of funds accounts. With these adjustments, capital income is the sum of corporate profits, part of proprietors' income, surplus on government enterprises, rents, net income, property taxes, depreciation of capital, and imputed capital services.

On the product side, revisions must also be made with regard to sales taxes and capital services. The sales taxes are assumed to be primarily taxes on personal consumption expenditures.¹ We assume pro rata shares when assessing how much of the taxes are on durables, nondurables, and services. We include nondurables and services with consumption and include durable goods with tangible investment. Therefore, we subtract sales taxes from both product categories. The imputed capital services only affect our measure of consumption, which combines personal and government consumption from the NIPA.

In the model, we distinguish between businesses that pay corporate income taxes (sector 1) and those that do not (sector 2). Businesses that pay corporate income taxes

¹Some taxes are assessed on purchases of goods and services that should in theory be subtracted from investment or government spending. Unfortunately, we do not have a breakdown by product category.

are Schedule C corporations. The others are Schedule S corporations, regulated investment companies, real estate investment trusts, proprietors, partnerships, household businesses, and government businesses. The BEA does not break out income and product data for Schedule C corporations, but the IRS does report data from tax returns separately for Schedule C corporations in the *Statistics of Income*. We use these return data to estimate the investment and capital of our sector 1. In particular, we use the ratio of depreciable assets for Schedule C and all other corporations to estimate the ratios of stocks and investments in the model. According to the IRS, 83.5 percent of corporate depreciable assets are owned by Schedule C corporations. If we decompose gross private domestic investment into corporate and noncorporate components and assign 83.5 percent of corporate investment to Schedule C corporations, then we estimate that 0.069 GNPs of investment is done by Schedule C corporations. The remaining investment, 0.142 times GNP, is the sum of gross private domestic investment for other private business plus consumer durable goods net of tax, nondefense government gross investment, and net foreign investment.

Fixed assets and other capital stocks used in our analysis are shown in Table A2. In addition to fixed assets and consumer durables reported by the BEA, we include inventories, land, and intangible assets. The source of data for inventories is the NIPA; the source of data for land values is the flow of funds. As with investment, we decompose

TABLE A2. Revised fixed asset tables with stocks end of period: Averages relative to adjusted GNP, 2000–2010.

TANGIBLE CAPITAL	4.117
Fixed assets, private ^a (FA 1.1)	2.193
Schedule C corporations	0.674
Other private business	1.519
Fixed assets, government (FA 1.1)	0.602
Consumer durables (FA 1.1)	0.304
Inventories ^a (NIPA 5.7.5)	0.134
Schedule C corporations	0.103
Other private business	0.031
Land ^a	0.885
Schedule C corporations	0.109
Other private business	0.776
Nonfinancial corporate (FOF B.102)	0.022
Nonfinancial noncorporate (FOF B.103)	0.298
Households and nonprofits (FOF B.100)	0.455
INTANGIBLE CAPITAL	1.7
TOTAL	5.8

Note: FA, fixed assets; FOF, flow of funds. Expressions in parentheses are the data sources and table numbers.

^aThe corporate shares of private fixed assets, inventories, and land are 36.8 percent, 92.1 percent, and 15.0 percent, respectively. In the case of inventories, we assume that 13 percent of farm inventories are corporate based on the ratio of corporate farmland and buildings relative to total corporate stocks reported in Table 828 of the *U.S. Statistical Abstract* (2012). To determine the share of Schedule C corporations, we assume that the ratio of stocks for these corporations and all other corporations is the same as the ratio of their depreciable assets. Based on balance sheet data from the IRS corporate tax returns, this would imply that 83.5 percent of corporate capital is owned by Schedule C corporations.

corporate capital stocks into those of all other corporations by assuming that the ratio of corporate stocks is equal to the ratio of depreciable assets reported in corporate tax returns. We then add together capital stocks of non-Schedule C corporations and non-corporate businesses. This results in an estimate of 0.885 GNPs for tangible capital in Schedule C corporations and 3.232 GNPs for tangible capital in all other businesses. Our estimate of 1.7 GNPs for the stock of intangible capital is based on studies that find that the stock of business intangible capital is as large as business tangible capital. We experimented with the share of this stock in our two sectors.

2.2 Balance sheets

Table A3 lists balance sheet items that we referenced in the paper, namely, household net worth and government debt. The source of these data is the flow of funds accounts.

The first item is net worth of households, which also includes assets of nonprofit institutions. Households have tangible assets that averaged 1.79 times adjusted GNP over the period 2000–2010 and financial assets that averaged 3.16 times adjusted GNP. Subtracting liabilities of 0.86 GNPs implies a net worth of 4.1 GNPs over the same period.

The second item is end-of-period government debt, which averaged 0.549 GNPs over 2000–2010. Close to 70 percent of this debt is in the form of U.S. Treasury securities.

2.3 Population, employment, and hours

Using data from the U.S. Census, the Social Security Administration, the NIPA, and the Bureau of Labor Statistics, we have estimates of population by age, survival probabilities, full-time equivalent employees, and annual hours of work. We summarize the relevant statistics for population, employment, and hours in Table A4.

According to U.S. Census estimates of the population, the annual growth rate in the population ages 16–64 over the decade 2000–2010 is a little over 1 percent per year, more specifically, 1.1 percent (see Table B-34 of the *Economic Report of the President (2012)*). The annual growth rate for the total population is slightly lower than 1 percent, more specifically 0.93 percent.

TABLE A3. U.S. household net worth and government debt: Averages relative to adjusted GNP, 2000–2010.

HOUSEHOLD NET WORTH, END OF PERIOD	4.100
Assets (FOF B.100)	4.947
Tangible	1.787
Financial	3.160
Liabilities (FOF B.100)	0.856
GOVERNMENT DEBT, END OF PERIOD	0.549
State and local municipal securities (FOF L.104)	0.166
Federal Treasury securities (FOF L.105)	0.381
Federal budget agency securities (FOF L.105)	0.002

Note: FOF, flow of funds. Expressions in parentheses are the data sources and table numbers.

TABLE A4. U.S. population, employment, and hours: Averages, 2000–2010.

POPULATION IN MILLIONS	
All ages (ERP B-34)	296
Ages 16–64 (ERP B-34)	194
POPULATION GROWTH (%)	
All ages (ERP B-34)	0.93
Ages 16–64 (ERP B-34)	1.09
FULL-TIME EMPLOYEES IN MILLIONS (NIPA 6.5)	124
ANNUAL HOURS PER POPULATION 16–64 (CPS, various)	1442

Note: ERP, *Economic Report of the President*; NIPA, national income and product accounts; CPS, Current Population Survey. Expressions in parentheses are the data sources and table numbers. See Prescott, Ueberfeldt, and Cociuba (2005) for the full details on primary sources.

Survival probabilities are found in the period life tables used by the Social Security Administration (see Bell and Miller (2005, Table 6)). We take an average over males and females for the year 2010.

Data on full-time equivalent (FTE) employees are found in the NIPA, Table 6.5. The number of FTE employees equals the number of employees on full-time schedules plus the number of employees on part-time schedules converted to a full-time basis. Over the period 2000–2010, the number of FTEs averaged 124 million.

The primary source of our annual hours of work series is the U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings*. The raw data underlying the series are persons at work, aged 16 years and over, and average hours worked per week for persons at work: they are based on the Current Population Survey (CPS). Total hours for military are added using data on military personnel from the Department of Defense and an estimate of a 40-hour week. (See Prescott, Ueberfeldt, and Cociuba (2005) for full details of the primary sources.)

2.4 Consistent parameters

The parameters that govern preferences and technologies are set so that the model national accounts and fixed asset tables are consistent with the data in Tables A1–A4. To accomplish this, we added additional equilibrium conditions to the code for computing a balanced growth path. The additional conditions are

$$K'_{1T} = 0.885\text{GNP}, \quad (2.1)$$

$$K'_{2T} = 3.232\text{GNP}, \quad (2.2)$$

$$K'_{1I} = \omega 1.7\text{GNP}, \quad (2.3)$$

$$K'_{2I} = (1 - \omega)1.7\text{GNP}, \quad (2.4)$$

$$wL = 0.585\text{GNP}, \quad (2.5)$$

$$L = L_1 + L_2 = 0.277, \quad (2.6)$$

where ω is a weight that we experiment with. The additional unknowns to be computed for the balanced growth path—in addition to the interest rate and one policy choice of the government that ensures budget balance—are the sectoral capital shares $(\theta_{1T}, \theta_{2T}, \theta_{1I}, \theta_{2I})$ and the preference parameters (α, β) . The depreciation rates $(\delta_{1T}, \delta_{2T}, \delta_{1I}, \delta_{2I})$ can be preset so that the investment rates of the model match those of the United States. When computing these rates, we detrend the investments and stocks by dividing by population and technological growth. The technological growth rate is chosen to be 2 percent. That leaves only one technology parameter, namely, θ_1 . We arbitrarily set this parameter to 1/2 because we do not have Schedule C incomes and stocks broken out in the U.S. accounts. This is another parameter that we experiment with.

For baseline policy parameters, we need the defense and debt shares, tax rates, and transfers. The ratio of defense spending to GNP is set equal to 0.044, which is equivalent to the U.S. share from the NIPA shown in Table A1. The ratio of debt to GNP is 0.533, which is equivalent to the U.S. share from the flow of funds shown in Table A3 after dividing by the growth terms $(1 + \gamma)(1 + \eta)$. Note that these shares depend on endogenously determined GNP, which must, in equilibrium, satisfy the resource constraint. The paths for tax rates and transfers differ depending on the policy experiment and are described in detail in the main text.

3. U.S. MICRO DATA

The main sources of our micro data are the March Supplement of the Current Population Survey (CPS) and the IRS *Statistics of Income*. In this section, we provide additional details about these data that are not in the main text.

3.1 Population counts

In our analysis, we rely heavily on tax data from the CPS. Table A5 shows the counts of tax filers and nonfilers—both unweighted and weighted—in the 2005 CPS March Supplement. Tax filers are listed as either independent if they do not appear as a dependent on another tax return or dependent if they do. As the numbers indicate, most filers are independent. Listed separately are the spouses and nonfiling dependents. About 42 percent of all tax returns include a joint-filing spouse. We separate dependents under and over age 15 because the latter are included in our working-age population count. We do the same for nonfilers. In this sample, 79 percent of the population is age 15 and older.

3.2 Comparison of AGI in CPS and IRS

To construct the distribution of incomes and transfers used in our analysis, we start by sorting families by per capita AGI. For some tax filers, data are missing because of topcoding. In these cases, we start with the taxable income. If that is topcoded, but we have data on federal or state tax payments, then we can use information about the filing status (that is, whether they are married filing jointly, head of household, etc.), along with the relevant 2004 tax schedules, to work backward to figure out the taxable income. Given taxable income, we can use IRS ratios of AGI to taxable income for the specific tax bracket to estimate the AGI. If all variables are topcoded, including the taxes paid, we use the CPS incomes to sort the filer into a tax bracket using IRS incomes.

TABLE A5. Aggregate population counts: CPS March Supplement, 2005.

NUMBER OF RECORDS:	210,648
Tax Filers	189,309
Filers	83,451
Independent	78,908
Dependent	4,543
Joint-filing spouses	38,320
Dependents	67,538
Under 15	49,374
15 and older	18,164
Nonfilers	21,339
Under 15	3,470
15 and older	17,869
POPULATION (IN MILLIONS):	291.2
Tax Filers	256.9
Filers	123.8
Independent	117.8
Dependent	6.0
Joint-filing spouses	52.4
Dependents	80.7
Under 15	56.3
15 and older	24.4
Nonfilers	34.3
Under 15	29.8
15 and older	4.4
ADDENDUM:	
Persons 15 and older	230.4
Persons 65 and older	35.2
Persons 15 and older, hours >0	135.0
Persons 15 and older, SS and Medicare recipients	45.1

To check the accuracy of these imputations, we compare the CPS estimates and IRS data with respect to numbers of returns, AGI, and AGI per return, sorting filers by AGI bracket. In Table A6, panels A–D, we show these results for all returns, married filing jointly, head of households, and a residual category that includes singles and all others. There are 132 million IRS returns and 124 million estimated based on the CPS. Breaking this down by filing status, we see that the largest discrepancy in total returns arises when comparing estimates for heads of households; the CPS records 13 million filings and the IRS records 20 million. These discrepancies are not a result of our imputations because most of the differences across reports are found in the lower AGI brackets that have not been topcoded. For example, in the case of singles, we see that 6.3 million in the CPS reported no AGI and 2.3 million reported AGI in the first bracket, whereas the IRS reports 1.2 million and 10 million, respectively. Despite these discrepancies, the AGI per return estimates are very similar in all cases, except in the very highest group of filers reporting over \$500,000 in income. As a result, when we construct parameter estimates for our model, we take those making \$200,000 or more as the top bracket.

TABLE A6. Adjusted gross incomes reported by IRS and estimated from CPS. A. All returns.

AGI Bracket	IRS Data			CPS Estimates		
	Returns (millions)	Total AGI (billions)	AGI per Return	Returns (millions)	Total AGI (billions)	AGI per Return
No AGI	1.9	-86	-46,536	7.4	-2	-315
1-5000	11.7	31	2665	3.4	8	2433
5-10,000	12.1	91	7488	6.8	51	7466
10-15,000	11.7	145	12,452	9.2	111	12,107
15-20,000	11.3	197	17,470	9.6	163	17,064
20-25,000	9.7	218	22,446	9.7	214	22,039
25-30,000	8.5	234	27,436	8.5	228	26,905
30-40,000	13.9	483	34,692	14.1	483	34,150
40-50,000	10.6	473	44,779	10.7	474	44,216
50-75,000	18.1	1110	61,484	19.0	1157	61,008
75-100,000	10.1	872	86,209	11.0	942	85,957
100-200,000	9.7	1288	132,331	10.7	1572	147,530
200-500,000	2.4	677	288,223	3.2	881	273,720
500,000+	0.7	1056	1,568,863	0.6	572	945,105
Total	132.2	6789	51,342	123.8	6854	55,380

TABLE A6. Adjusted gross incomes reported by IRS and estimated from CPS (*Cont.*). B. Married filing jointly.

AGI Bracket	IRS Data			CPS Estimates		
	Returns (millions)	Total AGI (billions)	AGI per Return	Returns (millions)	Total AGI (billions)	AGI per Return
No AGI	0.6	-54	-98,180	0.3	-1	-4006
1-5000	0.8	2	2665	0.5	1	2421
5-10,000	1.2	10	7707	0.6	5	7555
10-15,000	2.1	26	12,656	1.0	11	12,082
15-20,000	2.7	46	17,557	1.9	33	17,603
20-25,000	2.3	53	22,493	2.4	53	22,268
25-30,000	2.4	66	27,500	2.2	60	27,161
30-40,000	4.7	163	34,887	4.8	167	34,607
40-50,000	4.7	211	44,960	5.2	232	44,612
50-75,000	11.5	718	62,318	12.2	754	61,764
75-100,000	8.2	705	86,413	8.8	761	86,191
100-200,000	8.3	1106	132,547	9.2	1366	148,645
200-500,000	2.0	576	288,102	2.9	797	272,248
500,000+	0.6	873	1,528,869	0.5	472	935,140
Total	52.0	4502	86,612	52.4	4711	89,847

3.3 CPS money incomes and BEA personal incomes

In the main text, we report distributions of BEA incomes based on CPS data. Here, we show the money incomes underlying those estimates. In Table A7, we report the distri-

TABLE A6. Adjusted gross incomes reported by IRS and estimated from CPS (*Cont.*). C. Head of households.

AGI Bracket	IRS Data			CPS Estimates		
	Returns (millions)	Total AGI (billions)	AGI per Return	Returns (millions)	Total AGI (billions)	AGI per Return
No AGI	0.2	-3	-18,961	0.9	0	-329
1-5000	0.9	3	3054	0.7	2	2276
5-10,000	2.2	17	7681	0.8	6	7281
10-15,000	2.8	34	12,435	1.4	17	12,202
15-20,000	2.7	48	17,508	1.4	23	17,158
20-25,000	2.5	57	22,421	1.4	31	22,056
25-30,000	2.0	54	27,353	1.2	31	26,873
30-40,000	2.6	88	34,467	1.8	62	34,058
40-50,000	1.6	69	44,689	1.1	48	43,827
50-75,000	1.6	98	60,010	1.3	78	59,395
75-100,000	0.4	35	85,866	0.4	34	84,442
100-200,000	0.3	33	129,644	0.2	26	143,254
200-500,000	0.1	15	285,291	0.1	18	275,164
500,000+	0.0	20	1,526,938	0.0	22	1,035,194
Total	19.7	568	28,899	12.5	398	31,729

TABLE A6. Adjusted gross incomes reported by IRS and estimated from CPS (*Cont.*). D. Singles and others.

AGI Bracket	IRS Data			CPS Estimates		
	Returns (millions)	Total AGI (billions)	AGI per Return	Returns (millions)	Total AGI (billions)	AGI per Return
No AGI	1.2	-30	-25,661	6.3	-1	-157
1-5000	10.0	26	2629	2.3	6	2481
5-10,000	8.7	65	7410	5.4	40	7483
10-15,000	6.9	85	12,397	6.8	83	12,091
15-20,000	5.9	103	17,414	6.3	107	16,885
20-25,000	4.8	108	22,437	5.9	130	21,942
25-30,000	4.2	114	27,439	5.1	137	26,802
30-40,000	6.7	231	34,643	7.5	254	33,878
40-50,000	4.3	193	44,616	4.4	195	43,848
50-75,000	4.9	293	60,013	5.5	326	59,704
75-100,000	1.6	132	85,227	1.7	146	85,109
100-200,000	1.1	150	131,349	1.3	181	140,188
200-500,000	0.3	86	289,573	0.2	65	292,652
500,000+	0.1	163	1,832,644	0.1	78	984,399
Total	60.6	1719	28,370	58.8	1745	29,686

bution of money incomes from the 2005 CPS March Supplement. The grouping of AGI is not the same as in Table A6, which used the AGI of the tax filer. Here, we use the per capita AGI using all filings from the same family. To do this, we first group individuals

TABLE A7. Distribution of money incomes based on 2005 CPS March Supplement, with families sorted into AGI groups.

Per Capita Family AGI ^a	Tax Filers	Dependents			Wage & Salary	Self- Employed	Capital Income	Social Security	Worker's Comp.	Other Ret.	Public Assist.	Unempl. Ins.	Other Income	Family & Friends
		<15	≥15	Total ^b										
Nonfilers	0.0	4.4	29.8	261	8	0	13	174	2	21	20	0	14	8
Filers, by AGI														
No AGI	4.6	0.7	0.7	60	9	-1	5	30	0	9	2	1	3	3
1-5000	5.9	2.7	3.0	56	23	3	1	15	1	2	4	1	4	3
5-10,000	13.5	5.6	5.0	194	118	12	6	28	1	12	4	2	7	4
10-15,000	20.6	6.9	4.5	380	257	20	11	40	2	30	3	3	10	5
15-20,000	20.1	6.5	3.3	455	349	23	12	28	1	27	2	3	7	4
20-25,000	20.0	6.0	2.4	536	433	28	15	21	1	25	1	3	7	4
25-30,000	16.9	5.3	1.4	526	433	25	16	16	1	24	1	3	5	3
30-40,000	25.8	7.7	1.6	965	799	44	33	26	1	45	1	4	8	5
40-50,000	17.2	5.4	1.0	812	689	36	34	13	0	30	0	2	5	3
50-75,000	16.2	4.6	0.9	994	821	50	57	17	0	39	0	2	4	3
75-100,000	7.9	2.6	0.2	618	507	33	41	10	0	24	0	1	1	2
100-200,000	5.6	1.7	0.2	690	560	46	54	8	0	19	0	0	1	1
200-500,000	1.3	0.5	0.1	299	258	24	13	1	0	2	0	0	0	0
500,000+	0.3	0.1	0.0	101	88	7	5	0	0	0	0	0	0	0
Total ^c	176.2	60.7	54.2	6948	5351	350	313	426	12	312	36	25	76	47

Note: ^aFamilies consist of related persons and unmarried partners in a household. Family AGI is the sum of member AGIs divided by all members age 15 and over.

^bIncome categories are combined as follows: self-employed is business plus farm; capital income is dividends, interest, and rent; other retirement is retirement funds, survivors benefits, and disability; public assistance is supplemental security plus public assistance; other income is veteran's payments, educational assistance, and other income; and family and friends is child support, alimony, contributions, and assistance from friends.

^cPopulations are in millions and CPS incomes are in billions.

into families. Families are related persons in the same household or unmarried partners and their relatives grouped together. We sum together AGIs for all tax returns filed by members of the family and then divide by the number of people over the age of 15 in the family. Some households include multiple families, and these families are treated separately. Once an individual is put into an AGI bracket, we attribute CPS incomes for that individual to that particular bracket.

What we see from Table A7 is that wage and salary is the main category of money income, accounting for 77 percent of the total. Capital income, which is the sum of dividends, interest, and rents, is less than 5 percent, in large part because household assets are held indirectly by fiduciaries. Self-employed income that is part labor income and part capital income is 5 percent. All other money income, which is mostly government transfers, accounts for 13 percent of the total.

Table A8 shows the per capita estimates after dividing the total money incomes by the working-age population (that is, those age 15 and over). Note that the totals do not necessarily lie in the AGI brackets because IRS AGI and CPS money income are different income measures. This is especially true for those in the lowest and highest brackets; those in the lowest brackets rely heavily on government transfers, and those in the highest brackets have proprietors' and capital income that is not included in the CPS measures.

The distribution of money incomes shown in Table A7 is used to fill in the distribution of incomes in Table A9 (which is the same as Table 4 in the main text but reproduced here for convenience).² The totals in Table A9 are personal incomes in the BEA plus contributions for social insurance made by the employee and employer plus nondefense spending. Notice that now wage and salary income accounts for 44 percent of the total, proprietors' income accounts for 7 percent, and capital income accounts for 13 percent. If we compare totals, the measure of total CPS money income is about 59 percent of the total income used in our analysis.

For distributions of wages and salaries, we use the CPS wage and salary data. For proprietors' income, we use the CPS income of the self-employed. For capital income, which includes the same categories in both measures, we use the CPS capital income. For Social Security, we use the CPS social security. For Medicare, other transfers, and wage supplements listed in Table A9, we use CPS income data for transfers other than Social Security (with the exception of the category Family & Friends in Table A8, which is not included with BEA personal income) and other information that is not included in the measure of CPS money income. Specifically, for Medicare, we use the CPS estimate of the person market value, which is the average cost of the program for all respondents who say they are in the program. For other transfers, we add together income from worker's compensation, supplemental security, public assistance, unemployment compensation, and veteran's payments, as well as the person market value of Medicaid, the earned income tax credit, the child tax credit, and the additional child tax credit.

²As we note in the main text, the unassigned income is constructed by subtracting BEA-derived AGI plus nonfiler income from BEA personal income. See *Survey of Current Business* (SCB) (2007) for more information about BEA's measure of AGI and how it compares to the IRS AGI.

TABLE A8. Incomes based on 2005 CPS March Supplement per working-age person, with families sorted into AGI groups.

Per Capita Family AGI ^a	Tax Filers	Dependents			Wage & Salary	Self- Employed	Capital Income	Social Security	Worker's Comp.	Other Ret.	Public Assist.	Unempl. Ins.	Other Income	Family & Friends
		<15	≥15	Total ^b										
Nonfilers	0.0	4.4	29.8	8741	267	0	422	5823	74	718	670	15	505	245
Filers, by AGI														
No AGI	4.6	0.7	0.7	11,461	1757	-278	939	5715	51	1775	301	97	613	492
1-5000	5.9	2.7	3.0	6308	2549	386	121	1673	117	258	407	67	399	331
5-10,000	13.5	5.6	5.0	10,513	6373	632	304	1535	77	646	212	127	377	230
10-15,000	20.6	6.9	4.5	15,098	10,208	790	428	1587	73	1181	114	130	382	203
15-20,000	20.1	6.5	3.3	19,364	14,845	959	504	1192	49	1149	68	131	286	184
20-25,000	20.0	6.0	2.4	23,934	19,299	1235	650	917	56	1132	45	132	301	166
25-30,000	16.9	5.3	1.4	28,630	23,576	1366	861	857	40	1330	33	155	251	160
30-40,000	25.8	7.7	1.6	35,316	29,229	1613	1212	934	45	1664	20	138	282	178
40-50,000	17.2	5.4	1.0	44,412	37,704	1954	1848	728	22	1647	13	94	255	148
50-75,000	16.2	4.6	0.9	58,016	47,947	2916	3374	966	21	2255	14	108	236	180
75-100,000	7.9	2.6	0.2	75,742	62,044	4082	4927	1227	25	2932	13	113	162	215
100-200,000	5.6	1.7	0.2	118,020	95,744	7925	9268	1348	3	3319	7	72	182	152
200-500,000	1.3	0.5	0.1	209,156	180,372	17,014	8907	754	3	1573	12	191	200	132
500,000+	0.3	0.1	0.0	286,674	251,367	20,431	12,491	725	0	1419	0	44	197	0
Total ^c	176.2	60.7	54.2	30,150	23,220	1518	1360	1848	53	1353	158	109	328	203

Note: ^aFamilies consist of related persons and unmarried partners in a household. Family AGI is the sum of member AGIs divided by all members age 15 and over.

^bIncome categories are combined as follows: self-employed is business plus farm; capital income is dividends, interest, and rent; other retirement is retirement funds, survivors benefits, and disability; public assistance is supplemental security plus public assistance; other income is veteran's payments, educational assistance, and other income; and family and friends is child support, alimony, contributions, and assistance from friends.

^cPopulations are in millions and CPS incomes are in dollars.

TABLE A9. Distribution of incomes based on 2005 CPS March Supplement, scaled to BEA totals, with families sorted into AGI groups.

Per Capita Family AGI	Tax Filers	Dependents			Incomes			Transfers			Wage Supplements			Nondefense Spending
		<15	≥15	Total	W&S	Proprietors	Capital	SS	Medicare	Other	Insurance	Pension	FICA	
Nonfilers	0.0	4.4	29.8	773	8	0	19	198	136	194	1	0	1	217
Filers, by AGI ^a														
No AGI	4.6	0.7	0.7	129	9	-3	8	34	21	21	1	0	1	38
1-5000	5.9	2.7	3.0	181	22	8	2	17	11	51	3	0	2	64
5-10,000	13.5	5.6	5.0	450	117	28	9	32	20	82	14	3	11	134
10-15,000	20.6	6.9	4.5	717	254	47	16	46	29	77	33	9	22	183
15-20,000	20.1	6.5	3.3	781	345	53	18	32	19	52	46	15	30	171
20-25,000	20.0	6.0	2.4	873	428	65	22	23	14	41	57	22	37	163
25-30,000	16.9	5.3	1.4	818	428	59	24	18	11	30	55	24	36	133
30-40,000	25.8	7.7	1.6	1440	790	104	51	29	17	39	97	50	65	199
40-50,000	17.2	5.4	1.0	1174	681	84	52	15	9	21	76	47	55	133
50-75,000	16.2	4.6	0.9	1387	812	118	88	19	10	18	77	56	64	125
75-100,000	7.9	2.6	0.2	837	501	79	61	11	5	6	41	36	37	59
100-200,000	5.6	1.7	0.2	905	553	110	83	9	4	2	30	39	32	42
200-500,000	1.3	0.5	0.1	382	255	57	19	1	1	1	7	19	11	10
500,000+	0.3	0.1	0.0	125	87	17	7	0	0	0	2	5	4	3
Unassigned ^b	0.0	0.0	0.0	1263	103	84	1076	0	0	0	0	0	0	0
Total ^c	176.2	60.7	54.2	12,233	5392	911	1555	485	306	635	540	326	407	1675

Note: ^aFamilies consist of related persons and unmarried partners in a household. Family AGI is the sum of member AGIs divided by all members age 15 and over.

^bUnassigned income is BEA personal income less BEA-derived AGI and CPS income of nonfilers. See main text and SCB (2007) for details.

^cPopulations are in millions, BEA totals in billions. The BEA data are from the 2006Q4 archive to be consistent with estimates in SCB (2007).

To derive estimates for wage supplements, we use CPS data on employer contributions to health insurance, participation in employer pension plans, and FICA payments made by workers. The distribution of contributions for health insurance is used as a proxy for all insurance recorded by the BEA. For those who participate in a pension plan at work, we include a percentage of their wage as the supplement to wages, with that percentage chosen to have all payments sum to the BEA total (which turns out to be roughly 10 percent). Finally, FICA payments of employees can be used to infer the FICA payments of their employers.

The last column in Table A9 is the contribution of nondefense spending. Each person over age 15 is assumed to receive \$7269.

As before, we can compute the per capita estimates by dividing the incomes by persons of working age. These estimates are shown in Table A10. Again, note that the totals do not necessarily lie in the AGI brackets because IRS AGI and BEA income are different income measures and because we have included contributions to social insurance and nondefense spending in the BEA's measure of personal income. These per capita incomes reveal, perhaps not surprisingly, that transfers are significant for nonfilers and those with no AGI, and employer benefits are significant for those in the middle and higher brackets. These facts play an important role in our analysis.

3.4 CPS tax data

In addition to incomes and transfers, we need marginal and average tax rates by income bracket. In Table A11, we report the underlying data for our tax rate estimates taken from the CPS.

The total AGI is \$6854 billion, which is what we reported in Table A6, panel A. Here, we report the AGI data using per capita AGI for the family rather than AGI for an individual tax filer. For example, if the unit of analysis is an individual tax filer, then the AGI attributed to the \$50,000–\$75,000 bracket is \$1157 billion and the AGI per return is \$61,008. If, instead, the unit of analysis is a representative family member, then the AGI attributed to this bracket is \$1065 billion and the AGI per working-age person in the bracket is \$62,281.

Listed next, in the sixth column of Table A11, is taxable income, which is the measure of income used with the IRS 1040 tax schedules and can be used to calculate each tax filer's marginal tax rate. For jointly filing spouses, we assign the same marginal rate as the tax filer. The seventh column shows the distribution of FICA payments by workers. These data are used to construct FICA tax rates.

Federal and state income taxes are shown in the eighth through eleventh columns, both before credits (BC) and after credits (AC). The last three columns are the total amounts of credits by type: earned income tax credit (EITC), child tax credit (CTC), and additional child tax credit (ACTC). These data are used to adjust the marginal tax rates of recipients. We do this by using the IRS worksheets.

Table A12 shows our constructed marginal and average tax rates for all AGI brackets. We use the methodology of Barro and Redlick (2011) to construct income-weighted average marginal tax rates, and then we adjust the rates to account for refundable tax credits.

TABLE A10. Incomes based on 2005 CPS March Supplement per working-age person, scaled to BEA totals, with families sorted into AGI groups.

Per Capita Family AGI	Tax Filers	Dependents		Total ^d	Incomes			Transfers			Wage Supplements		
		<15	≥15		W&S	Proprietors	Capital	SS	Medicare	Other	Insurance	Pension	FICA
Nonfilers	0.0	4.4	29.8	25,922	264	0	644	6634	4544	6502	41	3	20
Filers, by AGI ^a													
No AGI	4.6	0.7	0.7	24,444	1737	-658	1433	6510	3943	3929	138	9	135
1-5000	5.9	2.7	3.0	20,453	2520	913	185	1906	1218	5810	339	34	258
5-10,000	13.5	5.6	5.0	24,337	6300	1494	464	1749	1101	4444	779	157	581
10-15,000	20.6	6.9	4.5	28,454	10,090	1870	653	1808	1161	3051	1311	350	890
15-20,000	20.1	6.5	3.3	33,248	14,674	2267	769	1358	815	2233	1941	658	1264
20-25,000	20.0	6.0	2.4	38,930	19,077	2920	992	1045	642	1826	2533	991	1636
25-30,000	16.9	5.3	1.4	44,559	23,304	3231	1315	977	573	1641	2992	1297	1961
30-40,000	25.8	7.7	1.6	52,658	28,892	3815	1851	1064	605	1412	3547	1817	2385
40-50,000	17.2	5.4	1.0	64,208	37,269	4620	2821	829	481	1172	4164	2574	3008
50-75,000	16.2	4.6	0.9	80,934	47,395	6896	5151	1100	568	1036	4513	3295	3709
75-100,000	7.9	2.6	0.2	102,473	61,329	9653	7522	1398	650	677	5039	4353	4584
100-200,000	5.6	1.7	0.2	154,775	94,640	18,744	14,147	1536	726	368	5204	6706	5435
200-500,000	1.3	0.5	0.1	267,121	178,293	40,239	13,596	859	411	561	4994	13,242	7657
500,000+	0.3	0.1	0.0	356,157	248,470	48,322	19,068	826	334	659	4809	14,705	11,696
Total ^c	176.2	60.7	54.2	53,085	23,400	3954	6748	2106	1328	2757	2345	1413	1767

Note: ^aFamilies consist of related persons and unmarried partners in a household. Family AGI is the sum of member AGIs divided by all members age 15 and over.

^bUnassigned income is BEA personal income less BEA-derived AGI and CPS income of nonfilers. See SCB (2007).

^cPopulations are in millions. The BEA data are from the 2006Q4 archive to be consistent with estimates in SCB (2007).

^dTotals include \$7269 of nondefense spending per working-age person.

TABLE A11. Tax data from the CPS March Supplement, with families sorted into AGI groups.

Per Capita Family AGI	Tax Filers	Dependents		Total AGI	Taxable Income	FICA Payment	Income Taxes				Tax Credits		
		<15	≥15				Fed BC	& AC	State BC	& AC	EITC	CTC	ACTC
Nonfilers	0.0	4.4	29.8	0	0	1	0	0	0	0	0	0	0
Filers, by AGI ^a													
No AGI	4.6	0.7	0.7	-2	0	1	0	0	0	0	0	0	0
1-5000	5.9	2.7	3.0	25	1	2	0	-5	0	0	4	0	0
5-10,000	13.5	5.6	5.0	142	23	10	2	-11	1	1	10	1	3
10-15,000	20.6	6.9	4.5	313	109	22	10	-1	5	4	7	3	4
15-20,000	20.1	6.5	3.3	408	204	29	20	15	9	8	3	4	3
20-25,000	20.0	6.0	2.4	500	294	36	32	29	12	11	2	5	2
25-30,000	16.9	5.3	1.4	500	322	35	38	37	14	13	1	5	1
30-40,000	25.8	7.7	1.6	941	656	64	86	85	28	26	0	8	0
40-50,000	17.2	5.4	1.0	814	603	54	92	92	26	25	0	5	0
50-75,000	16.2	4.6	0.9	1065	789	62	143	143	35	34	0	4	0
75-100,000	7.9	2.6	0.2	698	531	36	109	109	24	24	0	1	0
100-200,000	5.6	1.7	0.2	761	591	31	142	142	28	28	0	0	0
200-500,000	1.3	0.5	0.1	425	354	11	106	106	16	16	0	0	0
500,000+	0.3	0.1	0.0	265	203	4	66	66	10	10	0	0	0
Total ^b	176.2	60.7	54.2	6854	4681	397	846	807	208	198	26	36	13

Note: ^aFamilies consist of related persons and unmarried partners in a household. Family AGI is the sum of member AGIs divided by all members age 15 and over.

^bPopulations are in millions. CPS tax data are in billions.

TABLE A12. Tax rates based on data from the CPS March Supplement, with families sorted into AGI groups.

Per Capita Family AGI ^a	Tax Filers	Dependents		Marginal Tax Rates						Average Tax Rates			
		<15	≥15	Total	Federal	EITC ^c	CTC ^c	State	FICA	Total	Federal	State	FICA
Nonfilers ^b	0.0	4.4	29.8	14.2	0	0	0	0	14.2	14.2	0	0	14.2
Filers, by AGI													
No AGI	4.6	0.7	0.7	14.6	0.0	0.1	0.0	0.0	14.4	14.4	0.0	0.0	14.4
1–5,000	5.9	2.7	3.0	4.7	0.9	–10.3	–0.9	0.2	14.8	13.2	0.1	0.1	14.3
5–10,000	13.5	5.6	5.0	20.7	5.1	1.8	–2.2	1.2	14.7	13.8	–0.8	0.5	14.1
10–15,000	20.6	6.9	4.5	28.2	9.6	2.6	–1.1	2.4	14.7	15.3	0.5	1.1	13.7
15–20,000	20.1	6.5	3.3	32.6	13.1	1.9	–0.4	3.2	14.7	18.7	2.8	1.7	14.2
20–25,000	20.0	6.0	2.4	34.2	14.9	1.0	–0.1	3.8	14.7	21.4	4.8	2.1	14.4
25–30,000	16.9	5.3	1.4	35.3	15.8	1.0	0.0	4.0	14.5	23.5	6.5	2.4	14.6
30–40,000	25.8	7.7	1.6	35.9	17.1	0.3	0.0	4.3	14.2	25.6	8.3	2.7	14.6
40–50,000	17.2	5.4	1.0	41.2	23.2	0.0	0.0	4.7	13.3	28.2	10.6	3.1	14.5
50–75,000	16.2	4.6	0.9	41.9	24.8	0.0	0.0	5.0	12.1	30.3	13.0	3.3	14.0
75–100,000	7.9	2.6	0.2	41.8	27.3	0.0	0.0	5.1	9.4	32.3	15.5	3.5	13.3
100–200,000	5.6	1.7	0.2	41.2	30.0	0.0	0.0	5.4	5.9	32.7	18.1	3.8	10.9
200–500,000	1.3	0.5	0.1	43.6	34.4	0.0	0.0	5.3	3.9	35.2	24.1	3.9	7.2
500,000+	0.3	0.1	0.0	43.1	34.8	0.0	0.0	4.8	3.5	36.9	26.9	3.9	6.2

Note: ^aFamilies consist of related persons and unmarried partners in a household. Family AGI is the sum of member AGIs divided by all members age 15 and over.

^bPopulations of tax filers and dependents under and over age 15 are in millions; tax rates are in percent.

^cAdjustments are made to federal tax rates to account for the impact of refundable tax credits and public assistance. See U.S. Congress, CBO (2012).

For tax credits, we use the IRS worksheets to estimate the adjustments to the tax rates. As shown in Table A12, the income-weighted EITC adjustment is large and negative for the lowest income bracket, roughly—10 percent—but is positive for higher brackets. The child tax credit adjustment is negative for all income brackets.

In the case of means-tested transfer programs such as the Temporary Assistance for Needy Families (TANF) or the Supplemental Nutrition Assistance Program (SNAP), the CPS survey does not provide sufficient information to use tax worksheets, but even if it did, the task of constructing marginal tax rates is daunting. As the Congressional Budget Office (CBO) makes clear in their study of effective marginal tax rates on low- and moderate-income workers, “the income tax system does not make marginal tax rates readily apparent, and complex rules and interactions between the tax and transfer systems tend to further obscure those rates” (see U.S. Congress, Congressional Budget Office (2012)). We do know from hypothetical examples, however, that the marginal rates *can be* greatly affected by the phaseout of benefits, especially for low-income households. For example, the CBO shows that some households face marginal rates as high as 95 percent.

Adding the sixth through tenth columns, we have the total marginal rate used in the analysis. The total marginal rate is 5 percent for those with per capita family AGI in the \$1–\$5000 bracket and is as high as 44 percent for those with per capita family AGI over \$200,000. Average rates, including federal, state, and FICA, are around 14 percent for the lowest brackets and rise to around 37 percent for the top bracket.

4. COMPUTATION

In this section, we provide details on computing equilibria for the balanced growth paths and then for the transitions. To avoid messy notation, we assume one productivity level ($K = 1$) and, at the end, note where additional computations are needed for cases with multiple productivities.

4.1 *Balanced growth paths*

We have several codes in the code and data supplement on the journal website for computing balanced growth paths. They differ in the fixed-point method employed and in the choice of unknown variables. A fixed point is found for the equilibrium interest rate and for a residually determined variable, which is either common government transfers to households or the tax rate on consumption.

Two fixed-point methods are available: functional iteration and Newton–Raphson. The former simply updates the unknown variables iteratively as

$$x^{k+1} = \omega x^k + (1 - \omega)(x^k - r(x^k)), \quad (4.1)$$

where x^k is the k th iteration of the unknowns, $\omega \in [0, 1]$ is a weighting parameter that aids convergence in many cases, and $r(x^k)$ are the first-order conditions that need to be

satisfied by an appropriate choice of x^k . The Newton–Raphson method uses the updating scheme

$$x^{k+1} = x^k - [dr(x)/dx|_{x=x^k}]^{-1}r(x^k) \quad (4.2)$$

and, if necessary, a weighting parameter can be used to help with convergence:

$$x^{k+1} = \omega x^k + (1 - \omega)(x^k - [dr(x)/dx|_{x=x^k}]^{-1}r(x^k)). \quad (4.3)$$

The two first-order conditions $r(x)$ that have to be satisfied by x are (i) the condition that sets the return on tangible capital equal to its marginal product and (ii) the condition that imposes the government budget balance. After manipulating all of the other necessary conditions, we can write the step-by-step algorithm needed to evaluate $r(x)$, starting with a guess for x , as follows:³

- Set the interest rate i equal to the first element of x .
- Set the common transfer ζ equal to the second element of x .
- Use the fact that after-tax returns on capital net of depreciation are equated to the interest rate to get the four capital rental rates (that is, for the two types of capital in the two sectors),

$$r_{1T} = i/(1 - \tau_1^\pi) - \delta_{1T},$$

$$r_{2T} = i/(1 - \tau_2^\pi) - \delta_{2T},$$

$$r_{1I} = i - \delta_{1I},$$

$$r_{2I} = i - \delta_{2I}.$$

- Use the capital share parameters to get estimates for the two ratios of sectoral labor inputs to total labor inputs,

$$L_1/L = \theta_{1L} \theta_1 / (\theta_{1L} \theta_1 + \theta_{2L} \theta_2),$$

$$L_2/L = \theta_{2L} \theta_2 / (\theta_{1L} \theta_1 + \theta_{2L} \theta_2),$$

where $\theta_{iL} = 1 - \theta_{iT} - \theta_{iI}$.

- Use the capital shares and capital rental rates to get estimates for ratios of capital stocks to compensation. Note that there are four ratios because there are two types of capital and two sectors, that is,

$$K_{1T}/(wL_1) = \theta_{1T}/(\theta_{1L}r_{1T}),$$

$$K_{2T}/(wL_2) = \theta_{2T}/(\theta_{2L}r_{2T}),$$

$$K_{1I}/(wL_1) = \theta_{1I}/(\theta_{1L}r_{1I}),$$

$$K_{2I}/(wL_2) = \theta_{2I}/(\theta_{2L}r_{2I}).$$

³So as to be precise, assume that the second element of x is the level of common transfers given to the households.

- Use the aggregate production function, sectoral labor ratios, and capital–compensation ratios to get an intermediate variable, call it z :

$$z = 2 \left\{ \left[K_{1T}/(wL_1) \right]^{\theta_{1T}} \left[K_{1I}/(wL_1) \right]^{\theta_{1I}} L_1/L \right\}^{\theta_1} \\ \times \left\{ \left[K_{2T}/(wL_2) \right]^{\theta_{2T}} \left[K_{2I}/(wL_2) \right]^{\theta_{2I}} L_2/L \right\}^{\theta_2}.$$

Note that the coefficient of 2 is used to normalize the ratios of outputs (found below) but can be changed without loss of generality.

- Use capital shares and the intermediate variable z to get an estimate of the wage rate:

$$w = [z(\theta_{1L}\theta_1 + \theta_{2L}\theta_2)]^{1/(1-(1-\theta_{1L})\theta_1-(1-\theta_{2L})\theta_2)}.$$

- Multiply the four ratios of capital stocks to compensation by the wage rate to get estimates of the capital–labor ratios, K_{1T}/L_1 , K_{2T}/L_2 , K_{1I}/L_1 , and K_{2I}/L_2 .
- Use the capital–labor ratios to construct ratios of intangible to tangible capital for the two sectors and the ratio of tangible capitals across the two sectors:

$$K_{1I}/K_{1T} = (K_{1I}/L_1)/(K_{1T}/L_1),$$

$$K_{2I}/K_{2T} = (K_{2I}/L_2)/(K_{2T}/L_2),$$

$$K_{2T}/K_{1T} = [(K_{2T}/L_2)/(K_{1T}/L_1)] [(L/L_2)/(L/L_1)].$$

- Multiply the intermediate variable z by the wage rate raised to a power to get the aggregate labor productivity, that is,

$$Y/L = zw^{(1-\theta_{1L})\theta_1+(1-\theta_{2L})\theta_2}.$$

- Solve the household dynamic programming problem—assuming the set of asset choices are $\{a_i\}$, which are equally spaced points on $[0, \bar{a}]$. The steps are as follows:

- For the terminal value function v_J , assume that the optimal next period assets and current labor supply are both 0 (that is, if $J_r < J$), and that determines the final level of consumption via the household budget constraint.

- Working backward from $j = J$ to $j = 1$, iteratively solve

$$v_j(a, s) = \max_{a', c, \ell} \{u(c, \ell) + \beta \sigma^j v_{j+1}(a', s')\}$$

subject to the budget constraints

$$a' \sigma^j = (1 + i)a + (1 - \tau^\ell)w\ell - (1 + \tau^c)c + \psi^j.$$

The programs find the maximum in a brute-force way, which is slow but ensures that inequality constraints on asset holdings are enforced.

- At each step $j = J - 1, \dots, 1$, store the optimal decision functions.

- Use the probabilities of survival and the growth rate in the population to determine the fraction of people in each age group j , call this μ^j , where $\sum_j \mu^j = 1$.
- Add everything by summing optimal choices for consumption, labor, and asset holdings, weighted by the μ^j 's. This implies values for total consumption C , total labor L , and total beginning-of-period assets A .
- Multiply the aggregate labor productivity Y/L by L to get total output, Y .
- Multiply the ratios of sectoral labor to total labor by L to get L_1 and L_2 .
- Use the fact that assets are equal to business equity V plus government debt B to back out values for the capital stocks. In doing this, we need to remember that $B = \phi_B$ GNP and GNP is output less intangible investments. In other words, we have⁴

$$\begin{aligned}
 A &= V + B \\
 &= V_1 + V_2 + \phi_B \text{GNP} \\
 &= V_1 + V_2 + \phi_B (Y - X_{1I} - X_{2I}) \\
 &= (1 - \tau_1^d)(K_{1T} + (1 - \tau_1^\pi)K_{2T}) + K_{2T} + (1 - \tau_2^d)K_{2I} + \phi_B (Y - X_{1I} - X_{2I}).
 \end{aligned}$$

Also, note that on a balanced growth path, $X_{iI} = [(1 + \gamma)(1 + \eta) - 1 + \delta_{iI}]K_{iI}$. Using this fact plus the values for A and Y computed in the earlier steps, we have

$$\begin{aligned}
 K_{1T} &= (A - \phi_B Y) / \{ (1 - \tau_1^d)(1 + (1 - \tau_1^\pi)(K_{1I}/K_{1T})) \\
 &\quad + (K_{2T}/K_{1T}) + (1 - \tau_2^d)(K_{2I}/K_{2T})(K_{2T}/K_{1T}) \\
 &\quad - \phi_B [(1 + \gamma)(1 + \eta) - 1 + \delta_{1I}](K_{1I}/K_{1T}) \\
 &\quad - \phi_B [(1 + \gamma)(1 + \eta) - 1 + \delta_{2I}](K_{2I}/K_{2T})(K_{2T}/K_{1T}) \}, \\
 K_{1I} &= (K_{1I}/K_{1T})K_{1T}, \\
 K_{2T} &= (K_{2T}/K_{1T})K_{1T}, \\
 K_{2I} &= (K_{2I}/K_{2T})K_{2T}.
 \end{aligned}$$

- Use the capital stocks, growth rates, and depreciation rates to compute the four investments

$$\begin{aligned}
 X_{1T} &= [(1 + \gamma)(1 + \eta) - 1 + \delta_{1T}]K_{1T}, \\
 X_{1I} &= [(1 + \gamma)(1 + \eta) - 1 + \delta_{1I}]K_{1I}, \\
 X_{2T} &= [(1 + \gamma)(1 + \eta) - 1 + \delta_{2T}]K_{2T}, \\
 X_{2I} &= [(1 + \gamma)(1 + \eta) - 1 + \delta_{2I}]K_{2I}.
 \end{aligned}$$

- Use the capital stocks and labor inputs for the sectoral outputs and prices:

$$\begin{aligned}
 Y_i &= K_{iT}^{\theta_{iT}} K_{iI}^{\theta_{iI}} L_i^{\theta_{iL}}, \\
 p_i &= \theta_i Y / Y_i.
 \end{aligned}$$

⁴Note that here we are equating beginning-of-period stocks.

- Use output and the intangible investments to compute the NIPA analogues of GNP, accounting profits, and corporate dividends:

$$\text{GNP} = Y - X_{1I} - X_{2I},$$

$$\Pi_1 = p_1 Y_1 - wL_1 - \delta_{1T} K_{1T} - X_{1I},$$

$$D_1 = p_1 Y_1 - wL_1 - X_{1T} - X_{1I} - \tau_1^\pi \Pi_1,$$

$$D_2 = p_2 Y_2 - wL_2 - \delta_{2T} K_{2T} - X_{2I}.$$

- Use GNP and age-dependent transfers to construct the variables relevant to the government budget constraint:

$$G = \phi_G \text{GNP},$$

$$B = \phi_B \text{GNP},$$

$$\Psi = \sum_j \mu^j \psi^j + \zeta.$$

- Construct the first-order conditions $r(x)$ as

$$r_1(x) = r_{1T} - \theta_{1T} \theta_1 Y / K_{1T},$$

$$r_2(x) = \Psi + G - \tau^\ell wL - \tau_1^d D_1 - \tau_2^d D_2 - \tau_1^\pi \Pi_1 - B' + (1+i)B - \tau^c C.$$

- Update x and check whether the iterations have converged.

We add elements to $r(x)$ when we compute our initial baseline economy (with current demographics and current policy). Specifically, we add the constraints in (2.1)–(2.6) as residual equations in $r(x)$, and we add θ_{1T} , θ_{1I} , θ_{2T} , θ_{2I} , α , and β as unknowns in the vector x .

The Fortran programs for computing balanced growth equilibria are available in the data supplement in the directory `./codes/balgrowth`. The naming convention for the codes is `bgxxy.f90` with choices for `xx` and `yy`. The choices for `xx`, namely, `xx = tr` and `xx = tc`, depend on whether the residual variable is the common transfer to households (`tr`) or the tax rate on consumption (`tc`). The choices for `yy`, namely, `yy = fi` and `yy = nr`, depend on whether we employ a functional iteration update as in (4.1) or a Newton–Raphson update as in (4.2) or (4.3).

When we include multiple productivity levels ($K > 1$), we have to compute K different dynamic programs, which is straightforward. We also modified our codes to include the option of using a net tax schedule rather than a proportional tax and, therefore, included an additional subroutine that computes the marginal tax and the total tax paid.

4.2 Transitions

For the dynamic case, we need to compute time paths ($t = 1, \dots, T$) across different birth-year cohorts and productivity levels. To speed up the computations, we wrote the

transition code to take advantage of parallel processors, assuming they are available. To simplify the code (called `trantf.f90`), we assumed that T/n birth-year cohorts would be assigned to each processor, where n is the number of processors. For example, if $T = 240$ and $n = 48$ (as is true in our case), then there would be five birth-year cohorts with K different productivity levels per processor. For cohorts alive at $t = 1$, computation is done starting with the initial conditions of our baseline economy.

The core of the computation in transition is the same as for the balanced growth paths, namely, solving the household problem. But, in this case, we are solving the household problem for each cohort and, therefore, have to keep track of all variables by age and time.

The iterations for finding x_t to solve $r(x_t)$ are also similar except that now we keep track of time series for the unknown variables, and we add two other unknowns, namely, the wage rate and GNP. We add these additional variables to the vector of unknowns because we cannot write all other variables explicitly in terms of the interest rate and the residual variable for the government budget balance. In addition, we add two residual equations. First, we add an equation relating the wage rate in vector x to the marginal product of labor. Second, we add an equation relating GNP in vector x to output less intangible investments.

Otherwise, the steps are the same as in the case of the balanced growth path computation.

5. TRANSITION PATHS AND WELFARE GAINS

In this section, we report the full results for our numerical experiments in Section 5. Tables A13–A32 summarize the key variables on the transition paths as the U.S. economy transitions from the current demographics and current policy to the new demographics and new policy.

The first transition, which is a continuation of U.S. policy, is shown in Table A13. Components of the government budget constraint are shown first, as a share of GNP, national account and fixed assets are shown next, again as a share of GNP, and detrended levels of several key variables are shown in the last rows of the table. The main change in public financing that occurs during the transition is an increase in tax rates on consumption that finance the increased transfers to retirees. The consumption tax rate required to finance these transfers rises from a baseline rate of 6.5 percent to roughly 12 percent. The net tax schedules for workers and retirees are not changed, but revenues and transfers change in response to the demographic transition. In terms of outcomes, we find a steady decline in the labor input, with the eventual drop at roughly 10 percent below the current level. The GNP is 1 percent below trend in the first decade and eventually falls to 4.5 percent below trend. Consumption changes little, in part because there are increased transfers that affect all productivity types.

Tables A14 and A15 show the transition paths when FICA taxes and transfers are phased out. The first shows the case that these taxes and transfers are phased out gradually (at the same rate that the retiree population rises), and the second shows the case that transfers are phased out gradually and taxes are phased out more quickly. The latter

TABLE A13. Transitions from current U.S. policy to new policies: Continue U.S. policy.

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.173	0.174	0.176	0.186	0.207	0.217
Profits, Schedule C	0.026	0.026	0.026	0.027	0.027	0.028
Distributions, Schedule C	0.004	0.004	0.004	0.005	0.005	0.006
Distributions, other	0.094	0.094	0.094	0.094	0.094	0.094
Consumption	0.059	0.060	0.062	0.071	0.087	0.094
Labor inc. (net), by type	−0.009	−0.010	−0.011	−0.010	−0.006	−0.004
Low	−0.052	−0.052	−0.052	−0.051	−0.050	−0.049
Medium	−0.010	−0.010	−0.011	−0.010	−0.008	−0.007
High	0.040	0.040	0.040	0.040	0.040	0.040
Top 1 pct	0.012	0.012	0.012	0.012	0.012	0.012
Retiree transfers, by type	0.121	0.121	0.123	0.132	0.152	0.161
Low	0.046	0.046	0.047	0.050	0.058	0.061
Medium	0.048	0.049	0.049	0.053	0.061	0.064
High	0.025	0.026	0.026	0.028	0.032	0.034
Top 1 pct	0.001	0.001	0.001	0.001	0.002	0.002
Interest on debt	0.025	0.025	0.024	0.024	0.024	0.023
Labor income	0.585	0.584	0.583	0.581	0.579	0.577
Capital income	0.415	0.416	0.417	0.419	0.421	0.423
Consumption	0.745	0.747	0.752	0.760	0.772	0.778
Tangible investment	0.212	0.210	0.205	0.197	0.185	0.177
Intangible investment	0.134	0.133	0.131	0.127	0.122	0.119
Defense	0.044	0.044	0.044	0.044	0.044	0.044
Tangible capital	4.172	4.167	4.156	4.166	4.226	4.233
Intangible capital	1.732	1.730	1.725	1.724	1.733	1.727
LEVELS						
Interest rate	4.593	4.596	4.591	4.547	4.411	4.335
Wage rate	1.007	1.007	1.007	1.014	1.033	1.045
Labor input	0.982	0.979	0.972	0.952	0.916	0.900
GNP	0.990	0.987	0.983	0.973	0.958	0.955
Net worth	0.997	0.993	0.986	0.977	0.973	0.970

Note: Tables A13–A32 report averages over subperiods. Values for the wage rate, labor input, GNP, and net worth are detrended and defined relative to the current U.S. economy.

case was discussed in the main text. In Figures A1 and A2, we show the welfare gains for these policy reforms. Figure A1 shows that retirees alive at the time of the policy change are indifferent between continuing the current policy and switching because their benefits are not affected either way. Figure A2 (which is the same as Figure 3A in the main text) shows that retirees suffer slight losses if the taxes are phased out more quickly because the consumption tax rates must rise to make up the difference in revenues.

Table A16 shows the transition paths when we additionally phase out the deductibility of employer benefits. This case is discussed in the main text. The associated welfare gains are shown here in Figure A3 (and in Figure 3B in the main text). Most of the differences between the transition path in this case and those in Tables A14 and A15 show up in the timing of consumption and labor tax revenues and retiree transfers. We also find

TABLE A14. Transitions from current U.S. policy to new policies: Social Security, Medicare, and FICA taxes phased out; taxes and transfers phased out at same rate.

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.173	0.172	0.171	0.158	0.128	0.110
Profits, Schedule C	0.025	0.026	0.026	0.025	0.025	0.025
Distributions, Schedule C	0.004	0.004	0.004	0.004	0.004	0.005
Distributions, other	0.094	0.094	0.094	0.093	0.092	0.091
Consumption	0.059	0.059	0.060	0.054	0.040	0.028
Labor inc. (net), by type	−0.009	−0.010	−0.012	−0.018	−0.034	−0.040
Low	−0.051	−0.051	−0.051	−0.049	−0.046	−0.046
Medium	−0.010	−0.010	−0.011	−0.013	−0.022	−0.024
High	0.040	0.039	0.038	0.034	0.024	0.020
Top 1 pct	0.012	0.012	0.012	0.011	0.010	0.010
Retiree transfers, by type	0.120	0.120	0.118	0.106	0.075	0.057
Low	0.046	0.046	0.045	0.040	0.028	0.021
Medium	0.048	0.048	0.047	0.042	0.030	0.023
High	0.025	0.025	0.025	0.022	0.016	0.012
Top 1 pct	0.001	0.001	0.001	0.001	0.001	0.001
Interest on debt	0.025	0.024	0.024	0.024	0.022	0.020
Labor income	0.585	0.585	0.585	0.586	0.584	0.581
Capital income	0.415	0.415	0.415	0.414	0.416	0.419
Consumption	0.742	0.743	0.743	0.738	0.748	0.756
Tangible investment	0.215	0.213	0.214	0.219	0.209	0.195
Intangible investment	0.135	0.135	0.135	0.136	0.132	0.127
Defense	0.044	0.044	0.044	0.044	0.044	0.044
Tangible capital	4.178	4.186	4.197	4.303	4.542	4.710
Intangible capital	1.734	1.736	1.739	1.765	1.816	1.849
LEVELS						
Interest rate	4.591	4.579	4.570	4.431	4.075	3.828
Wage rate	1.007	1.008	1.009	1.031	1.088	1.128
Labor input	0.985	0.982	0.984	0.996	0.991	0.981
GNP	0.992	0.991	0.994	1.026	1.081	1.115
Net worth	1.000	1.001	1.005	1.060	1.167	1.241

that the labor input on the new balanced growth path is higher than the current U.S. level, not lower.

Tables A17 and A18 show transition paths for our baseline reforms with marginal tax rates reduced temporarily and permanently, respectively. We noted in the main text that we can generate a Pareto improvement in these cases because the net tax revenues from workers are higher than if the current policy is continued or if there is policy reform without a flattening of the tax schedule. This can be seen by comparing the fifth and sixth rows in Tables A17 and A18 with those rows in Table A13–A16. The welfare gains for these cases are reproduced here for convenience in Figures A4 and A5. For the experiments in Tables A19–A32 (and the corresponding Figures A6–A19), we use the same tax schedule as we did in generating Table A18 and Figure A5 (with marginal tax rates permanently reduced). We refer to the latter case as the baseline reform.

TABLE A15. Transitions from current U.S. policy to new policies: Social Security, Medicare, and FICA taxes phased out; taxes phased out more quickly than transfers.

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.174	0.171	0.166	0.152	0.125	0.110
Profits, Schedule C	0.026	0.025	0.025	0.024	0.025	0.026
Distributions, Schedule C	0.004	0.003	0.003	0.003	0.004	0.005
Distributions, other	0.094	0.094	0.094	0.093	0.092	0.091
Consumption	0.070	0.092	0.107	0.090	0.050	0.029
Labor inc. (net), by type	−0.021	−0.044	−0.062	−0.058	−0.045	−0.040
Low	−0.052	−0.054	−0.054	−0.051	−0.047	−0.046
Medium	−0.015	−0.026	−0.034	−0.033	−0.027	−0.025
High	0.035	0.025	0.016	0.016	0.018	0.020
Top 1 pct	0.012	0.010	0.009	0.010	0.010	0.010
Retiree transfers, by type	0.121	0.119	0.114	0.101	0.072	0.057
Low	0.046	0.045	0.043	0.038	0.028	0.022
Medium	0.048	0.048	0.046	0.040	0.029	0.023
High	0.025	0.025	0.024	0.021	0.015	0.012
Top 1 pct	0.001	0.001	0.001	0.001	0.001	0.001
Interest on debt	0.025	0.025	0.025	0.023	0.021	0.020
Labor income	0.584	0.587	0.588	0.587	0.584	0.581
Capital income	0.416	0.413	0.412	0.413	0.416	0.419
Consumption	0.749	0.737	0.725	0.730	0.748	0.761
Tangible investment	0.207	0.219	0.231	0.227	0.209	0.195
Intangible investment	0.133	0.138	0.141	0.138	0.132	0.127
Defense	0.044	0.044	0.044	0.044	0.044	0.044
Tangible capital	4.161	4.124	4.190	4.414	4.660	4.693
Intangible capital	1.729	1.724	1.742	1.793	1.844	1.841
LEVELS						
Interest rate	4.600	4.697	4.631	4.298	3.934	3.823
Wage rate	1.006	0.993	1.002	1.050	1.109	1.128
Labor input	0.979	1.008	1.034	1.030	0.997	0.979
GNP	0.987	0.999	1.031	1.079	1.110	1.113
Net worth	0.992	0.996	1.042	1.139	1.225	1.234

The next two tables show the transition paths for two alternative reforms. Table A19 reports the case with only Social Security phased out and Medicare payments left in household transfers. Not surprisingly, the transition paths are similar to the baseline and the changes in aggregate data are smaller by roughly 30–40 percent. Figure A6 shows the welfare gains in this case. For all productivity types, there is a gain to switching to the new policy.

Table A20 assumes that the debt to GNP ratio is equal to 1 in the current and future periods. Capital stocks rise by less than in the baseline case, but the higher debt levels make it easier to find a Pareto-improving transition. In fact, the welfare gains, which are displayed in Figure A7, do not fall below 0.6 percent for any birth-year cohort or type.

Results in Table A21 are based on the case with the more productive living longer than the less productive. The welfare gains in this case are displayed in Figure A8. If we

TABLE A16. Transitions from current U.S. policy to new policies: Social Security, Medicare, and FICA taxes phased out; nonmarginal employer benefits phased out.

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.172	0.169	0.165	0.152	0.126	0.111
Profits, Schedule C	0.026	0.025	0.025	0.025	0.026	0.026
Distributions, Schedule C	0.004	0.003	0.003	0.004	0.005	0.005
Distributions, other	0.094	0.094	0.094	0.093	0.092	0.092
Consumption	0.063	0.072	0.077	0.060	0.020	0.001
Labor inc. (net), by type	−0.014	−0.026	−0.035	−0.029	−0.017	−0.013
Low	−0.051	−0.051	−0.051	−0.048	−0.044	−0.043
Medium	−0.013	−0.019	−0.024	−0.021	−0.014	−0.012
High	0.038	0.033	0.029	0.029	0.031	0.031
Top 1 pct	0.012	0.011	0.010	0.010	0.010	0.010
Retiree transfers, by type	0.120	0.117	0.113	0.100	0.072	0.057
Low	0.046	0.045	0.043	0.038	0.027	0.021
Medium	0.048	0.047	0.045	0.040	0.029	0.023
High	0.025	0.025	0.024	0.021	0.015	0.012
Top 1 pct	0.001	0.001	0.001	0.001	0.001	0.001
Interest on debt	0.025	0.025	0.025	0.024	0.022	0.021
Labor income	0.585	0.587	0.587	0.586	0.582	0.580
Capital income	0.415	0.413	0.413	0.414	0.418	0.420
Consumption	0.744	0.739	0.733	0.737	0.757	0.764
Tangible investment	0.212	0.218	0.224	0.220	0.200	0.189
Intangible investment	0.135	0.137	0.139	0.136	0.128	0.125
Defense	0.044	0.044	0.044	0.044	0.044	0.044
Tangible capital	4.159	4.121	4.139	4.319	4.518	4.559
Intangible capital	1.730	1.723	1.728	1.768	1.808	1.814
LEVELS						
Interest rate	4.619	4.700	4.688	4.409	4.078	3.999
Wage rate	1.003	0.993	0.994	1.034	1.085	1.099
Labor input	0.990	1.022	1.053	1.053	1.022	1.006
GNP	0.994	1.013	1.044	1.089	1.116	1.116
Net worth	0.998	1.010	1.045	1.128	1.200	1.207

assume that the more productive live longer than the less productive, our predictions for the welfare gains are slightly higher for all but a few cohorts, and our predictions for the rise in GNP and household net worth are slightly lower than in the baseline. Overall, there is little difference between this case and the baseline case.

We experimented with two alternative choices for productivities over the life cycle. In the first, we use CPS data to construct family wage profiles and derive estimates of productivities over the life cycle. In the second, we use Hansen's (1993) productivity estimates, which are based on data for individual wages. Tables A22 and A23 report the transition paths for these experiments, and Figures A9 and A10 report the welfare results. In both cases, we find the results are surprisingly close to those of the baseline model that has constant profiles by type over the life cycle.

TABLE A17. Transitions from current U.S. policy to new policies: Social Security, Medicare, and FICA taxes phased out; worker net tax functions temporarily changed.

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.169	0.164	0.160	0.149	0.126	0.110
Profits, Schedule C	0.025	0.025	0.025	0.025	0.026	0.025
Distributions, Schedule C	0.003	0.003	0.003	0.004	0.005	0.005
Distributions, other	0.094	0.094	0.094	0.093	0.092	0.091
Consumption	0.055	0.050	0.047	0.030	0.015	0.029
Labor inc. (net), by type	−0.007	−0.008	−0.009	−0.003	−0.012	−0.040
Low	−0.052	−0.052	−0.053	−0.051	−0.048	−0.046
Medium	−0.008	−0.009	−0.009	−0.005	−0.010	−0.024
High	0.041	0.042	0.042	0.042	0.035	0.020
Top 1 pct	0.012	0.011	0.011	0.011	0.010	0.010
Retiree transfers, by type	0.118	0.114	0.108	0.096	0.071	0.057
Low	0.045	0.043	0.041	0.037	0.027	0.022
Medium	0.047	0.046	0.043	0.038	0.028	0.023
High	0.025	0.024	0.023	0.020	0.015	0.012
Top 1 pct	0.001	0.001	0.001	0.001	0.001	0.001
Interest on debt	0.025	0.025	0.025	0.023	0.022	0.020
Labor income	0.587	0.588	0.587	0.586	0.580	0.582
Capital income	0.413	0.412	0.413	0.414	0.420	0.418
Consumption	0.732	0.730	0.730	0.739	0.764	0.758
Tangible investment	0.224	0.226	0.227	0.218	0.193	0.196
Intangible investment	0.140	0.141	0.140	0.135	0.125	0.128
Defense	0.044	0.044	0.044	0.044	0.044	0.044
Tangible capital	4.166	4.155	4.177	4.335	4.475	4.729
Intangible capital	1.736	1.734	1.737	1.773	1.795	1.856
LEVELS						
Interest rate	4.648	4.678	4.636	4.386	4.112	3.828
Wage rate	0.999	0.995	0.999	1.038	1.081	1.128
Labor input	1.013	1.054	1.088	1.086	1.035	0.981
GNP	1.008	1.044	1.085	1.128	1.128	1.114
Net worth	1.015	1.049	1.094	1.172	1.202	1.244

We investigated the impact of assuming perfect annuity markets by first shutting them down and then allowing for intergenerational transfers. For the latter, we assume that each age cohort bequeaths 10 percent of their assets to family members 5 years younger. This choice is arbitrary because we do not have detailed data on intrafamily transfers, but the experiment allows us to test this channel of intertemporal smoothing. With the annuity markets shut down but no intrafamily transfers, there is a modest impact of policy on the welfare gains for future cohorts, which are between 1 and 3 percentage points higher than in the baseline. The full results of this experiment are displayed in Table A24 and Figure A11. The findings when we assume that families do not have access to annuity markets but do use intergenerational transfers and bequests are shown in Table A25 and Figure A12. In this case, the equilibrium outcomes are closer to the baseline estimates.

TABLE A18. Transitions from current U.S. policy to new policies: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed.

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.169	0.164	0.160	0.148	0.123	0.109
Profits, Schedule C	0.025	0.025	0.025	0.025	0.026	0.026
Distributions, Schedule C	0.003	0.003	0.003	0.004	0.005	0.005
Distributions, other	0.094	0.094	0.094	0.093	0.092	0.092
Consumption	0.055	0.050	0.047	0.029	−0.008	−0.025
Labor inc. (net), by type	−0.008	−0.008	−0.009	−0.003	0.008	0.010
Low	−0.052	−0.052	−0.053	−0.051	−0.047	−0.045
Medium	−0.008	−0.009	−0.009	−0.005	0.001	0.002
High	0.041	0.042	0.042	0.043	0.043	0.044
Top 1 pct	0.012	0.011	0.011	0.011	0.011	0.011
Retiree transfers, by type	0.118	0.114	0.108	0.096	0.069	0.054
Low	0.045	0.043	0.041	0.036	0.026	0.021
Medium	0.047	0.046	0.043	0.038	0.028	0.022
High	0.025	0.024	0.023	0.020	0.015	0.011
Top 1 pct	0.001	0.001	0.001	0.001	0.001	0.001
Interest on debt	0.025	0.025	0.025	0.023	0.022	0.021
Labor income	0.587	0.588	0.587	0.586	0.582	0.580
Capital income	0.413	0.412	0.413	0.414	0.418	0.420
Consumption	0.733	0.730	0.730	0.737	0.757	0.766
Tangible investment	0.224	0.226	0.227	0.220	0.199	0.188
Intangible investment	0.140	0.141	0.140	0.136	0.128	0.124
Defense	0.044	0.044	0.044	0.044	0.044	0.044
Tangible capital	4.166	4.151	4.172	4.338	4.494	4.527
Intangible capital	1.736	1.733	1.736	1.773	1.802	1.805
LEVELS						
Interest rate	4.648	4.681	4.643	4.379	4.108	4.025
Wage rate	0.999	0.995	1.000	1.038	1.080	1.094
Labor input	1.012	1.054	1.089	1.089	1.069	1.050
GNP	1.008	1.044	1.085	1.131	1.162	1.161
Net worth	1.014	1.048	1.093	1.176	1.243	1.249

We varied the parameter ζ governing the labor elasticity with the results shown in Tables A26 and A27 and Figures A13 and A14. As we discuss in the paper, the choice of ζ has important consequences for the overall increases in aggregate data, much as it does for business cycle predictions. Interestingly, however, the welfare plots in Figures A13 and A14 are not that different from the baseline case shown in Figure A5. There are some welfare losses when $\zeta = 5$ (and the elasticity is 0.5), but they are small relative to the huge gains for future cohorts.

We investigated the impact of including only national defense spending in our measure of G . The transition paths for these experiments are shown in Tables A28 and A29, and the welfare gains for the policy reform are shown in Figures A15 and A16. In our baseline parameterization, nondefense spending is included with private consumption because many of the goods and services purchased by the government are fairly sub-

TABLE A19. Transitions from current U.S. policy to new policies: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed; Medicare transfers not phased out.

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.170	0.165	0.162	0.158	0.149	0.143
Profits, Schedule C	0.025	0.025	0.025	0.026	0.027	0.027
Distributions, Schedule C	0.003	0.003	0.003	0.004	0.005	0.005
Distributions, other	0.094	0.094	0.094	0.093	0.093	0.093
Consumption	0.055	0.052	0.050	0.042	0.024	0.016
Labor inc. (net), by type	−0.008	−0.008	−0.010	−0.007	0.001	0.003
Low	−0.052	−0.053	−0.054	−0.053	−0.050	−0.049
Medium	−0.008	−0.009	−0.010	−0.007	−0.003	−0.002
High	0.041	0.042	0.042	0.042	0.043	0.043
Top 1 pct	0.012	0.011	0.011	0.011	0.011	0.011
Retiree transfers, by type	0.119	0.115	0.110	0.105	0.094	0.088
Low	0.045	0.044	0.042	0.040	0.036	0.033
Medium	0.047	0.046	0.044	0.042	0.038	0.035
High	0.025	0.024	0.023	0.022	0.020	0.018
Top 1 pct	0.001	0.001	0.001	0.001	0.001	0.001
Interest on debt	0.025	0.025	0.025	0.024	0.023	0.022
Labor income	0.587	0.588	0.587	0.584	0.580	0.579
Capital income	0.413	0.412	0.413	0.416	0.420	0.421
Consumption	0.733	0.733	0.734	0.748	0.765	0.774
Tangible investment	0.223	0.223	0.223	0.210	0.192	0.183
Intangible investment	0.139	0.140	0.138	0.132	0.125	0.122
Defense	0.044	0.044	0.044	0.044	0.044	0.044
Tangible capital	4.165	4.143	4.153	4.268	4.365	4.396
Intangible capital	1.735	1.731	1.731	1.754	1.770	1.774
LEVELS						
Interest rate	4.646	4.688	4.665	4.452	4.255	4.188
Wage rate	0.999	0.994	0.997	1.027	1.058	1.068
Labor input	1.011	1.051	1.083	1.072	1.044	1.024
GNP	1.008	1.041	1.078	1.105	1.114	1.107
Net worth	1.014	1.042	1.082	1.133	1.163	1.162

stitutable with goods and services purchased by households. To check this assumption, we recategorize some categories of spending that are less substitutable with private consumption—specifically, public order and safety and general public service—and include those categories along with defense spending in G . (See Table A28 and Figure A15.) We also ran an experiment recategorizing defense spending with other government spending. (See Table A29 and Figure A16.) The results in both cases are similar to the baseline case, with all types and cohorts benefiting from the policy reform and a significant increase in the wage rate, GNP, and household net worth.

We considered an alternative one-capital, one-sector model with the results shown in Table A30 and Figure A17. In this case, we needed to modify the net tax function to include more AGI bins. Because the piecewise linear net tax function allows for discon-

TABLE A20. Transitions from current U.S. policy to new policies: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (debt to GNP = 1).

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.176	0.173	0.170	0.159	0.134	0.121
Profits, Schedule C	0.026	0.025	0.025	0.025	0.026	0.027
Distributions, Schedule C	0.004	0.003	0.003	0.004	0.005	0.005
Distributions, other	0.094	0.094	0.094	0.094	0.093	0.093
Consumption	0.062	0.060	0.060	0.043	0.006	−0.010
Labor inc. (net), by type	−0.009	−0.010	−0.013	−0.007	0.004	0.006
Low	−0.051	−0.053	−0.054	−0.052	−0.048	−0.047
Medium	−0.009	−0.010	−0.011	−0.007	−0.001	−0.000
High	0.041	0.041	0.041	0.042	0.043	0.043
Top 1 pct	0.012	0.011	0.011	0.011	0.011	0.011
Retiree transfers, by type	0.119	0.115	0.110	0.098	0.071	0.056
Low	0.045	0.044	0.042	0.037	0.027	0.021
Medium	0.048	0.046	0.044	0.039	0.028	0.022
High	0.025	0.024	0.023	0.021	0.015	0.012
Top 1 pct	0.001	0.001	0.001	0.001	0.001	0.001
Interest on debt	0.047	0.047	0.047	0.045	0.042	0.042
Labor income	0.586	0.587	0.586	0.585	0.581	0.579
Capital income	0.414	0.413	0.414	0.415	0.419	0.421
Consumption	0.741	0.737	0.737	0.742	0.762	0.773
Tangible investment	0.215	0.219	0.219	0.215	0.194	0.184
Intangible investment	0.136	0.138	0.137	0.134	0.126	0.122
Defense	0.044	0.044	0.044	0.044	0.044	0.044
Tangible capital	4.117	4.091	4.096	4.257	4.393	4.411
Intangible capital	1.720	1.715	1.715	1.753	1.777	1.777
LEVELS						
Interest rate	4.693	4.745	4.738	4.488	4.220	4.163
Wage rate	1.006	0.998	1.000	1.035	1.076	1.087
Labor input	1.014	1.052	1.084	1.085	1.065	1.048
GNP	1.019	1.049	1.083	1.125	1.156	1.152
Net worth	1.007	1.031	1.065	1.139	1.198	1.196

tinuities, we had trouble computing the optimal household decision functions as they did not converge in the case that the United States continues its current policy. We added more AGI bins to help with convergence.⁵ Specifically, we replaced one AGI bin with five by linearly interpolating the slopes and intercepts of $\alpha_i + \beta_i y$ between income intervals for $i = 10$ and $i = 12$.

A comparison of Table A30 with Table A18 shows sizeable differences in magnitudes along the transition paths. First, the government budget financing is much different. For example, all tax revenues must be generated from Schedule C profits, consumption, and labor when we shut down the second sector. Second, with a smaller capital stock, interest rates are much lower and increases in aggregate variables are much smaller. In

⁵In this project, we use published data from the IRS. If we had the data for all tax returns, we could more precisely estimate the U.S. net tax function.

TABLE A21. Transitions from current U.S. policy to new policies: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (life expectancy depends on productivity).

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.169	0.166	0.162	0.151	0.125	0.110
Profits, Schedule C	0.025	0.025	0.025	0.025	0.026	0.026
Distributions, Schedule C	0.003	0.003	0.003	0.004	0.005	0.005
Distributions, other	0.094	0.094	0.094	0.093	0.092	0.092
Consumption	0.058	0.057	0.055	0.037	−0.001	−0.019
Labor inc. (net), by type	−0.012	−0.013	−0.014	−0.008	0.003	0.006
Low	−0.055	−0.056	−0.057	−0.055	−0.050	−0.049
Medium	−0.008	−0.009	−0.009	−0.005	0.001	0.002
High	0.040	0.041	0.041	0.042	0.042	0.043
Top 1 pct	0.011	0.011	0.011	0.011	0.010	0.010
Retiree transfers, by type	0.118	0.116	0.111	0.099	0.071	0.056
Low	0.042	0.044	0.043	0.039	0.028	0.022
Medium	0.048	0.046	0.044	0.039	0.028	0.022
High	0.027	0.024	0.022	0.020	0.014	0.011
Top 1 pct	0.001	0.001	0.001	0.001	0.001	0.001
Interest on debt	0.025	0.025	0.025	0.023	0.022	0.021
Labor income	0.586	0.588	0.588	0.586	0.582	0.580
Capital income	0.414	0.412	0.412	0.414	0.418	0.420
Consumption	0.737	0.730	0.729	0.737	0.757	0.767
Tangible investment	0.219	0.226	0.228	0.220	0.199	0.189
Intangible investment	0.138	0.141	0.140	0.136	0.128	0.125
Defense	0.044	0.044	0.044	0.044	0.044	0.044
Tangible capital	4.148	4.143	4.175	4.341	4.495	4.543
Intangible capital	1.729	1.731	1.737	1.774	1.802	1.810
LEVELS						
Interest rate	4.658	4.692	4.642	4.375	4.107	4.015
Wage rate	0.996	0.992	0.998	1.037	1.080	1.095
Labor input	1.016	1.051	1.081	1.080	1.060	1.042
GNP	1.007	1.034	1.073	1.116	1.148	1.149
Net worth	1.005	1.032	1.076	1.156	1.223	1.234

terms of welfare, this translates into much smaller gains from the policy reform for all but the top 1 percent of households. However, we were surprised to find that while there were some losses on the transition path, they were not large. In other words, including all capital available to retirees is important for the quantitative results, but less important for devising a Pareto-improving transition than we originally thought.

Because we introduced more AGI bins in the one-sector, one-capital model, we also reran our baseline parameterization with the modified net tax function so as to determine if we still generate a Pareto-improving transition. We find that we do. The results of this exercise are shown in Table A31 and Figure A18.

Finally, we added more productivity types so as to introduce a very low productivity type, one with a productivity level set so as to generate the same share of labor income

TABLE A22. Transitions from current U.S. policy to new policies: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (age-dependent productivities—CPS profiles).

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.162	0.157	0.153	0.143	0.119	0.105
Profits, Schedule C	0.025	0.025	0.025	0.025	0.026	0.026
Distributions, Schedule C	0.003	0.003	0.003	0.004	0.004	0.005
Distributions, other	0.094	0.094	0.094	0.093	0.092	0.092
Consumption	0.037	0.032	0.028	0.013	−0.019	−0.038
Labor inc. (net), by type	0.003	0.004	0.003	0.007	0.016	0.019
Low	−0.047	−0.048	−0.049	−0.047	−0.043	−0.042
Medium	−0.004	−0.003	−0.003	0.000	0.004	0.005
High	0.043	0.044	0.044	0.045	0.045	0.046
Top 1 pct	0.011	0.011	0.010	0.010	0.010	0.010
Retiree transfers, by type	0.111	0.107	0.102	0.090	0.065	0.051
Low	0.042	0.041	0.039	0.034	0.025	0.019
Medium	0.045	0.043	0.041	0.036	0.026	0.020
High	0.023	0.022	0.021	0.019	0.014	0.011
Top 1 pct	0.001	0.001	0.001	0.001	0.001	0.001
Interest on debt	0.025	0.025	0.025	0.023	0.022	0.021
Labor income	0.587	0.588	0.588	0.585	0.582	0.580
Capital income	0.413	0.412	0.412	0.415	0.418	0.420
Consumption	0.735	0.729	0.729	0.740	0.756	0.766
Tangible investment	0.221	0.228	0.228	0.217	0.201	0.190
Intangible investment	0.139	0.142	0.140	0.135	0.129	0.125
Defense	0.044	0.044	0.044	0.044	0.044	0.044
Tangible capital	4.166	4.145	4.171	4.326	4.493	4.558
Intangible capital	1.735	1.732	1.736	1.769	1.803	1.812
LEVELS						
Interest rate	4.641	4.696	4.649	4.387	4.115	3.987
Wage rate	0.997	0.990	0.996	1.034	1.076	1.097
Labor input	1.015	1.063	1.100	1.095	1.073	1.056
GNP	1.009	1.047	1.091	1.132	1.161	1.169
Net worth	1.011	1.046	1.095	1.170	1.238	1.260

as that of U.S. families in the lowest AGI bracket of our sample (with either no AGI or AGI less than \$5000 in 2004 dollars). The average per capita compensation for this group is only \$1200, much lower than what they receive in government transfers. If we use the same net tax schedule and retiree transfers as we did in the baseline case (corresponding to Figure A5), we again find a Pareto-improving transition for all existing and future cohorts. All families prefer to switch policies, even those with very low per capita earnings. The results of the experiment are shown in Table A32 and Figure A19.

TABLE A23. Transitions from current U.S. policy to new policies: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (age-dependent productivities—Hansen).

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.173	0.167	0.163	0.150	0.124	0.110
Profits, Schedule C	0.026	0.026	0.026	0.026	0.027	0.028
Distributions, Schedule C	0.004	0.004	0.004	0.004	0.005	0.006
Distributions, other	0.095	0.095	0.095	0.094	0.094	0.094
Consumption	0.058	0.052	0.049	0.029	−0.009	−0.028
Labor inc. (net), by type	−0.010	−0.010	−0.011	−0.004	0.008	0.011
Low	−0.052	−0.053	−0.054	−0.051	−0.047	−0.045
Medium	−0.009	−0.009	−0.010	−0.005	0.000	0.002
High	0.039	0.041	0.041	0.042	0.043	0.044
Top 1 pct	0.012	0.011	0.011	0.011	0.011	0.010
Retiree transfers, by type	0.120	0.115	0.109	0.096	0.069	0.054
Low	0.045	0.044	0.042	0.037	0.026	0.020
Medium	0.048	0.046	0.044	0.039	0.028	0.022
High	0.025	0.024	0.023	0.020	0.014	0.011
Top 1 pct	0.001	0.001	0.001	0.001	0.001	0.001
Interest on debt	0.027	0.027	0.027	0.025	0.024	0.023
Labor income	0.585	0.586	0.585	0.583	0.580	0.577
Capital income	0.415	0.414	0.415	0.417	0.420	0.423
Consumption	0.744	0.743	0.744	0.749	0.766	0.776
Tangible investment	0.212	0.213	0.213	0.207	0.191	0.178
Intangible investment	0.135	0.135	0.134	0.131	0.124	0.120
Defense	0.044	0.044	0.044	0.044	0.044	0.044
Tangible capital	3.933	3.914	3.929	4.068	4.233	4.261
Intangible capital	1.672	1.667	1.669	1.701	1.736	1.737
LEVELS						
Interest rate	4.980	5.007	4.977	4.729	4.424	4.330
Wage rate	0.992	0.989	0.992	1.025	1.070	1.082
Labor input	1.012	1.055	1.090	1.100	1.089	1.074
GNP	0.997	1.036	1.076	1.126	1.170	1.172
Net worth	1.014	1.049	1.092	1.175	1.261	1.270

TABLE A24. Transitions from current U.S. policy to new policies: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (no annuity markets).

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.145	0.142	0.138	0.121	0.083	0.064
Profits, Schedule C	0.027	0.027	0.027	0.027	0.028	0.028
Distributions, Schedule C	0.004	0.004	0.004	0.004	0.005	0.006
Distributions, other	0.095	0.095	0.096	0.095	0.094	0.094
Consumption	0.041	0.041	0.038	0.016	−0.037	−0.058
Labor inc. (net), by type	−0.023	−0.025	−0.027	−0.021	−0.008	−0.006
Low	−0.057	−0.058	−0.060	−0.057	−0.052	−0.051
Medium	−0.015	−0.016	−0.017	−0.013	−0.007	−0.006
High	0.037	0.039	0.039	0.039	0.041	0.041
Top 1 pct	0.011	0.011	0.011	0.011	0.011	0.011
Retiree transfers, by type	0.128	0.124	0.119	0.106	0.076	0.060
Low	0.049	0.047	0.045	0.040	0.029	0.023
Medium	0.051	0.050	0.048	0.042	0.030	0.024
High	0.027	0.026	0.025	0.022	0.016	0.013
Top 1 pct	0.001	0.001	0.001	0.001	0.001	0.001
Interest on debt	0.027	0.027	0.027	0.026	0.024	0.024
Labor income	0.583	0.584	0.583	0.581	0.579	0.577
Capital income	0.417	0.416	0.417	0.419	0.421	0.423
Consumption	0.753	0.751	0.751	0.755	0.771	0.790
Tangible investment	0.204	0.206	0.205	0.201	0.185	0.173
Intangible investment	0.131	0.132	0.131	0.128	0.122	0.118
Defense	0.044	0.044	0.044	0.044	0.044	0.044
Tangible capital	3.894	3.858	3.849	3.974	4.120	4.154
Intangible capital	1.659	1.650	1.645	1.675	1.706	1.714
LEVELS						
Interest rate	5.011	5.076	5.083	4.849	4.560	4.504
Wage rate	1.007	0.999	0.997	1.028	1.071	1.080
Labor input	1.013	1.050	1.084	1.087	1.075	1.056
GNP	1.019	1.047	1.081	1.120	1.160	1.152
Net worth	1.007	1.026	1.057	1.124	1.198	1.198

TABLE A25. Transitions from current U.S. policy to new policies: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (intergenerational transfers included).

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.103	0.099	0.096	0.080	0.043	0.025
Profits, Schedule C	0.024	0.024	0.024	0.025	0.025	0.026
Distributions, Schedule C	0.003	0.003	0.003	0.003	0.004	0.005
Distributions, other	0.093	0.094	0.094	0.093	0.092	0.092
Consumption	0.023	0.018	0.014	−0.006	−0.051	−0.075
Labor inc. (net), by type	−0.040	−0.039	−0.040	−0.034	−0.027	−0.024
Low	−0.053	−0.054	−0.055	−0.052	−0.049	−0.047
Medium	−0.022	−0.021	−0.020	−0.016	−0.012	−0.011
High	0.025	0.027	0.027	0.026	0.026	0.027
Top 1 pct	0.009	0.009	0.008	0.008	0.008	0.007
Retiree transfers, by type	0.089	0.085	0.081	0.068	0.039	0.023
Low	0.045	0.043	0.041	0.037	0.027	0.021
Medium	0.037	0.036	0.034	0.029	0.017	0.011
High	0.008	0.008	0.007	0.004	−0.002	−0.006
Top 1 pct	−0.002	−0.002	−0.002	−0.002	−0.002	−0.002
Interest on debt	0.024	0.024	0.024	0.023	0.021	0.021
Labor income	0.588	0.589	0.588	0.586	0.583	0.580
Capital income	0.412	0.411	0.412	0.414	0.417	0.420
Consumption	0.729	0.728	0.727	0.734	0.754	0.763
Tangible investment	0.227	0.229	0.229	0.223	0.203	0.189
Intangible investment	0.141	0.142	0.141	0.137	0.130	0.124
Defense	0.044	0.044	0.044	0.044	0.044	0.044
Tangible capital	4.284	4.250	4.254	4.426	4.569	4.552
Intangible capital	1.766	1.759	1.758	1.795	1.822	1.806
LEVELS						
Interest rate	4.487	4.545	4.536	4.270	4.028	3.963
Wage rate	0.999	0.992	0.993	1.033	1.070	1.081
Labor input	1.008	1.052	1.089	1.086	1.063	1.054
GNP	1.006	1.040	1.079	1.123	1.146	1.153
Net worth	1.011	1.039	1.078	1.159	1.214	1.216

TABLE A26. Transitions from current U.S. policy to new policies: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (labor elasticity cut by 5).

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.176	0.174	0.172	0.161	0.134	0.117
Profits, Schedule C	0.026	0.026	0.026	0.026	0.026	0.027
Distributions, Schedule C	0.004	0.004	0.004	0.004	0.005	0.005
Distributions, other	0.094	0.094	0.094	0.094	0.093	0.093
Consumption	0.066	0.071	0.075	0.061	0.024	0.004
Labor inc. (net), by type	−0.015	−0.021	−0.027	−0.024	−0.015	−0.012
Low	−0.050	−0.054	−0.057	−0.055	−0.052	−0.051
Medium	−0.011	−0.012	−0.013	−0.012	−0.008	−0.006
High	0.036	0.035	0.033	0.033	0.035	0.036
Top 1 pct	0.010	0.010	0.010	0.010	0.010	0.010
Retiree transfers, by type	0.123	0.121	0.119	0.107	0.079	0.062
Low	0.047	0.046	0.045	0.041	0.030	0.024
Medium	0.049	0.049	0.048	0.043	0.032	0.025
High	0.026	0.026	0.025	0.023	0.017	0.013
Top 1 pct	0.001	0.001	0.001	0.001	0.001	0.001
Interest on debt	0.025	0.025	0.025	0.024	0.023	0.022
Labor income	0.584	0.584	0.585	0.583	0.581	0.579
Capital income	0.416	0.416	0.415	0.417	0.419	0.421
Consumption	0.749	0.747	0.744	0.750	0.763	0.774
Tangible investment	0.208	0.209	0.212	0.207	0.194	0.183
Intangible investment	0.133	0.134	0.134	0.131	0.126	0.122
Defense	0.044	0.044	0.044	0.044	0.044	0.044
Tangible capital	4.115	4.082	4.087	4.193	4.351	4.403
Intangible capital	1.717	1.709	1.711	1.733	1.766	1.774
LEVELS						
Interest rate	4.669	4.723	4.725	4.541	4.273	4.163
Wage rate	1.008	1.001	1.001	1.027	1.068	1.085
Labor input	0.979	0.992	1.004	0.995	0.962	0.942
GNP	0.986	0.991	1.003	1.023	1.032	1.030
Net worth	0.961	0.960	0.972	1.011	1.052	1.060

TABLE A27. Transitions from current U.S. policy to new policies: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (labor elasticity cut by 2).

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.174	0.171	0.166	0.154	0.127	0.113
Profits, Schedule C	0.026	0.026	0.026	0.025	0.026	0.027
Distributions, Schedule C	0.004	0.004	0.004	0.004	0.005	0.005
Distributions, other	0.094	0.094	0.094	0.094	0.093	0.092
Consumption	0.065	0.064	0.062	0.045	0.007	−0.011
Labor inc. (net), by type	−0.015	−0.017	−0.019	−0.013	−0.003	0.000
Low	−0.052	−0.054	−0.056	−0.053	−0.050	−0.048
Medium	−0.010	−0.011	−0.011	−0.008	−0.004	−0.003
High	0.036	0.037	0.037	0.038	0.041	0.041
Top 1 pct	0.011	0.011	0.010	0.010	0.010	0.010
Retiree transfers, by type	0.122	0.119	0.114	0.102	0.074	0.058
Low	0.046	0.045	0.043	0.039	0.028	0.022
Medium	0.049	0.048	0.046	0.041	0.029	0.023
High	0.026	0.025	0.024	0.021	0.015	0.012
Top 1 pct	0.001	0.001	0.001	0.001	0.001	0.001
Interest on debt	0.025	0.025	0.025	0.024	0.022	0.022
Labor income	0.585	0.586	0.586	0.585	0.581	0.579
Capital income	0.415	0.414	0.414	0.415	0.419	0.421
Consumption	0.743	0.740	0.737	0.740	0.758	0.770
Tangible investment	0.213	0.216	0.219	0.216	0.198	0.186
Intangible investment	0.136	0.137	0.137	0.135	0.128	0.123
Defense	0.044	0.044	0.044	0.044	0.044	0.044
Tangible capital	4.125	4.086	4.098	4.262	4.462	4.471
Intangible capital	1.722	1.713	1.715	1.753	1.794	1.791
LEVELS						
Interest rate	4.673	4.744	4.728	4.473	4.139	4.089
Wage rate	1.006	0.997	0.999	1.035	1.086	1.096
Labor input	0.996	1.029	1.057	1.056	1.024	1.007
GNP	1.000	1.022	1.053	1.092	1.118	1.112
Net worth	0.967	0.980	1.012	1.084	1.152	1.147

TABLE A28. Transitions from current U.S. policy to new policies: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (more spending categories included in *G*).

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.196	0.190	0.186	0.175	0.148	0.133
Profits, Schedule C	0.025	0.025	0.025	0.025	0.026	0.026
Distributions, Schedule C	0.003	0.003	0.003	0.004	0.005	0.005
Distributions, other	0.094	0.094	0.094	0.093	0.092	0.092
Consumption	0.056	0.050	0.046	0.030	−0.006	−0.025
Labor inc. (net), by type	0.018	0.018	0.018	0.022	0.031	0.034
Low	−0.042	−0.042	−0.043	−0.041	−0.037	−0.036
Medium	0.002	0.002	0.002	0.005	0.010	0.011
High	0.046	0.047	0.047	0.047	0.047	0.048
Top 1 pct	0.012	0.011	0.011	0.011	0.011	0.011
Retiree transfers, by type	0.111	0.106	0.101	0.089	0.060	0.045
Low	0.042	0.040	0.038	0.034	0.023	0.017
Medium	0.044	0.042	0.040	0.035	0.024	0.018
High	0.023	0.022	0.021	0.019	0.013	0.009
Top 1 pct	0.001	0.001	0.001	0.001	0.001	0.000
Interest on debt	0.025	0.025	0.025	0.024	0.022	0.022
Labor income	0.587	0.588	0.587	0.586	0.582	0.580
Capital income	0.413	0.412	0.413	0.414	0.418	0.420
Consumption	0.701	0.700	0.699	0.709	0.725	0.739
Tangible investment	0.222	0.224	0.224	0.215	0.199	0.188
Intangible investment	0.139	0.140	0.138	0.134	0.128	0.124
Defense	0.077	0.077	0.077	0.077	0.077	0.077
Tangible capital	4.109	4.099	4.123	4.262	4.438	4.520
Intangible capital	1.721	1.719	1.723	1.752	1.787	1.806
LEVELS						
Interest rate	4.730	4.752	4.710	4.464	4.168	4.056
Wage rate	0.996	0.993	0.998	1.036	1.081	1.099
Labor input	1.015	1.057	1.090	1.087	1.070	1.051
GNP	1.004	1.042	1.082	1.122	1.159	1.162
Net worth	1.016	1.052	1.098	1.170	1.249	1.270

TABLE A29. Transitions from current U.S. policy to new policies: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (fewer spending categories included in *G*).

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.140	0.135	0.130	0.120	0.095	0.082
Profits, Schedule C	0.024	0.025	0.025	0.025	0.025	0.026
Distributions, Schedule C	0.003	0.003	0.003	0.004	0.004	0.005
Distributions, other	0.094	0.094	0.094	0.093	0.092	0.092
Consumption	0.056	0.053	0.050	0.032	−0.006	−0.023
Labor inc. (net), by type	−0.037	−0.039	−0.041	−0.034	−0.020	−0.017
Low	−0.063	−0.065	−0.066	−0.063	−0.058	−0.057
Medium	−0.021	−0.022	−0.023	−0.019	−0.011	−0.010
High	0.035	0.037	0.037	0.037	0.038	0.039
Top 1 pct	0.012	0.012	0.011	0.011	0.011	0.011
Retiree transfers, by type	0.127	0.123	0.117	0.105	0.080	0.066
Low	0.048	0.047	0.044	0.040	0.030	0.025
Medium	0.051	0.049	0.047	0.042	0.032	0.026
High	0.027	0.026	0.025	0.022	0.017	0.014
Top 1 pct	0.001	0.001	0.001	0.001	0.001	0.001
Interest on debt	0.024	0.025	0.024	0.023	0.022	0.021
Labor income	0.588	0.588	0.588	0.585	0.582	0.580
Capital income	0.412	0.412	0.412	0.415	0.418	0.420
Consumption	0.764	0.768	0.766	0.774	0.790	0.804
Tangible investment	0.230	0.227	0.228	0.220	0.203	0.192
Intangible investment	0.142	0.141	0.140	0.136	0.130	0.126
Defense	0.006	0.006	0.006	0.006	0.006	0.006
Tangible capital	4.220	4.206	4.216	4.361	4.544	4.614
Intangible capital	1.751	1.748	1.748	1.778	1.814	1.830
LEVELS						
Interest rate	4.586	4.607	4.584	4.345	4.051	3.960
Wage rate	0.994	0.992	0.995	1.029	1.075	1.089
Labor input	1.018	1.053	1.089	1.091	1.074	1.054
GNP	1.008	1.041	1.080	1.124	1.162	1.160
Net worth	1.020	1.051	1.093	1.168	1.249	1.262

TABLE A30. Transitions from current U.S. policy to new policies: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (one-sector, one-capital model).

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.156	0.154	0.151	0.143	0.119	0.105
Profits, Schedule C	0.051	0.051	0.052	0.051	0.049	0.048
Distributions, Schedule C	0.000	0.000	0.000	0.000	0.000	0.000
Distributions, other	0.000	0.000	0.000	0.000	0.000	0.000
Consumption	0.087	0.083	0.077	0.068	0.039	0.024
Labor inc. (net), by type	0.018	0.020	0.022	0.024	0.031	0.034
Low	−0.047	−0.048	−0.049	−0.048	−0.046	−0.045
Medium	0.003	0.004	0.005	0.006	0.009	0.010
High	0.048	0.050	0.053	0.054	0.056	0.056
Top 1 pct	0.014	0.014	0.013	0.013	0.012	0.012
Retiree transfers, by type	0.111	0.108	0.104	0.095	0.070	0.055
Low	0.042	0.041	0.040	0.036	0.027	0.021
Medium	0.044	0.043	0.042	0.038	0.028	0.022
High	0.023	0.023	0.022	0.020	0.015	0.012
Top 1 pct	0.001	0.001	0.001	0.001	0.001	0.001
Interest on debt	0.019	0.019	0.019	0.018	0.017	0.017
Labor income	0.670	0.670	0.670	0.670	0.670	0.670
Capital income	0.330	0.330	0.330	0.330	0.330	0.330
Consumption	0.681	0.693	0.694	0.699	0.705	0.710
Tangible investment	0.276	0.264	0.263	0.256	0.251	0.246
Intangible investment	0.001	0.001	0.001	0.001	0.001	0.001
Defense	0.044	0.044	0.044	0.044	0.044	0.044
Tangible capital	3.028	3.020	2.977	3.019	3.108	3.138
Intangible capital	0.011	0.011	0.011	0.011	0.011	0.011
LEVELS						
Interest rate	3.558	3.564	3.637	3.462	3.238	3.180
Wage rate	1.004	1.003	0.999	1.010	1.026	1.031
Labor input	1.005	1.028	1.065	1.067	1.053	1.042
GNP	1.010	1.033	1.065	1.079	1.081	1.074
Net worth	1.023	1.044	1.063	1.089	1.118	1.120

TABLE A31. Transitions from current U.S. policy to new policies: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (more AGI bins for net tax function).

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.165	0.161	0.158	0.149	0.123	0.109
Profits, Schedule C	0.024	0.024	0.025	0.025	0.026	0.026
Distributions, Schedule C	0.003	0.003	0.003	0.004	0.005	0.005
Distributions, other	0.093	0.093	0.094	0.093	0.092	0.092
Consumption	0.052	0.047	0.044	0.029	−0.007	−0.025
Labor inc. (net), by type	−0.007	−0.006	−0.008	−0.003	0.008	0.010
Low	−0.050	−0.051	−0.052	−0.051	−0.047	−0.046
Medium	−0.007	−0.006	−0.007	−0.005	0.000	0.001
High	0.037	0.039	0.040	0.042	0.044	0.045
Top 1 pct	0.012	0.012	0.011	0.011	0.011	0.011
Retiree transfers, by type	0.115	0.111	0.107	0.096	0.070	0.055
Low	0.044	0.042	0.041	0.037	0.026	0.021
Medium	0.046	0.045	0.043	0.038	0.028	0.022
High	0.024	0.023	0.023	0.020	0.015	0.011
Top 1 pct	0.001	0.001	0.001	0.001	0.001	0.001
Interest on debt	0.024	0.024	0.024	0.023	0.022	0.022
Labor income	0.588	0.588	0.586	0.585	0.581	0.580
Capital income	0.412	0.412	0.414	0.415	0.419	0.420
Consumption	0.728	0.731	0.735	0.741	0.759	0.769
Tangible investment	0.228	0.225	0.221	0.216	0.198	0.188
Intangible investment	0.142	0.141	0.138	0.135	0.128	0.124
Defense	0.044	0.044	0.044	0.044	0.044	0.044
Tangible capital	4.318	4.280	4.252	4.347	4.467	4.523
Intangible capital	1.775	1.764	1.754	1.775	1.796	1.808
LEVELS						
Interest rate	4.444	4.482	4.506	4.360	4.141	4.057
Wage rate	0.999	0.993	0.990	1.011	1.045	1.059
Labor input	1.010	1.043	1.072	1.077	1.062	1.044
GNP	1.005	1.033	1.061	1.091	1.118	1.118
Net worth	1.010	1.031	1.052	1.101	1.153	1.164

TABLE A32. Transitions from current U.S. policy to new policies: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (seven productivity levels).

	2011–20	2021–30	2031–40	2041–70	2071–99	∞
SHARES OF GNP						
Tax revenues (net)	0.170	0.166	0.164	0.153	0.127	0.112
Profits, Schedule C	0.024	0.024	0.025	0.025	0.026	0.027
Distributions, Schedule C	0.003	0.003	0.003	0.004	0.005	0.005
Distributions, other	0.093	0.093	0.094	0.093	0.092	0.092
Consumption	0.059	0.055	0.055	0.039	0.002	–0.015
Labor inc. (net), by type	–0.010	–0.010	–0.013	–0.008	0.001	0.003
Very low	–0.028	–0.029	–0.029	–0.029	–0.027	–0.026
:	–0.022	–0.023	–0.024	–0.023	–0.022	–0.021
:	–0.011	–0.012	–0.013	–0.011	–0.008	–0.008
:	0.002	0.003	0.003	0.004	0.005	0.006
:	0.019	0.019	0.019	0.020	0.022	0.022
:	0.019	0.020	0.020	0.020	0.021	0.021
Top 1 pct	0.012	0.012	0.012	0.011	0.011	0.011
Retiree transfers, by type	0.120	0.116	0.112	0.101	0.073	0.058
Very low	0.023	0.022	0.021	0.019	0.014	0.011
:	0.023	0.022	0.021	0.019	0.014	0.011
:	0.024	0.023	0.022	0.020	0.015	0.012
:	0.024	0.023	0.022	0.020	0.015	0.012
:	0.018	0.017	0.017	0.015	0.011	0.009
:	0.007	0.007	0.007	0.006	0.004	0.003
Top 1 pct	0.001	0.001	0.001	0.001	0.001	0.001
Interest on debt	0.024	0.024	0.024	0.023	0.022	0.022
Labor income	0.588	0.588	0.586	0.585	0.581	0.579
Capital income	0.412	0.412	0.414	0.415	0.419	0.421
Consumption	0.727	0.731	0.737	0.739	0.759	0.770
Tangible investment	0.229	0.225	0.219	0.217	0.197	0.186
Intangible investment	0.142	0.140	0.137	0.135	0.128	0.124
Defense	0.044	0.044	0.044	0.044	0.044	0.044
Tangible capital	4.295	4.281	4.253	4.347	4.482	4.482
Intangible capital	1.769	1.764	1.754	1.774	1.798	1.795
LEVELS						
Interest rate	4.478	4.481	4.497	4.355	4.114	4.084
Wage rate	0.999	0.999	0.997	1.018	1.054	1.059
Labor input	1.012	1.037	1.061	1.069	1.045	1.031
GNP	1.006	1.031	1.055	1.087	1.108	1.102
Net worth	1.012	1.035	1.052	1.104	1.153	1.146

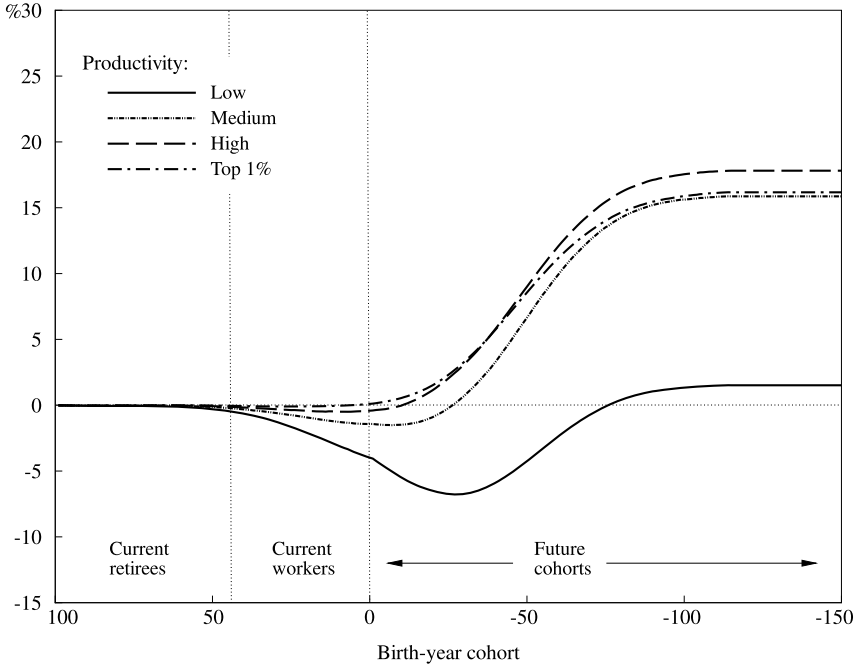


FIGURE A1. Percentage welfare gains by age cohort and productivity type: Social Security, Medicare, and FICA taxes phased out; taxes and transfers phased out at the same rate.

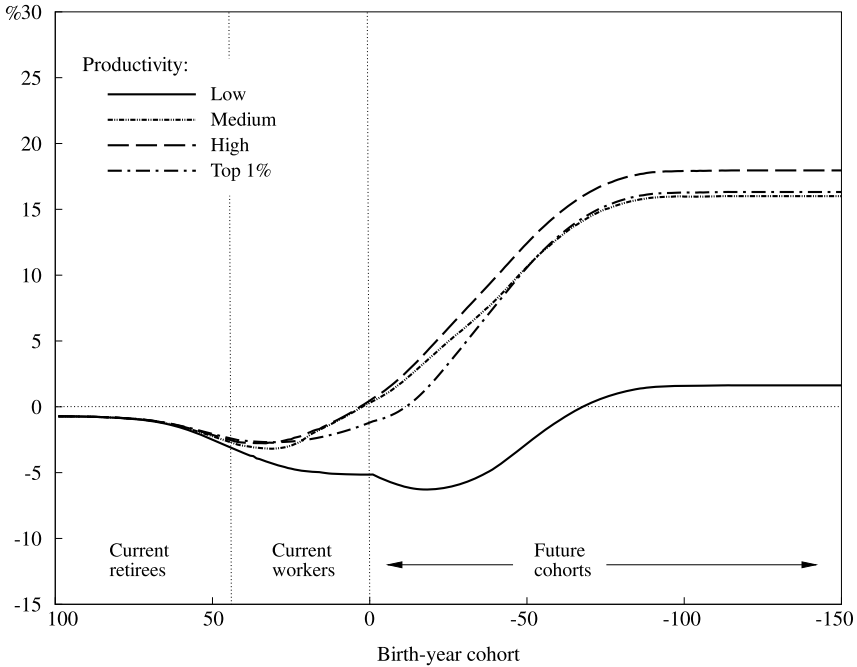


FIGURE A2. Percentage welfare gains by age cohort and baseline AGI: Social Security, Medicare, and FICA taxes phased out; taxes phased out more quickly than transfers.

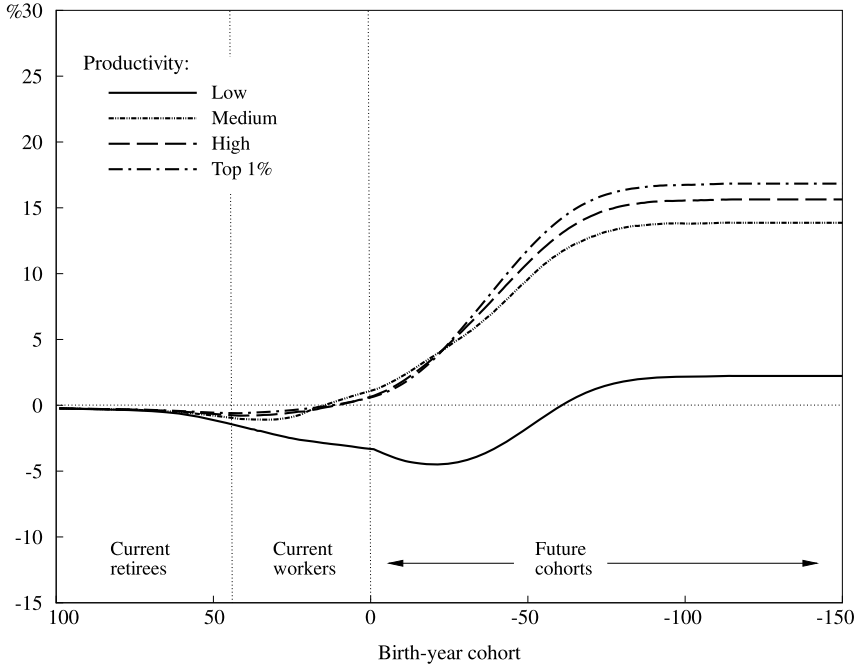


FIGURE A3. Percentage welfare gains by age cohort and baseline AGI: Social Security, Medicare, and FICA taxes phased out; nonmarginal employer benefits phased out.

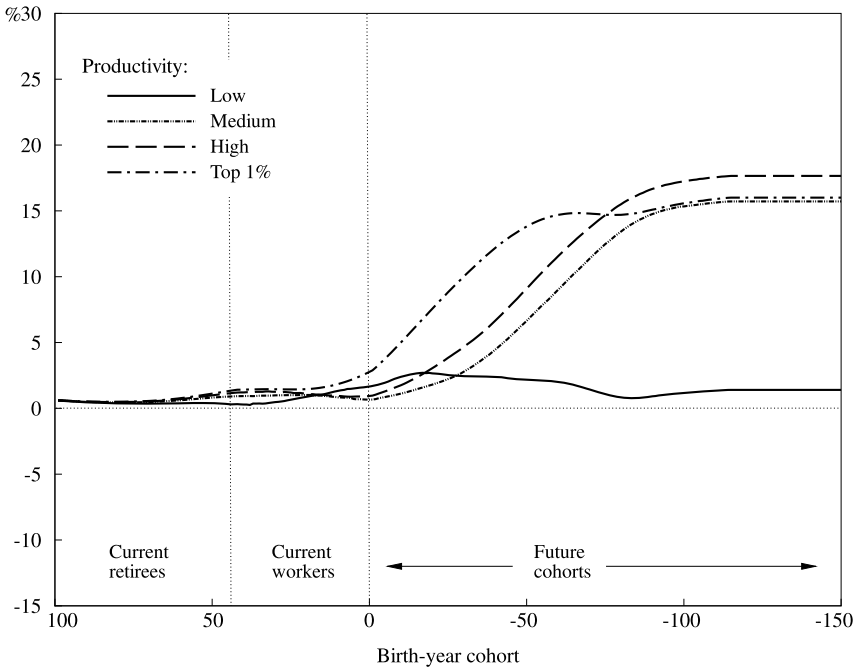


FIGURE A4. Percentage welfare gains by age cohort and baseline AGI: Social Security, Medicare, and FICA taxes phased out; worker net tax functions temporarily changed.

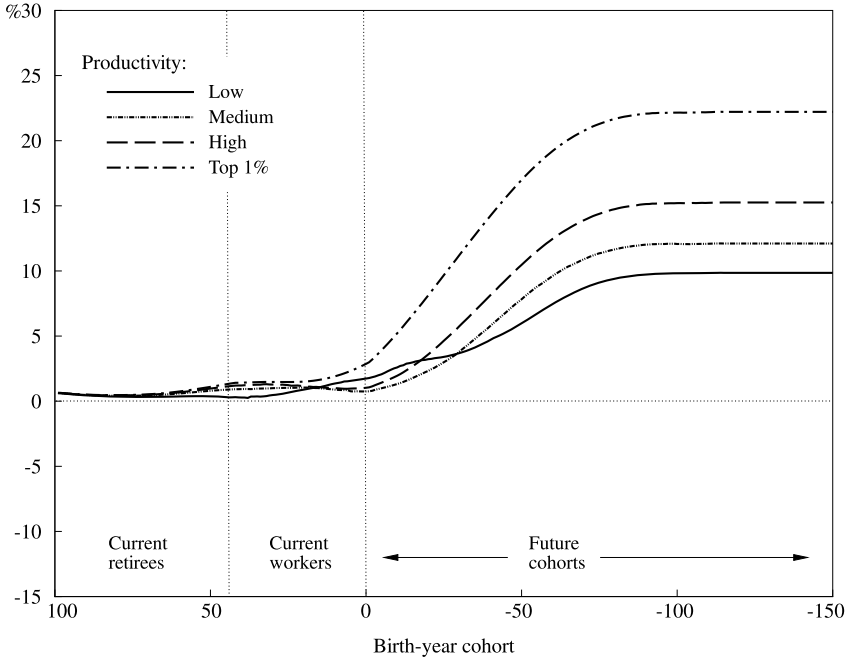


FIGURE A5. Percentage welfare gains by age cohort and baseline AGI: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed.

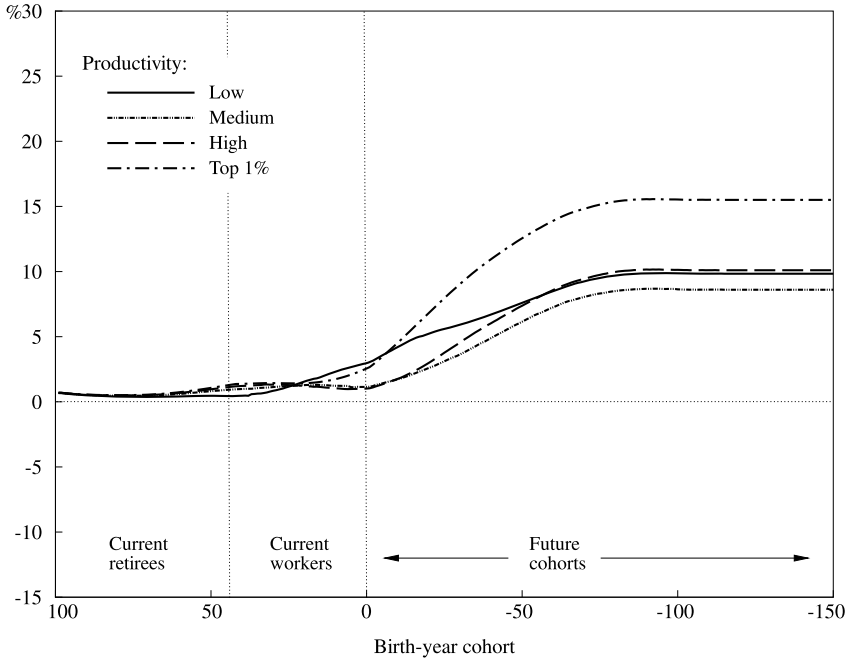


FIGURE A6. Percentage welfare gains by age cohort and baseline AGI: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (Medicare transfers not phased out).

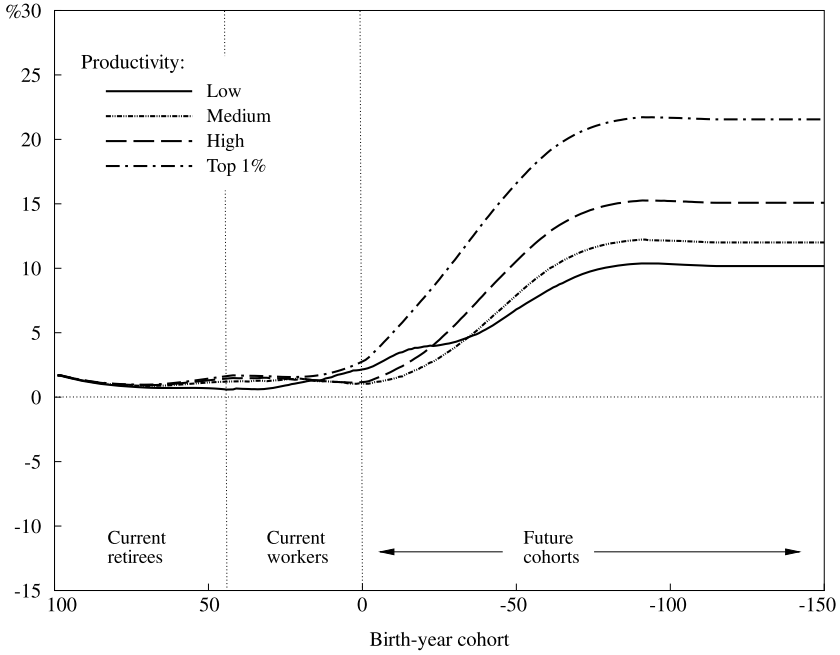


FIGURE A7. Percentage welfare gains by age cohort and baseline AGI: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (debt to GNP = 1).

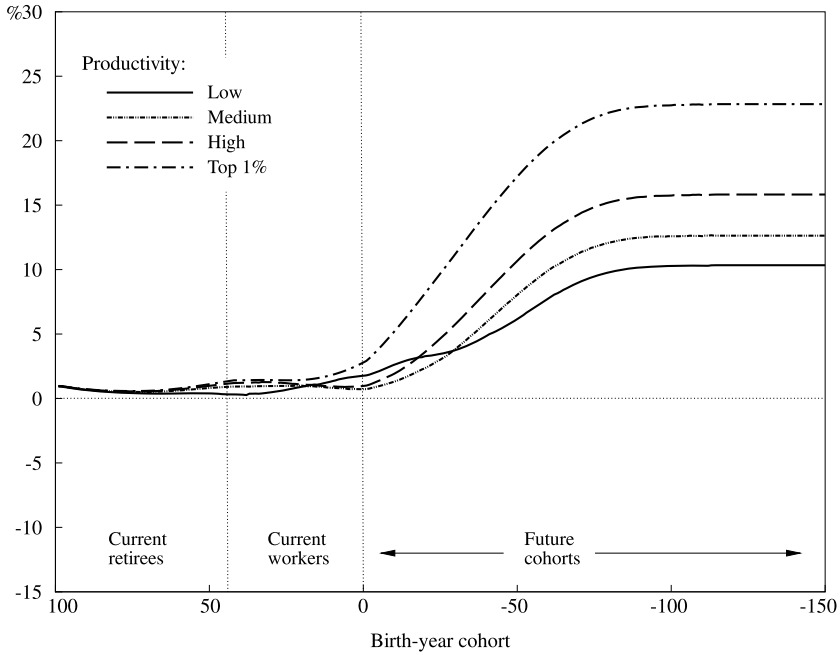


FIGURE A8. Percentage welfare gains by age cohort and baseline AGI: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (life expectancy depends on productivity).

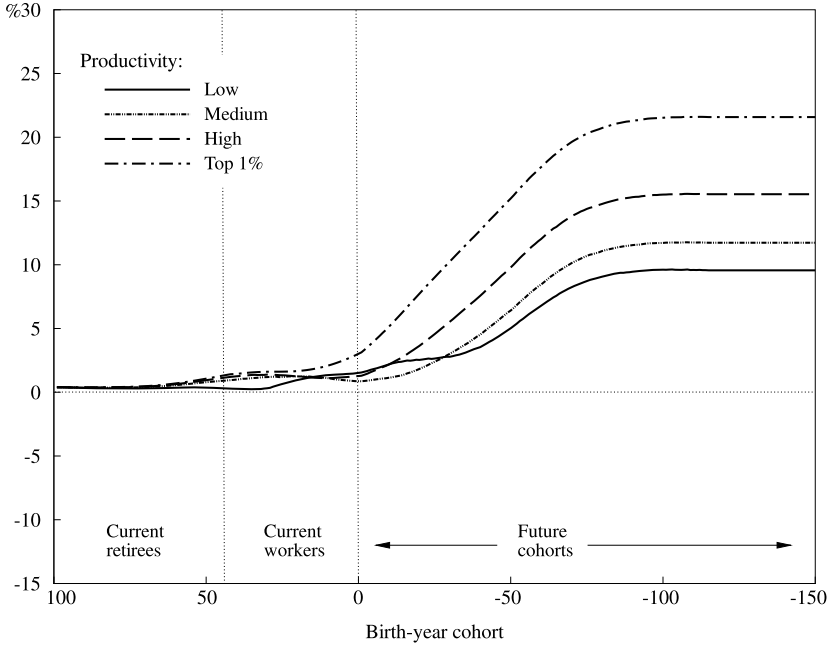


FIGURE A9. Percentage welfare gains by age cohort and baseline AGI: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (age-dependent productivities—CPS profiles).

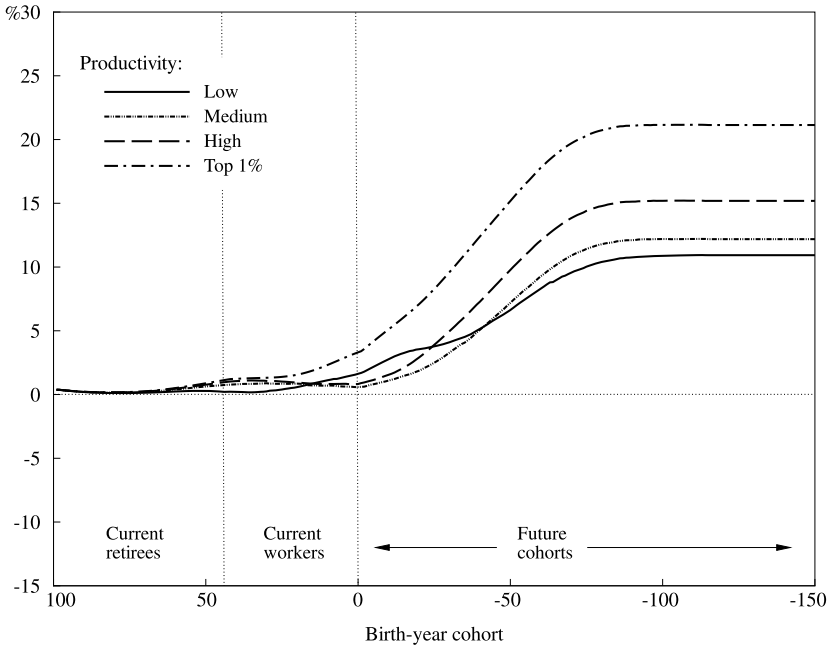


FIGURE A10. Percentage welfare gains by age cohort and baseline AGI: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (age-dependent productivities—Hansen (1993)).

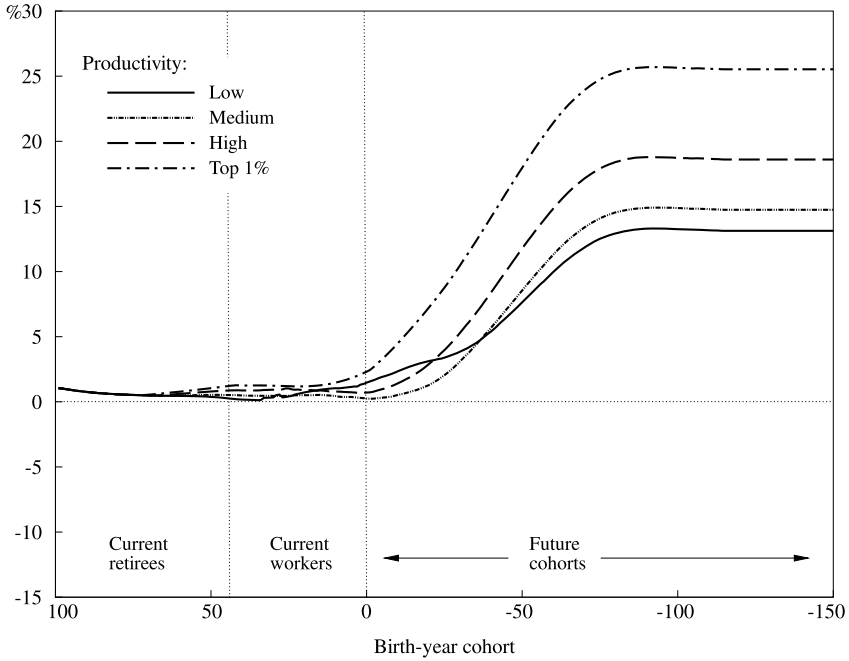


FIGURE A11. Percentage welfare gains by age cohort and baseline AGI: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (no annuity markets).

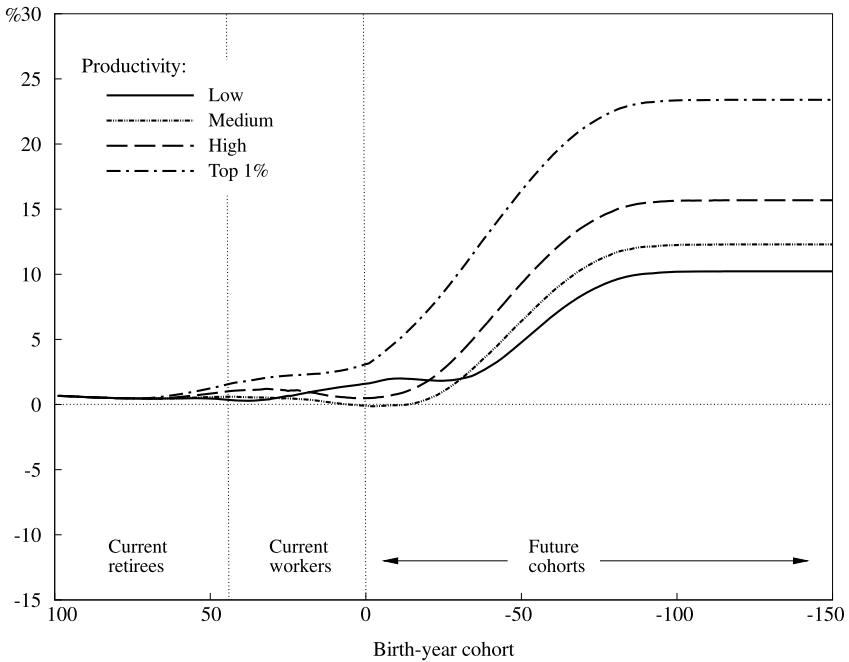


FIGURE A12. Percentage welfare gains by age cohort and baseline AGI: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (intergenerational transfers included).

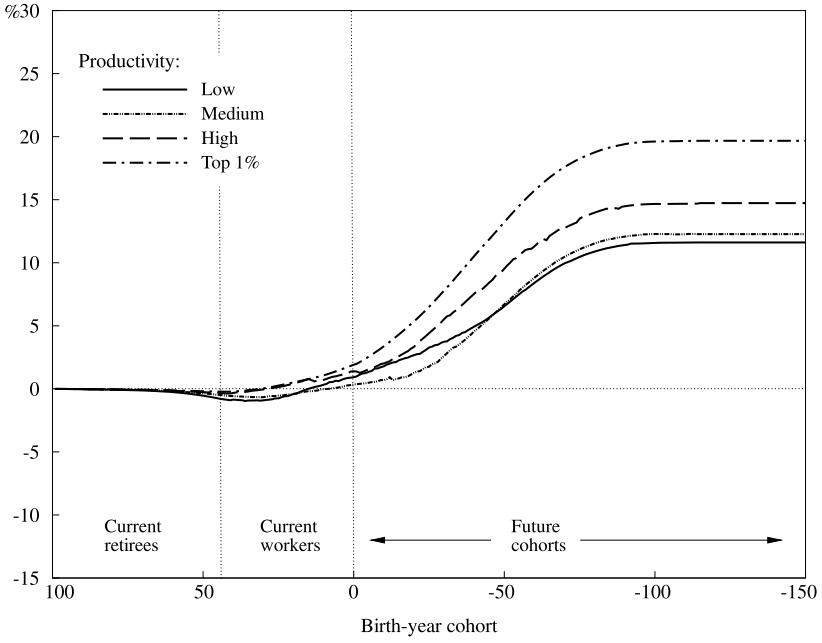


FIGURE A13. Percentage welfare gains by age cohort and baseline AGI: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (labor elasticity cut by 5).

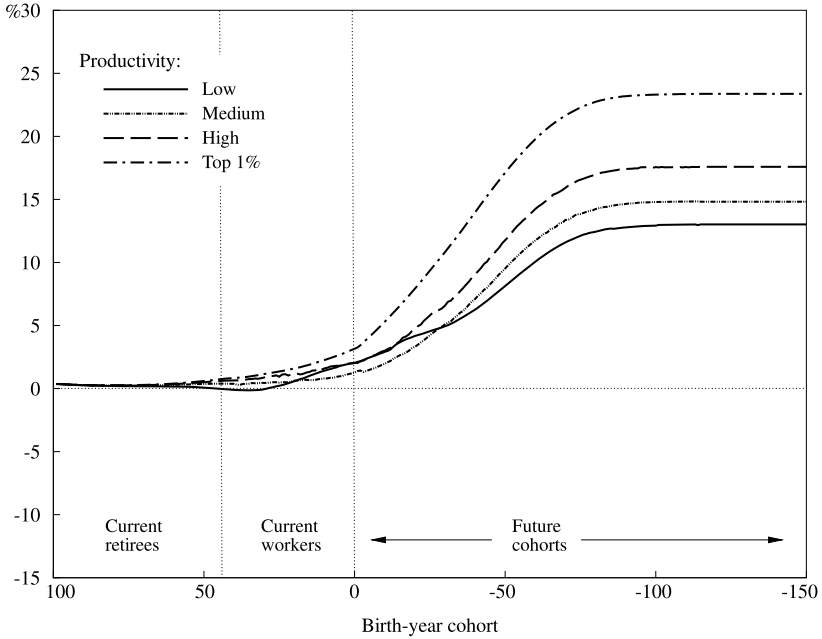


FIGURE A14. Percentage welfare gains by age cohort and baseline AGI: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (labor elasticity cut by 2).

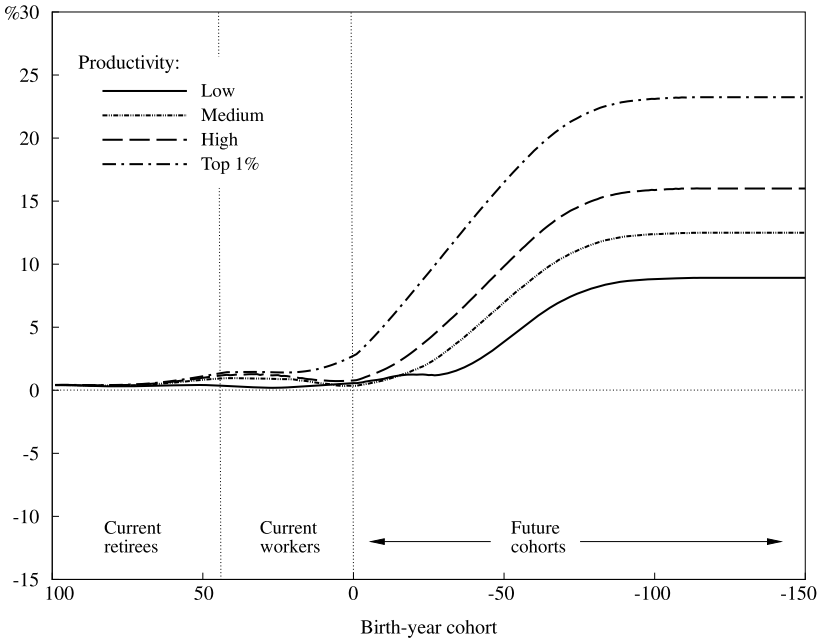


FIGURE A15. Percentage welfare gains by age cohort and baseline AGI: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (more spending categories included in G).

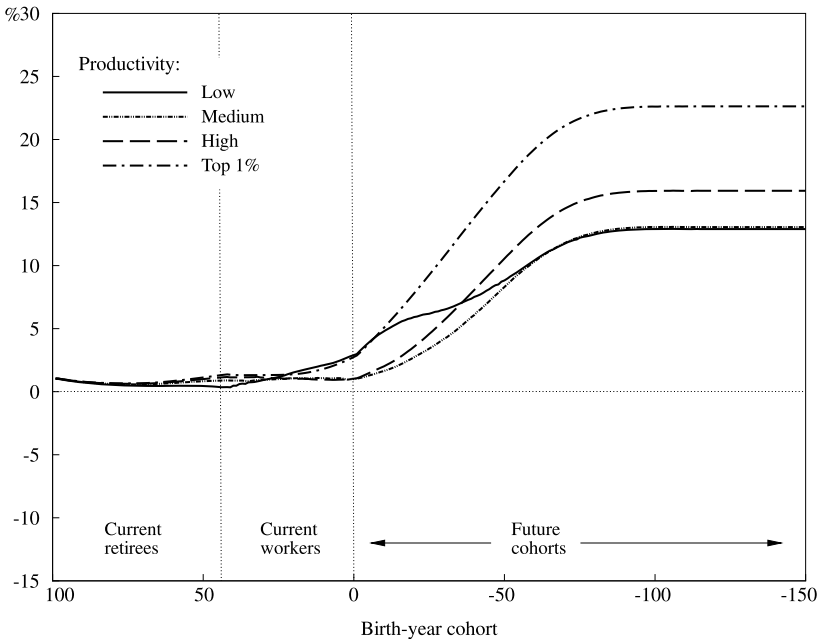


FIGURE A16. Percentage welfare gains by age cohort and baseline AGI: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (fewer spending categories included in G).

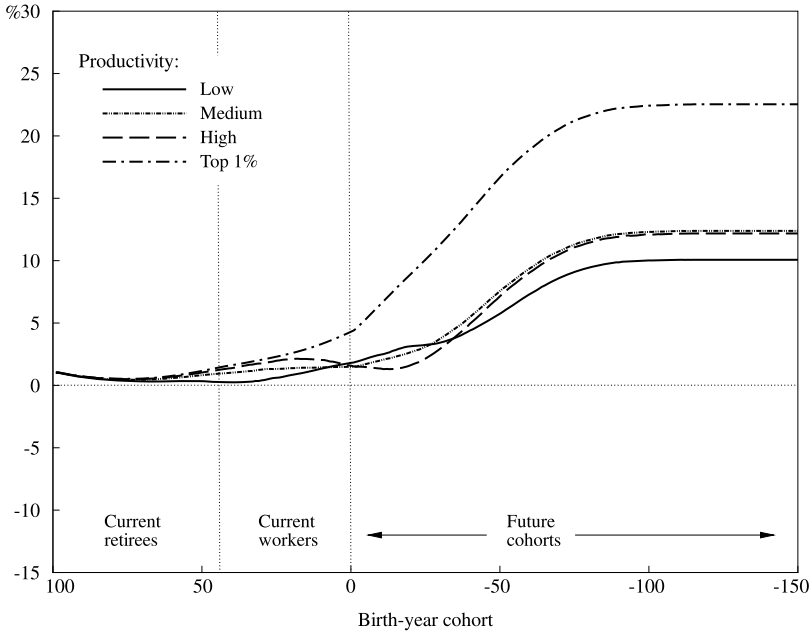


FIGURE A17. Percentage welfare gains by age cohort and baseline AGI: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (more AGI bins for net tax function).

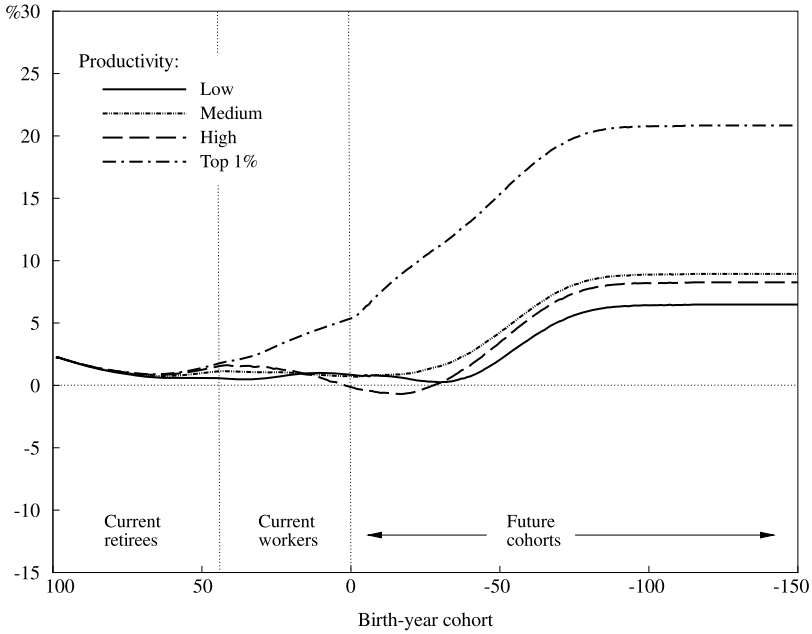


FIGURE A18. Percentage welfare gains by age cohort and baseline AGI: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (one-sector, one-capital model).

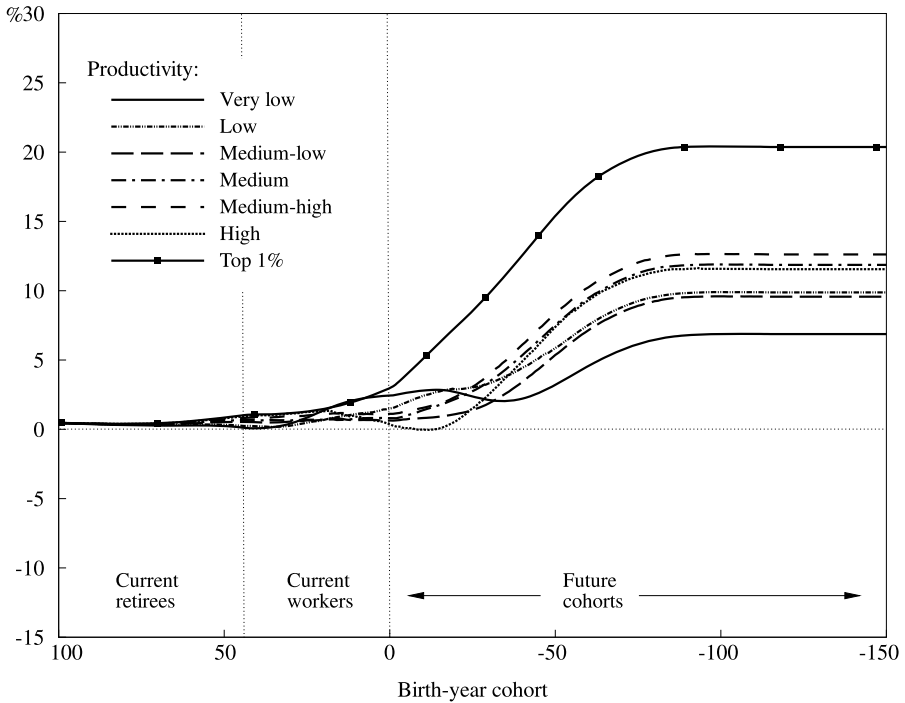


FIGURE A19. Percentage welfare gains by age cohort and baseline AGI: Social Security, Medicare, and FICA taxes phased out; worker net tax functions permanently changed (seven productivity levels).

REFERENCES

- Barro, R. J. and C. J. Redlick (2011), “Macroeconomic effects from government purchases and taxes.” *Quarterly Journal of Economics*, 126 (1), 51–102. [15]
- Bell, F. C. and M. L. Miller (2005), “Life tables for the United States social security area 1900–2100.” Publication No. 11-11536, Social Security Administration. [6]
- Board of Governors (1945–2016), *Flow of Funds Accounts of the United States, Statistical Release Z.1*. Board of Governors of the Federal Reserve System, Washington, DC. [2]
- Economic Report of the President* (2012). U.S. Government Printing Office, Washington, DC. [5]
- Hansen, G. D. (1993), “The cyclical and secular behaviour of the labour input: Comparing efficiency units and hours worked.” *Journal of Applied Econometrics*, 8 (1), 71–80. [28, 49]
- Prescott, E. C., A. Ueberfeldt, and S. Cociuba (2005), “U.S. hours and productivity behavior using CPS hours worked data: 1959-I to 2005-II.” Manuscript, Research, Department, Federal Reserve Bank of Minneapolis. [6]

U.S. Congress, Congressional Budget Office (2012), *Effective Marginal Tax Rates for Low- and Moderate-Income Workers*. U.S. Government Printing Office, Washington, DC. [18, 19]

U.S. Department of Commerce, Bureau of Economic Analysis (1929–2016), “National income and product accounts of the United States.” *Survey of Current Business*. U.S. Government Printing Office, Washington, DC. [2]

U.S. Department of Commerce, Bureau of Economic Analysis (2007), “Comparison of BEA estimates of personal income and IRS estimates of adjusted gross income: New estimates for 2005 and revised estimates for 2004.” *Survey of Current Business*. U.S. Government Printing Office, Washington, DC. [12, 14, 16]

U.S. Department of Commerce, Bureau of the Census (2012), *Statistical Abstract of the United States*. U.S. Government Printing Office, Washington, DC. [4]

U.S. Department of the Treasury, Internal Revenue Service (1918–2016), *Statistics of Income*. U.S. Government Printing Office, Washington, DC. [2]

Co-editor Rosa L. Matzkin handled this manuscript.

Manuscript received 8 December, 2015; final version accepted 29 February, 2016; available online 15 March, 2016.