Fiscal Policy

Mark Huggett

Georgetown University

March 2, 2018
Fiscal policy focuses on the connection between elements of government policy (spending, taxation and debt) and the overall economy.

Some issues:

1. Proximate sources of changes in debt-output ratio?
2. Composition of government spending and tax revenues?
3. Effect of spending shocks (e.g. wars)?
4. Effect of deficit finance, spending held equal?
5. Effect of starting a pay-as-you-go social security system or privatizing social security?
6. Optimal taxation with distributional objectives?
There are a small number of big movements in the US federal government Debt-GDP ratio. You can see (in order) the Civil War, WW I, the Great Depression, WW II, Reaganomics and the Great Recession.

The behavior of the debt-GDP ratio motivates the development of the government budget constraint which connects government spending, taxation and debt.
Government Budget Constraint

\[ B_{t+1} = B_t + D_t \]
\[ B_{t+1} = B_t + [G_t - T_t + r_t B_t] \]

Terms:
- \( B_t \) - government debt
- \( D_t \) - government deficit
- \( G_t \) - government spending on goods and services
- \( T_t \) - (net) taxes
- \( G_t - T_t \) - primary budget deficit
Decompose changes in the debt-output ratio into components: (1) primary deficit, (2) an interest rate and growth rate term

\[ B_{t+1} = B_t + D_t \]

\[
\frac{B_{t+1}}{Y_{t+1}} = \frac{B_t}{Y_{t+1}} + \frac{D_t}{Y_{t+1}}
\]

\[
\frac{B_{t+1}}{Y_{t+1}} - \frac{B_t}{Y_t} = \frac{B_t}{Y_{t+1}} - \frac{B_t}{Y_t} + \frac{D_t}{Y_{t+1}}
\]

\[
\frac{B_{t+1}}{Y_{t+1}} - \frac{B_t}{Y_t} = \frac{D_t}{Y_{t+1}} - \frac{B_t}{Y_{t+1}} \left( \frac{Y_t - Y_{t+1}}{Y_t} \right)
\]

\[
\frac{B_{t+1}}{Y_{t+1}} - \frac{B_t}{Y_t} = G_t - T_t \left( \frac{Y_{t+1}}{Y_{t+1}} - \frac{Y_t}{Y_{t+1}} \right) + \left[ \frac{B_t r_t}{Y_{t+1}} - \frac{B_t}{Y_{t+1}} \left( \frac{Y_{t+1} - Y_t}{Y_t} \right) \right]
\]
Decompose changes in the debt-output ratio

Does the primary deficit term explain all of the steep decline in the US debt-output ratio in the years right after WW II?

Answer: No. The decline in the debt-GDP ratio was typically greater from 1950-1970 than the surplus in the primary deficit.

This implies that the term \( \frac{B_t r_t}{Y_{t+1}} - \frac{B_t}{Y_{t+1}} \left( \frac{Y_{t+1} - Y_t}{Y_t} \right) \) must have been negative on average over the period. Thus, the growth rate of GDP exceeded the interest rate on the debt on average.

This is a slightly uncomfortable result for neoclassical growth theory.
Change in US Debt-GDP Ratio

- Change in Debt-GDP Ratio
- Primary Deficit
Present-Value Budget:

It would be useful to convert the sequence of budget constraints into a single present-value budget constraint. This was done in consumer theory. One difficulty is that it is natural to view a government as living forever. Thus, there is no LAST period for such a government.
Issue: NO LAST PERIOD:

If a government faced a “last period” and was responsible, then it would be natural to require that it pay back all debt and not contract additional debt in the last period. This would then imply a present-value budget constraint. We will deal with the no last period issue by assuming a useful condition on how debt can behave far into the future.
Some Algebra (Use $R_t \equiv 1 + r_t$):

\[ B_t = \frac{T_t - G_t}{R_t} + \frac{B_{t+1}}{R_t} \]
\[ B_t = \frac{T_t - G_t}{R_t} + \frac{T_{t+1} - G_{t+1}}{R_t R_{t+1}} + \frac{B_{t+2}}{R_t R_{t+1}} \]
\[ B_t = \frac{T_t - G_t}{R_t} + \frac{T_{t+1} - G_{t+1}}{R_t R_{t+1}} + \cdots + \frac{B_{t+n}}{R_t R_{t+1} \cdots R_{t+n-1}} \]

Assume: the term $\frac{B_{t+n}}{R_t R_{t+1} \cdots R_{t+n-1}}$ goes to zero as $n$ gets large.

Implication is the Present-Value Budget Constraint:

\[ B_t R_t + G_t + \frac{G_{t+1}}{R_{t+1}} + \frac{G_{t+2}}{R_{t+1} R_{t+2}} + \cdots = T_t + \frac{T_{t+1}}{R_{t+1}} + \frac{T_{t+2}}{R_{t+1} R_{t+2}} + \cdots \]
Some Interpretations of the Assumption:

1. Mathematically it says that the debt must grow at a rate less than the interest rate far into the future. Intuitively, it rules out *rolling over* the debt forever.

2. What does the Present-Value Budget imply:
   (i) taxes must pay for spending and initial debt
   (ii) implicit assumption: government debt is default-free
   (iii) The theory we develop focuses on governments that do not default. Argentina and Greece are not covered by this theory. They require a theory of debt with default.

1. Total (federal, state and local) government spending as a fraction of GDP increased over 1929-2016.
2. Transfer payments (e.g. social security, medicare, medicaid, ..) are a key reason behind this increase.
3. ”Consumption Expenditures” (schools, roads, defense, govt bureaucracy, ...) are relatively constant as a fraction of GDP
4. Federal govt consumption expenditures (e.g. defense and govt bureaucracy) decreased as a fraction of GDP over time while federal transfers increased over time.
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Spending and Taxation

Govt. Spending/GDP: 1929-2016

- Total expenditures
- Consumption expenditures
- Transfer payments
- Interest Payments

- Total Expenditures
- Consumption expenditures
- Transfer payments
- Interest payments

1. Total (federal, state and local) government taxes as a fraction of GDP increased over 1929-2016.
2. Taxes supporting social insurance programs increased as a fraction of GDP
3. Federal Corporate income tax decreased as a fraction of GDP
4. Federal spending was roughly 22 percent of GDP in 2016 while federal taxation was 18.5 percent of GDP in 2016
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Spending and Taxation

Govt. Taxes/GDP: 1929-2016

- Personal current taxes
- Total Taxes
- Taxes on production and imports
- Taxes on corporate income
- Social Insurance

0 2 04 06 08 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100

0 0.05 0.1 0.15 0.2 0.25 0.3 0.35

Govt. Taxes/GDP: 1929-2016

0

0.05

0.1

0.15

0.2

0.25

0.3

0.35

0 2 04 06 08 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100

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Govt. Taxes/GDP: 1929-2016

- Personal current taxes
- Total Taxes
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- Taxes on corporate income
- Social Insurance
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Spending and Taxation


- Total Taxes
- Income Tax
- Tax on Production
- Corp Tax
- Social Insurance
Life-Cycle Model w/ Government:

1. Consider the Life-Cycle Model ... but with
2. Government: \((G_t, T_{yt}, T_{ot}, B_t)\) w/
\[ T_t = N[T_{yt} + T_{ot}] \]
3. Government obeys the present-value budget
4. Assume: \(U(c_y, c_o) = \log(c_0)\) ... thus \(\alpha = 0\)
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A Theoretical Model

Life-Cycle Model: Mechanics

No Govt: \( K_{t+1} = N a_{t+1} = N(1 - \beta)A k_{t}^{\beta} \)

Govt which spends, taxes and borrows:
\( N a_{t+1} = K_{t+1} + B_{t+1} \)
\( K_{t+1} = N a_{t+1} - B_{t+1} = N[(1 - \beta)A k_{t}^{\beta} - T_{yt}] - B_{t+1} \)
\( k_{t+1} = a_{t+1} - b_{t+1} = [(1 - \beta)A k_{t}^{\beta} - T_{yt}] - b_{t+1} \)
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A Theoretical Model

\[ k_{t+1} = (1 - \beta) A k_t^\beta \]

\[ k_{t+1} = (1 + \beta) A b_t^\beta - T y_t b_{t+1} \]
Example: A “Temporary” War

1. start at steady state w/ $G_0 = B_0 = 0$
2. war lasts one period: $G_1 > 0$
3. Finance: $NT_{y1} = NT_{o1} = G_1/2$
4. Future: $G_t = B_t = T_{yt} = T_{ot} = 0$ for $t = 2, 3, ...$
Example: A “Temporary” War

We can analyze this example using the assumption that agents only care about consumption in old age (i.e. \( \alpha = 0 \)) or for any value of \( \alpha \). In fact, this example was analyzed in homework 5! Other examples will lead to “complications” unless we focus on \( \alpha = 0 \).
Example: A “Temporary” War

\[ k_{t+1} = a_{t+1} - b_{t+1} = [(1 - \beta)A k_t^\beta - T_yt] - b_{t+1} \]

At t=1 the law of motion shifts down as young agents are poorer as a result of the tax. At t=2,3,... the law of motion shifts back up to its original position. Thus, we have a one period fall in k and then a slow return to the original steady state. [same result as for \( \alpha \neq 0 \)] Output also falls and then returns to the original steady state.
"Temporary" War Multipliers
We talked about Multipliers in the Business-Cycle Lecture. Multipliers measure the impact on output produced by a policy change. Here the policy change is the govt spending change:

$$Multiplier(n) = \frac{\Delta Y_{t+n}}{\Delta G_t}$$

This multiplier is ZERO for $n = 0$ and NEGATIVE for $n \geq 1$ in the Temporary War example. This contrasts with the POSITIVE (balanced and unbalanced budget) govt spending multipliers that come from the Simple Keynesian model for $n = 0$. 
“Temporary” War Multipliers

The only way to get a positive government spending multiplier in the life-cycle model is via an increase in \((K_t, L_t, A_t)\) as \(Y_t = A_t F(K_t, L_t)\). Labor is always unchanged in the model. Capital falls because young agents are poorer as a result of the war tax.

Open Issue: Endogenous labor choice leads to a positive multiplier?

One (theoretical) possibility is that the tax increase to finance the spending increase leads agents to be poorer and to work more provided that leisure is a normal good.
The Cold War: Three Plans

start at steady state w/ $G_0 = B_0 = 0$

war lasts forever: $G_t = G = N g > 0$ for all $t \geq 1$

Plan 1 (Tax Old): $(T_{yt}, T_{ot}) = (0, g)$ all $t \geq 1$

Plan 2 (Tax Young): $(T_{yt}, T_{ot}) = (g, 0)$ all $t \geq 1$

Plan 3 (Deficit Finance):
$(T_{y1}, T_{o1}) = (0, 0)$ and $(T_{yt}, T_{ot}) = (0, g(1 + r_t))$ for $t \geq 2$
The Cold War: Do All Plans Satisfy the Govt Budget?

Plan 1: Intuition - yes as it runs a balanced budget each period \( G_t = Ng = NT_{ot} \)
Plan 2: Intuition - yes as it runs a balanced budget each period \( G_t = Ng = NT_{yt} \)
Plan 3: Not initially obvious, but yes as debt does not explode.
Plan 1: Analysis

\[ k_{t+1} = a_{t+1} - b_{t+1} = [(1 - \beta)AK_t^\beta - Ty_t] - b_{t+1} \]
\[ k_{t+1} = [(1 - \beta)AK_t^\beta - 0] - 0 - \text{law of motion} \]

Because the law of motion does not move, then GDP, capital and investment do not move. Since government spending increases some other component of GDP must decrease. Consumption of the old falls by the full amount of the war expenditure in each period.

\[ C_t \downarrow + I_t + G_t \uparrow = Y_t = F(K_t, N) \]
Plan 2: Analysis

\[ k_{t+1} = a_{t+1} - b_{t+1} = [(1 - \beta)A k_t^\beta - T_y] - b_{t+1} \]
\[ k_{t+1} = [(1 - \beta)A k_t^\beta - g] - 0 - \text{law of motion} \]

Law of motion shifts down. Thus, over time capital and output fall. Consumption of agents born far in the future in Plan 2 must be lower than under Plan 1. This holds if the economy was initially below the Golden Rule steady state.

\[ C_t \downarrow + I_t \downarrow + G_t \uparrow = Y_t \downarrow = F(K_t \downarrow, N) \]
Plan 3: Analysis

\[ k_{t+1} = a_{t+1} - b_{t+1} = [(1 - \beta)A k^\beta_t - T y_t] - b_{t+1} \]
\[ k_{t+1} = [(1 - \beta)A k^\beta_t - 0] - g \text{ - law of motion} \]

Law of motion shifts down. It shifts down by EXACTLY the amount of the downward shift in Plan 2. Thus, the aggregate consequences (for GDP, investment, consumption, factor prices) are exactly the same as in Plan 2. Welfare for each agent born in each time period is also exactly the same as in Plan 2. The only difference with Plan 2 is that in Plan 3 govt debt is positive.
Understanding why Plan 2 and Plan 3 are equivalent

Plan 2: \( PV Tax = T_{y,t} + \frac{T_{o,t+1}}{1+r} = g + 0 = g \)

Plan 3: \( PV Tax = T_{y,t} + \frac{T_{o,t+1}}{1+r} = 0 + \frac{g(1+r)}{1+r} = g \)

The timing of taxes differs in Plan 2 and 3 but the present value for any agent is the same in Plan 2 and 3. A graph of this situation is useful!
Ricardian Equivalence

The equivalence between Plan 2 and Plan 3 is an illustration of a general principle called Ricardian Equivalence. Within an economic model with lump-sum taxation, two plans that finance the same government expenditure will be equivalent provided the present value of taxation on each household is the same across the two plans. This result holds FOR ANY utility function as it follows from the budget sets being unchanged.
Ricardian Equivalence: Definition

Two government tax policies that finance the same government expenditures will be said to display Ricardian Equivalence (RE) provided that the consumption allocation to all agents in the model is the same for the two policies.
Theory: When Might Two Policies Display Ricardian Equivalence?

Answer: When budget sets across the two policies are the same for all agents in the economy.

When might that hold?

1. Present value of taxes are the same for all agents but timing of taxes changes. (example: equivalence of Plan 2 and 3 in ”Cold War” example)
2. Altruistic bonds that hold across generations of the same family. This might lead family dynasties to offset any shifting of tax burdens across generations by varying the generosity of bequests (inter vivos or at death).

The life-cycle model abstracts from such altruistic bonds.
Deviations from Ricardian Equivalence

1. Non-lump-sum taxes
2. Borrowing limits
3. Uninsured risks and taxation as insurance provision
A Shred of Evidence
Barro mentions the case of Israel in the 1980’s. In 1984 Israel experienced a large increase in the budget deficit. This was associated with a (temporary) fall in real taxes collected due to a sharp rise in inflation. Barro highlights the behavior of public and private savings rates over time.

Perhaps private savings increase in Israel when public savings fall exactly because private citizens anticipate that the tax cut will be balanced with future tax increases.
Fiscal Policy

A Theoretical Model

Definitions

\[ Y = C + I + G \]
\[ I = [Y - C - Tax] + [Tax - G] \]

\[ [Y - C - Tax] = \text{Private Savings} \]
\[ [Tax - G] = \text{Public Savings} \]
National Savings = Private Savings + Public Savings
### Israel: 1983-87

<table>
<thead>
<tr>
<th>Year</th>
<th>National Savings</th>
<th>Private Savings</th>
<th>Public Savings</th>
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</thead>
<tbody>
<tr>
<td>1983</td>
<td>13</td>
<td>17</td>
<td>-4</td>
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<td>1984</td>
<td>15</td>
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<tr>
<td>1987</td>
<td>12</td>
<td>14</td>
<td>-2</td>
</tr>
</tbody>
</table>
A Theoretical Model

Temporary Tax Cut: Analysis
The US govt some years ago (under GW Bush) sent $500 checks to many tax-paying families. One might view this episode as coming close to the theoretical ideal of a temporary tax cut. The reason is that there was no clear discussion of how this action was related to corresponding spending cuts. Thus, one might think that nearly equal tax increases might come within a few years.
Regardless of whether or not one views this episode in this way, there is the theoretical issue of how an idealized temporary tax cut, without any change in govt spending, might impact the economy.
Fiscal Policy

A Theoretical Model

Temporary Tax Cut: Assumptions

1. Consider the Life-Cycle Model in steady state. Government spending is constant across all periods.
2. Government: \( G_0 = Ng = NT_{y0} + NT_{o0} \) and \( T_{y0} = T_{o0} = g/2 \)
3. At \( t = 1 \) the govt collects no taxes.
4. At \( t = 2, 3, \ldots \) then \( T_{yt} = T_{ot} = g/2 + gr_t/2 \)

Thus, for \( t = 2, 3, \ldots \) the government collects enough tax to pay for spending and to pay the interest on the debt. The debt is positive because the government runs a deficit in period 1.
Temporary Tax Cut: Conclusions

\[ k_{t+1} = a_{t+1} - b_{t+1} = [(1 - \beta)A_k^\beta - T_y] - b_{t+1} \]

\[ k_{t+1} = [(1 - \beta)A_k^\beta - g/2] - 0 \text{ - at } t = 0 \]

\[ k_{t+1} = [(1 - \beta)A_k^\beta - 0] - g \text{ - at } t = 1 \]

\[ k_{t+1} = [(1 - \beta)A_k^\beta - g/2 - gr_t/2] - g \text{ - at } t = 2, 3, \ldots \]

Law of motion keeps shifting downward. Tax cut is not expansionary. It is a trick to shift the burden of paying for spending onto future generations within this simple model.
Social Security: Theory

Most governments run a mandatory tax-transfer system whereby working-age individuals are taxed to fund transfer payments to older individuals. Such systems are often labeled social security systems. We will analyze within the Life-Cycle model a pure pay-as-you-go social security system:

\[(T_{yt}, T_{ot}) = (s, -s) \text{ all } t \geq 1\]
Social Security: Analysis

\[ k_{t+1} = a_{t+1} - b_{t+1} = [(1 - \beta)Ak_{t}^{\beta} - Tyt] - b_{t+1} \]
\[ k_{t+1} = [(1 - \beta)Ak_{t}^{\beta} - s] - 0 \text{ - law of motion} \]

Thus, starting a pay-as-you-go system in the model results in a downward shift of the law of motion. The initial old generation clearly benefits. Other generations clearly do not benefit as long as the initial steady state is below the Golden-Rule level.
Fiscal Policy

Social Security

\[ k_{t+1} = (1 - \beta) AK_t^\beta \]

\[ k_{t+1} = (1 - \beta) AK_t^\beta - S \]
Social Security: Analysis

If the economy is initially in a steady state below the Golden Rule, then neither social security nor anything else produces a Pareto improvement in this model. Recall the Proposition from Chapter 5! This proposition argue that, with positive interest rates, allocations produced by competitive markets in the life-cycle model are Pareto efficient. The model now has taxes and transfers added, but with these being lump-sum this will not change the upshot of the Proposition.
Social Security: Analysis
Calculate Present Value of Tax in Social Security

\[ PVTax = T_{yt} + \frac{T_{ot+1}}{1+r} = s - \frac{s}{1+r} = \frac{sr}{1+r} > 0 \text{ when } r > 0 \]

Upshot: Social security is equivalent to either (i) a present-value tax \( \frac{sr}{1+r} \) or (ii) the government forcing agents into a low return investment.
Social Security: Would this analysis change if we allow population growth?

\[(T_{yt}, T_{ot}) = (s, -s(1 + n)) \text{ all } t \geq 1\]

\[k_{t+1} = \frac{a_{t+1} - b_{t+1}}{1+n} = \frac{[(1-\beta)Ak_t^\beta - T_{yt}] - b_{t+1}}{1+n}\]

\[k_{t+1} = \frac{[(1-\beta)Ak_t^\beta - s] - 0}{1+n} \text{ - law of motion}\]

Here an ”interest rate” of size \(n\) is paid because the population grows.
Social Security: Would this analysis change if we allow population growth?

\[ PVTax = T_y + \frac{T_{ot}}{1+r} = s - \frac{s(1+n)}{1+r} = \frac{s(r-n)}{1+r} > 0 \]

Answer: No, provided real return to capital exceeds population growth (i.e. when \( r > n \)).
Why do Social Security systems exist when the model says they do not lead to Pareto improvements?

Three possibilities:

1. (Insurance) Social security provides insurance for individual earnings risk or macro risks (e.g. a depression). Model abstracts from all risks.
2. (Nanny State) Some consumers would systematically undersave w/o forced “savings” via govt old-age pension programs.
3. (Politics) Old agents find a benefit to starting a pay-as-you-go system.
James Mirrlees (1995) states:
“From the point of view of insurance, there seem to me to be two compelling theoretical arguments for having the State rather than the market provide a wide range of insurance, for old-age pensions, disability and sickness, unemployment and low income: the first is that the market handles adverse selection badly. The second is that, even if adverse selection were not important, people should take out insurance at an age when they are incapable of doing so rationally, namely zero.”

Mirrlees won the Nobel Prize in economics in 1996
Larry Summers (1986) states:

“The point can be made more strongly. America’s largest social program, social security, is premised to no small degree on the view that individuals are not rational in preparing for old age and need to be coerced to do so. The existence of TIAA-CREF as a custodian of the retirement funds of many of us in this room is due to a conviction that college professors cannot be trusted to save enough for their own or their spouses old age. If important, these behavior patterns are likely to dwarf liquidity constraints in explaining consumption and saving. Indeed, liquidity constraints arise in no small part from rules that are explicitly designed to prevent the profligate from getting too far over their heads.”

Summers is famous for theorizing about the possible reasons for why there are few women PhD’s in science.
Social Security (Medicare) Facts:

2. Major Expansions:

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<thead>
<tr>
<th>Benefit</th>
<th>Earnings Tax Rate</th>
<th>Starting Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>OASI</td>
<td>10.6</td>
<td>1935 and 1939</td>
</tr>
<tr>
<td>DI</td>
<td>1.8</td>
<td>1956</td>
</tr>
<tr>
<td>HI (Medicare)</td>
<td>2.9</td>
<td>1965</td>
</tr>
<tr>
<td>Medicare Part D</td>
<td>0</td>
<td>2003</td>
</tr>
</tbody>
</table>
Social Security Facts:

3. Earnings Cap 128,400 in 2018. Earnings beyond this level are not taxed for OA SI or DI taxes.
4. Since the mid 1950’s social security is effectively a mandatory program for the vast majority of US workers (85 percent or so).
5. Old Age Benefit formula- paid monthly based on
- 35 highest indexed earnings years produces AIME
- progressive formula based on an individual’s AIME
- benefits paid as a real annuity linked to CPI
- spousal benefit: benefit equals the greater of old-age benefit based on own earnings history or half of spouse’s benefit
US Benefit Function:
1. Some argue that the benefit function provides insurance. Those with bad luck on lifetime earnings have a higher benefit to earnings ratio. The bad earnings luck could stem from bad parents, bad schools, bad employment or health luck over the lifetime.
2. The benefit function can also be read as providing HIGH marginal earnings tax rates on high lifetime earners and LOW marginal earnings tax rates on low lifetime earners.

\[ Marginal \text{ Tax Rate} = SS \text{ Tax Rate} - Marginal \text{ Benefit} \]
Old-Age transfers:

If one adds up total transfers from US government transfer programs directed at older Americans (roughly age 65+) and expresses total transfers to GDP, then there is a clear pattern for this to increase over time.

What explains this? The median age of voters is increasing? Does this change old-age transfer politics?
Old-Age Transfer/ GDP Ratio

Fraction of GDP

Medicaid to 65+
Medicare supp.
Medicare hospital
DI
OASI