Explaining the Decline of the U.S. Saving Rate: the Role of Health Expenditure

Yi Chen† Maurizio Mazzocco‡ Béla Személy§


Abstract

In this paper we provide evidence that most of the decline in the U.S. personal saving rate from 10 percent in the early eighties to 3 percent in the late 2000s can be explained by the steep increase in health expenditure experienced by the U.S. economy during the same period. The most convincing evidence is provided using the FDA approval of new drugs as a source of exogenous variation in medical expenses. Employing this source of variation, we find that a 1 percentage point increase in health expenditure generated a decline in the U.S. saving rate that is between 0.58 and 0.67 percentage points. Using this result, we calculate that the rise in health expenditure explains about 83 percent of the drop in the U.S. saving rate. To understand the economic meaning of this coefficient and evaluate whether households changed their consumption decisions to mitigate the effect of higher medical expenses, we develop a stylized model of households’ and government’s decisions. Using the model jointly with our data, we find that only the increase in private health expenditure caused the decline in the personal saving rate and that households responded to the rise in health costs by reducing the consumption of other goods. Without the response, the U.S. personal saving rate would have dropped by 8.7 percentage points and not by the observed 7 percentage points.

†Xi’An Jiaotong University, Jinhe Center for Economic Research, Xi’An, Shannxi, China. Email: chenyiecon@xjtu.edu.cn.
‡UCLA, Department of Economics, Bunche Hall, Los Angeles, CA. Email: mmazzocc@econ.ucla.edu.
§Office of the Comptroller of the Currency, Washington, DC. Email: bela.szemely@occ.treas.gov.

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1 Introduction

It is well-known that the U.S. personal saving rate declined from 10 percent in the early eighties to about 3 percent in the late 2000s. Economists and policy-makers are concerned with this drop because it may signal an increased dependence on foreign investment and a future reduction in capital stock with negative consequences for labor productivity, wages, and national output. In the past twenty years economists have attempted to explain this sharp drop. An examination of the related literature indicates that the decline is still a puzzle. Parker (1999) states that “Each of the major current theories of the decline in the U.S. saving rate fails on its own to match significant aspects of the macroeconomic or household data.” Guidolin and Jeunesse (2007) review a number of arguments and theories that have been proposed and conclude that “The recent decline of the U.S. private saving rate remains a puzzle.”

The main contribution of this paper is to provide evidence that the increase in medical expenditure as a share of disposable income explains about 83 percent of the decline in the U.S. personal saving rate. We provide this evidence in three steps.

In the first step, we use a simple accounting exercise to provide evidence that the share of health expenditure on its own can explain most of the drop in the U.S. saving rate that started at the beginning of the eighties. Papers in the literature have discarded health expenditure as a possible explanation for the decline in the U.S. saving rate because this variable has been growing since the early sixties. They therefore concluded that, if this variable was the main determinant of the drop, the saving rate should have started its decline in the sixties. In the paper we confirm the finding that health expenditure has been rising since the sixties. But we provide evidence that, in spite of this, medical expenses can be the main driver of the drop in the saving rate because of the following remarkable coincidence. From the early sixties to the end of the seventies, the social security benefits paid to households increased as a fraction of income at the same rate as the share of health expenditure, therefore offsetting the negative effect of health expenditure on the saving rate. Starting from the early eighties, however, the share of social security benefits stopped increasing, whereas medical expenses continued to rise at the same rate. As a result, the saving rate began to decline at approximately the rate health expenditure was increasing.

To test whether medical expenses can explain on its own the decline in the saving rate, in the accounting exercise we consider a hypothetical situation in which health expenditure net of social
security benefits remains constant as a fraction of disposable income for the entire period and compute the corresponding saving rate. If our variable is the main factor behind the drop in the saving rate, in this hypothetical exercise we should observe that the saving rate fluctuates around a constant rate from the sixties to today. When we plot the hypothetical saving rate, this is the pattern we observe therefore confirming our hypothesis. The main limitation of the accounting exercise is that it does not allow us to make the causal statement that the increase in medical expenditure has generated the drop in the U.S. saving rate. It only delivers a variable that has the potential of explaining this decline.

To address this issue, as a second step, we use cross-state variation in household saving rates and health expenditure to provide a first set of results in support of a causal relationship between changes in medical expenses and saving rates. The state-level saving rates are constructed using as our main source of data a measure of retail sales, whereas state-level medical expenses are calculated employing the National Health Expenditure Accounts (NHEA). To evaluate the relationship between these two variables, we run a standard fixed-effect regression in which the state-level saving rate is our dependent variable and the state-level share of health expenditure is our main explanatory variable. This specification enables us to test whether states that experienced larger increases in medical expenses had more significant drops in their saving rate. If this is not the case, we can reject the hypothesis that changes in health expenditure caused the drop in the U.S. saving rate. We find that a 1 percentage point increase in the share of medical expenses is associated with a 0.64 percentage point decline in the saving rate. The main concern with our cross-state analysis is that there may be omitted variables that are correlated with both the saving rate and medical expenditure. In that case, our estimated coefficient will be affected by an omitted-variable bias that invalidates our causal interpretation.

To overcome this problem, in the third part of the paper we use as an arguably exogenous source of variation in medical expenditure the approval of new drugs by the Food and Drug Administration (FDA). The idea behind the choice of this instrument is straightforward. When a new drug is approved and made available to users, medical expenses will generally increase since consumers have a new product that can help treat medical conditions. The main limitation of this variable is that, in each time period, it is constant for the entire U.S., whereas in our analysis we need changes across states. To generate the required cross-state variation, we interact the FDA approval of new drugs with the demographic characteristics of a state. The constructed
variables provide the needed variation, since the approval of a new drug produces larger increases in health expenditure in states with a larger fraction of families that make extensive use of medical products. Using these variables as our instruments, we find that a 1 percentage point increase in health expenses generates a reduction in the saving rate of between 0.58 and 0.67 percentage points. Our instrumental variable results are therefore similar to our fixed-effect estimates, which suggests that the omitted-variable bias in our first set of results was negligible. Using our estimates and back of the envelope calculations, we conclude that about 83 percent of the drop in the U.S. saving rate is explained by the rise in health expenditure.

Using the reduced-form results alone, it is not possible to understand the economic meaning of our estimates and whether households responded optimally to the rise in health expenditure by reducing the consumption of other goods. To address this issue, in the last part of the paper we develop a model of households’ and government’s decisions that enables us to provide an economic interpretation of our empirical results and to evaluate the households’ response. Using our estimated coefficients and the model, we show that only the rise in private health expenditure had an effect on the decline in the personal saving rate. Moreover, we provide evidence that households responded to the increase in medical expenses by reducing the consumption of other goods. We document that, without the response, the saving rate would have declined by 8.7 percentage points and not by the 7 percentage points observed in the data.

A few papers have used micro data to investigate the relationship between health expenditure of the elderly and their savings. The main example is the paper by De Nardi, French, and Jones (2010) who find, using the Health and Retirement Study, that higher medical expenses increase savings of older households. Our results do not contradict these findings. Health costs affect savings in a direct and indirect way. When medical expenses occur, they reduce mechanically the level of savings of the households that experience the disbursement. In addition, if households expect higher health costs tomorrow, they will increase their precautionary savings. The measure of health expenditure used in De Nardi, French, and Jones (2010) includes out-of-pocket expenses but, given the question considered, correctly excludes expenses covered by insurance, either public or private. Since, as we will document, health costs covered by some type of insurance represents the overwhelming part of medical expenses, De Nardi, French, and Jones (2010) captures mainly the effect of medical costs on precautionary savings. NIPA, instead, includes all medical expenses in its definition of health expenditure. It therefore fully accounts for both the direct and indirect
effects. Our results indicate that the direct effect dominates the indirect effect.

Our results have policy implications. They indicate that households responded optimally to the rise in medical expenditure and, as a consequence, they are not at fault for the decline in the U.S. personal saving rate. The main lesson from this finding is that, if policy makers intend to raise the saving rate, it is essential to reduce the rate at which medical expenses grow. The recent debate on health costs has focused on two sets of policies that have the potential of reducing the effect of increasing medical expenses on the U.S. economy. The first set includes policies aimed at eliminating inefficiencies in the provision of health care. This is clearly a good starting point, to the extent that it is able to generate significant reductions in medical costs. The second set of policies requires health institutions to be more selective in the adoption of newer technologies. These policies can have a large impact on health expenses and, hence, on the saving rate. But they come at a cost. First, as pointed out by Hall and Jones (2007), if health care is a superior good, in a rich country such as the U.S. it may be welfare improving to adopt the latest health technology. Second, the constant adoption of new health technologies had the positive effect of fostering a large number of innovations in the health sector. A more frequent use of older technologies might slow this progress and could have negative welfare effects in the long run.

The rest of the paper proceeds as follows. The next section provides a discussion of related papers. In section 3, we describe the data sets and define the variables used in this paper. Section 4 uses an accounting exercise to show that most of the decline in the U.S. household saving rate can be explained by the rise in health expenditure. In section 5, we use cross-state variation to provide evidence on a causal relationship between health expenditure and saving rates. Section 6 develops a model to provide an economic interpretation of the estimation results. In section 7, we provide evidence on how the increase in public health costs was funded. Section 8 concludes.

2 Related Papers

A large number of studies have analyzed the decline in the U.S. saving rate. In this section, we will discuss the papers with findings that are related to ours. For a thorough review of the literature see Browning and Lusardi (1996), Parker (1999), and Guidolin and Jeunesse (2007).

One of the first papers to address the decline in the U.S. saving rate is the work by Summers and Carroll (1987), where they study the change in the national and household saving rate from
the fifties to 1986. Their main conclusion is that the decline in the private sector U.S. saving rate is real and not a result of measurement issue and that the most likely cause of the decline is the increase in expected income after retirement that has induces the younger cohorts to reduce the rate at which they save. In our paper, we only focus on the household saving rate which experienced most of its decline after 1986, the last year considered by Summers and Carroll.

The paper by Gokhale, Kotlikoff, and Sabelhaus (1996) is the first one to discuss the steep increase in health expenditure in the past 50 years and to suggest a possible relationship with the drop in the saving rate. They report that medical consumption as a percentage of disposable income was 3.9 in the fifties, 5.2 in the sixties, 7.3 in the seventies, 10.1 in the eighties, and 12.8 in the early nineties. This pattern suggests that it is difficult for medical expenditure to explain the decline in the saving rate. Health expenses were already growing in the sixties and seventies, whereas the saving rate started its decline in the eighties. Probably for this reason, Gokhale, Kotlikoff, and Sabelhaus (1996) do not directly explore the effect of the increase in medical consumption on household saving. Instead, they use it mainly as a motivation for decomposing the changes in the saving rate in four components: the changes generated by variations in the intergenerational distribution of resources; the effects produced by changes in the cohort-specific consumption propensities; the changes produced by modifications in the rate of government spending; the effects of changes in demographics. The decomposition of the changes in the saving rate is based on a simple life-cycle model and relies on the assumptions implicit in it. Their results suggest that the decline in the saving rate is mainly a consequence of government redistribution of resources from the young generation with low propensities to consume to the old generation with higher propensities. Our results differ from theirs in two respects. First, we show that the sharp increase in health expenditure can explain on its own the decline in the U.S. saving rate if considered jointly with the evolution of social security benefits to households. Second, we use exogenous variation in medical expenditure to provide evidence on the existence of a causal relationship between health expenses and saving rates.

Attanasio (1998) uses the Consumer Expenditure Survey (CEX) and synthetic cohorts to study the reduction in the U.S. saving rate for the period 1981-1991. His main conclusion is that the decline was mostly generated by cohorts born between 1925 and 1939. In this paper we study a longer sample period and provide evidence that the U.S. saving rate continued to decline for another two decades. This suggests that many more cohorts are responsible for the observed
pattern in saving rates.

In a related paper, Parker (1999) considers the main explanations given in the literature for the decline in the saving rate, namely the effect of asset value appreciations, durable goods, changes in the intergenerational distribution of resources, financial innovations, and changes in discount factors. He then evaluates whether these hypotheses are consistent with patterns observed in micro and macro data. He concludes that each of the main theories fails on its own to explain the decline in the saving rate since it cannot match significant aspects of aggregate and household data. In particular, he rejects the hypothesis that changes in the intergenerational distribution of resources, which include the increase in medical expenditure, can explain the decline for two reasons. First, the trends in the government redistribution of resources and the increase in health expenditure predate the drop in the saving rate. Second, the ratio of consumption to income increases for all generations and not only the old ones. Both conclusions are correct. Without considering the growth in the share of social security benefits during the sixties and seventies, health expenditure cannot explain the decline in the saving rate. Moreover, we show that the expansion in health expenditure paid by some form of private health insurance is of the same order of magnitude as the increase experienced by Medicare. Health expenses therefore increased for all generations.

In a paper that is contemporaneous to Parker's, Gale and Sabelhaus (1999) start from the observation that one may require different measures of aggregate savings to answer different economic questions. They then study the evolution of the U.S. saving rate using several measures of this aggregate variable. They first use the measure employed by the National Income and Product Accounts (NIPA). In this case, the pattern displayed by the saving rate is consistent with the findings of previous papers, which document a steep decline that starts in the early eighties. They then consider an alternative measure that modifies the NIPA definition of the saving rate in a way that enables them to take into account the evolution of durable goods, retirement accounts, inflation, and tax accruals. Using this measure, the authors still report a decline in the saving rate but of a smaller magnitude. Gale and Sabelhaus consider also a third measure that adds capital gains. In this case, as one may expect, the saving rate at the end of the nineties was at the highest level in the last forty years. In our paper, we only consider the standard measure of aggregate savings provided by NIPA and we have nothing to say about the evolution of alternative measures.
The most recent survey we could find is the paper by Guidolin and Jeunesse (2007). The first part of the paper examines whether the decline in the U.S. saving rate is real or a simple statistical artifact generated by measurement issues. Since the decline is evident in all the standard measures considered in their paper, they conclude that it cannot be easily explained by measurement issues. In the second part of the paper, Guidolin and La Jeunesse review many of the theories that have been proposed and conclude that the drop in the saving rate is still a puzzle.

We conclude this section with one remark. In this paper, we do not make statements about the optimal saving rate for the U.S. economy. We do not argue that a saving rate of 3 percent is low or that a saving rate of 10 percent is optimal. We only provide an explanation for its decline in the past thirty years. For a discussion on the optimality of the current saving rate, one can read Scholz, Seshadri, and Khitatrakun (2006) and Lusardi, Skinner, and Venti (2001).

3 Data Description and Variable Definition

In this section we describe the main data sets used in the paper, which are the NIPA, the NHEA, the retail sale data prepared by the private company Claritas, the Current Population Survey (CPS), and the Survey of Epidemiology and End Results (SEER).

The NIPA are published by the Bureau of Economic Analysis and constitute the major source of aggregate data for the U.S. economy. We use annual data for the years 1960-2009, which is the period for which the second data set employed in the paper, the NHEA, has data available. All files were downloaded on March 2015 from the BEA website (http://bea.gov/national/index.htm).

We construct our expenditure, income, and savings variables using data from Table 2.1, Personal Income and Its Disposition, and Table 2.4.5, Personal Consumption Expenditures by Function. Specifically, we compute health expenditure as the sum of the items in the NIPA Table 2.4.5, which are listed in the first part of Table 1. Other variables used in the analysis are defined in the second part of Table 1.

The NHEA have been published since 1964 by the Department of Health and Human Services. The NHEA provide not only a comprehensive measure of total spending on health care goods and services, but also a breakdown of the sources of funds that finance these expenditures. This level of detail is important because it allows us to determine how health expenses were funded and hence what was their effect on households’ decisions. All NHEA files were downloaded on March
Table 1: NIPA Data

<table>
<thead>
<tr>
<th>Components of Personal Health Expenditures</th>
<th>Line in NIPA Table 2.4.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Therapeutic appliances and equipment</td>
<td>line 21</td>
</tr>
<tr>
<td>Pharmaceutical and other medical products</td>
<td>line 40</td>
</tr>
<tr>
<td>Health care</td>
<td>line 60</td>
</tr>
<tr>
<td>Net health insurance</td>
<td>line 93</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other Variables</th>
<th>Line in NIPA Tables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal saving rate</td>
<td>line 35 in NIPA Table 2.1</td>
</tr>
<tr>
<td>Social Security Benefits to Households</td>
<td>line 18 in NIPA 2.1</td>
</tr>
<tr>
<td>Employer contributions for health plans</td>
<td>line 17 in NIPA Table 7.8</td>
</tr>
<tr>
<td>Personal taxes</td>
<td>line 26 in NIPA Table 2.1</td>
</tr>
<tr>
<td>Government current expenditures by function</td>
<td>various lines in NIPA Table 3.16</td>
</tr>
</tbody>
</table>

2015 from the Centers for Medicare and Medicaid Services website (http://www.cms.hhs.gov). To make the NHEA data as comparable as possible to the NIPA health data, we use the Personal Health Care data from the NHEA which tracks the personal health expenditure measures in the NIPA remarkably well. Throughout the period 1960-2009, the ratio of the two health expenditure measures obtained using the NIPA and NHEA is between 0.94 - 1.06. The variables that we use from the NHEA are defined in Table 2. The measure of total health expenditure reported by the NHEA is available yearly for the entire U.S. and also for each state separately.

Retail sales are one of the main inputs in the construction of the saving rate at the state level. We employ the most commonly used retail sale data which are prepared by the private company Claritas and can be found in the Survey of Buying Power published by the Sales & Marketing Management magazine. These data were first used by Asdrubali, Sorensen, and Yoshia (1996) and subsequently in several other studies.

Finally, we use the CPS to construct income at the state level for some industries and some ages to perform robustness checks and the SEER to compute population estimates.

1The reconciliation project discussed in Sensenig and Wilcox (2001) shows that the NHEA data are generally compatible with the NIPA data.
Table 2: Definitions of Variables from NHEA

<table>
<thead>
<tr>
<th>Item</th>
<th>Line in NHEA Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal Health Care</td>
<td>line 73</td>
</tr>
<tr>
<td>Out of pocket expenditure</td>
<td>line 74</td>
</tr>
<tr>
<td>Health Institutions</td>
<td>line 73 minus line 74</td>
</tr>
<tr>
<td>Private Health Insurance</td>
<td>line 76</td>
</tr>
<tr>
<td>Private Funds</td>
<td>line 74+76+87+88</td>
</tr>
<tr>
<td>Public Funds</td>
<td>line 73 minus line above</td>
</tr>
<tr>
<td>Gov’t programs</td>
<td>line 102</td>
</tr>
<tr>
<td>Medicare</td>
<td>line 77</td>
</tr>
<tr>
<td>Medicare Part A</td>
<td>line 107+227+347</td>
</tr>
<tr>
<td>Medicare Part B, C, D</td>
<td>line 77 minus line above</td>
</tr>
<tr>
<td>Medicaid</td>
<td>line 78</td>
</tr>
<tr>
<td>Health insurance premiums paid by employers</td>
<td>NIPA Table 7.8, line 16</td>
</tr>
<tr>
<td>Health insurance premiums paid by households</td>
<td>NIPA Table 2.4.5, line 93</td>
</tr>
</tbody>
</table>

4 Health Expenditure and the Evolution of the U.S. Saving Rate: an Accounting Exercise

In this section we provide evidence that the drop in the private saving rate that occurred over the past three decades can be explained by the evolution over this period of health expenditure. We document this finding in three steps. We first show that medical expenses grew as a share of disposable income at an approximately constant rate starting from the early sixties. We then provide evidence that, in spite of this, health expenditure can explain the decline in the saving rate because of the following coincidence. From the early sixties to the end of the seventies, the social security benefits paid by the government to households, which enter the saving rate through disposable income, increased as a fraction of income at approximately the same rate as the share of medical expenses. As a result, during the sixties and seventies the rise in health expenditure had no effect on the saving rate since it was matched by a corresponding increase in social security benefits. Beginning from the early eighties, however, the social security benefits stopped growing. The rise in health expenditure was therefore transformed into a corresponding decline in the U.S. saving rate. Finally, we show that health expenditure can explain on its own the drop in the saving rate by considering a hypothetical situation in which health expenses and social security
benefits are set equal to a constant fraction of household disposable income for the entire period.

We start by introducing the definition of the saving rate that is commonly used in the savings literature:

\[ r_t = \frac{\text{disposable income} - \text{total expenditure}}{\text{disposable income}}. \]  

Using this measure, Figure 1 illustrates the evolution of the U.S. personal saving rate in the last fifty years. As many other papers have documented, during the sixties and seventies the saving rate in the household sector was approximately constant at around 10%. But in the early eighties it started to decline at a fast pace until in the second half of the last decade it reached the unusually low level of 3%. It is noteworthy the upward trend displayed by the U.S. saving rate during the recent recession. This increasing pattern is common to most economic downturns. It can be observed during the recessions that took place in the early eighties, during the downturn of the early nineties, and also during the recession that characterized the beginning of the new century. It is remarkable, however, that from the end of the recent recession the U.S. saving rate resumed its downward trend.

In Figure 2 we document the evolution of health expenditure as a percentage of income from the early sixties to the present. Gokhale, Kotlikoff, and Sabelhaus (1996) have provided evidence that this variable has increased at a steep rate during the period under consideration. Figure 2 uses data from the NHEA to confirm their finding.

As mentioned above, during the sixties and seventies the growth in the share of medical expenses was matched by a similar increase in the share of social security benefits, therefore offsetting its effect on the saving rate. But starting in the eighties the share of social security benefits stopped growing. Figure 3 documents this pattern jointly with the evolution of the share of health expenditure and of a new variable obtained by subtracting the share of social security benefits from medical expenses. The share of social security benefits clearly grew at a similar rate as the share of medical costs until the end of the seventies. It then remained constant at around 6 percent of disposable income. As a consequence, the new variable we have constructed displays the pattern required to explain the decline in the saving rate. It was constant until the end of the seventies and grew at a steep rate since then.

To confirm this hypothesis, we perform a simple empirical exercise. We consider the evolution of the saving rate for a hypothetical situation in which health expenditure net of social security
benefits is set equal to a constant fraction of income throughout the period. Without loss of
generality, we consider the case in which the constant fraction is zero. If the increase in medical
expenditure net of social security benefits is the main driver of the drop in the saving rate, in this
hypothetical exercise we should observe that the saving rate fluctuates around a constant rate
throughout the period. Figure 4, in which we report the share of health expenditure net of social
security benefits, the actual saving rate, and the hypothetical saving rate, shows that this is the
case. The hypothetical saving rate fluctuates around 15% for the entire period. It is remarkable
that with our variable we can explain even the slight decline in the saving rate that occurred in
the second part of the seventies.

This result supports the hypothesis that the increase in health expenditure net of social security
benefits can explain on its own the decline in the U.S. saving rate. It also explains why the increase
in health expenditure did not affect the saving rate of the household sector in the sixties and
seventies. During that period, the household sector experienced a similar increase in the inflow
of resources from the government sector in the form of social security payments. Later in the
paper, we will provide evidence that the rise in those benefits was paid by reducing expenditure
on other public goods and by increasing debt, and not by increasing taxes on the household sector.
For the household sector, the increase in the share of social security benefits was therefore a net
inflow of resources. Figure 5 provides evidence in support of this by reporting the evolution of the
saving rate for the household and government sectors. The government saving rate is computed as
government receipts minus government expenditure everything divided by household disposable
income. We divide by household disposable income and not by government receipts to facilitate
the comparison of the two saving rates. In the sixties and seventies, the government saving rate
declined rapidly, which is consistent with the hypothesis that in those two decades the rise in
health costs were funded by an inflow of resources from the government sector.

The hypothetical exercise of this section can be performed using two methods. Since they
generate similar results and the discussion of their differences entails technical aspects of how NIPA
constructs the saving rate, we provide a detailed description of the two approaches in Appendix
A.1 and the outcome of the hypothetical exercise obtained using the alternative method in Figure
A.1. The discussion in the Appendix reveals interesting aspects about the way NIPA computes
the U.S. personal saving rate.

The main limitation of the analysis performed in this section is that our findings are based on
a simple accounting exercise. We believe that the accounting exercise is informative because it suggests a potential simple explanation for the puzzling decline in the U.S. saving rate. However, on its own it cannot be used to establish whether there is a causal relationship between the growth in health expenditure and the saving rate decline. The reason for this is that we cannot rule out the existence of one or more variables that are correlated with both the saving rate and health expenditure and are the real drivers of the decline. To address this issue, in the next section we use cross-state variation to provide evidence on a possible causal relationship between our two main variables.

5 Health Expenditure and the Evolution of the U.S. Saving Rate: Cross-state Variation

To understand whether there is a causal relationship between changes in health expenditure and changes in the saving rate, we proceed in two steps. In the next subsection, we use variation across states in our two main variables to test this hypothesis. Results obtained using cross-state variation may be affected by an omitted-variable bias. To address this potential problem, in the second subsection, we instrument the changes in health expenditure using as an arguably exogenous source of variation the FDA approval of new drugs interacted with demographic characteristics of a particular state.

For reasons that will be clear in the next subsection, we can only perform the cross-state analysis for the sample period 1980-2009. The previous section made clear that from around 1980 the social security benefits remained approximately constant as a fraction of disposable income. They had therefore at most a limited effect on the decline of the saving rate. For this reason in the rest of the paper we will only focus on the rise in the share of medical expenditure.

5.1 Changes in Health Expenditure Across States

The idea behind using cross-state variation to determine whether there is a causal relationship between health expenditure and the saving rate is straightforward. If there is a causal relationship, states that experience larger increases in health expenditure should display larger declines in their saving rate. If this is not the case, we can reject that the relationship is causal.

The implementation of this strategy requires the construction of saving rates at the state
level. The computation of state-level saving rates requires knowledge of disposable income and total expenditure for each state. State-level disposable income can be easily measured, since data on this variable have been regularly published by NIPA since 1948. The computation of state-level total expenditure is more complicated since there is no readily available measure for this variable. To overcome this problem, we experimented with two different approaches. We first attempted to construct this variable by using micro-level data on household expenditure. Since the most reliable source of household-level expenditure in the U.S. is the Consumer Expenditure Survey (CEX), we employed this data set. There are two main issues with using the CEX to construct state-level expenditure. First, the sample size for most states is small, which makes this measure of expenditure imprecise and volatile. Second, a well-known fact in the savings literature is that the changes in the aggregate U.S. saving rate obtained using the CEX differ in a significant way from the changes constructed using NIPA data. Our analysis confirms this result and therefore disqualifies this first approach as a possible way of understanding the reasons behind the recent decline in the U.S. saving rate.

A second possible method for constructing state-level expenditure is to use retail sale data. Evidence has been provided that retail sale data approximate well household expenditure at the aggregate level if one is interested in changes and not in levels. Since in this section we exploit changes over time in savings rates, all we need is a state-level variable that, divided by disposable income, can replicate well the changes in the share of household expenditure. The retail sale data are, therefore, well suited for the construction of our variable. As mentioned in the data section, the retail sale data used in this paper are prepared by the private company Claritas and can be found in the Survey of Buying Power published by the Sales & Marketing Management magazine.

There are four main expenditure components that are missing from retail sale data: health expenditure, expenses related to renting a house, the rental value associated with owning a house, and expenditure on services. Unfortunately, there is no state-level measure of household expenditure on services. There exist, however, state-level measures for the other three components. We add them to retail sales to improve the ability of our measure to approximate household expenditure. Health expenditure at the state level can be constructed using data from the NHEA. The NHEA publishes two measures at the state level: by state of the provider of the health service

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2See for instance Slesnick (2001), Garner et al. (2006), and Heathcote, Perri, and Violante (2010).

3See for instance the detailed and careful discussion in Zhou (2010).
and by residence of the consumer buying the health service. Since the data by residence are only available starting in 1991, we use as our main variable state-level health expenses by provider. The second expenditure component that is missing from retail sale data - expenses related to renting or buying a house - can be approximated using the state-level NIPA measure of housing services which is available as part of disposable income. For renters, it corresponds to the rent paid to the owner minus expenses related to housing services such as depreciation, maintenance and repairs, property taxes, and mortgage interest. For owners, it is constructed as the imputed rental value of the house minus the housing expenses described above. This state-level measure of expenditure of housing services is only an approximation of the true measure because depreciation, property taxes, and mortgage interest should be included in this measure. Notice that expenses from maintenance and repairs are correctly subtracted from our measure of housing expenses since they are already included in the retail sale data.

In Figures 6 and 7, we provide evidence on the ability of our measure of the share of household expenditure to approximate the variable constructed by NIPA. Since the NHEA started publishing health expenditure data in 1980 and the last year for which we have retail sale data is 2009, our expenditure measure covers the period 1980-2009. In Figure 6, we describe the ratio between the aggregate household expenditure obtained using our measure and using NIPA data. As expected, our measure is always below the variable constructed by NIPA. But, remarkably, the difference between the two measures is approximately constant during our sample period with a ratio that stays around 65% from 1980 to 2009. This result suggests that our measure should be able to approximate the changes in the share of household expenditure as measured by NIPA. To confirm this, in Figure 7 we plot the changes between \( t \) and \( t + 1 \) for the NIPA saving rate and the corresponding changes computed using our measure. The graph indicates that our measure matches remarkably well the changes constructed using the NIPA data.\(^4\)

We can now use cross-state variation to estimate the effect of a change in the share of health expenditure on the saving rate. In Figure 8, we report preliminary evidence on the relationship between state-level health expenditure and state-level saving rates by plotting these two variables.

\(^4\)During our sample period, one data point is missing from the retail sale data. Until 2000 the survey recorded retail sale data for the previous calendar year. But starting from 2000, it began reporting retail sale data for the current year. The retail sale number for 1999 is therefore missing. As a consequence, when we use changes in the saving rate, two data points are missing.
for each state and time period. The first panel reports our two main variables in levels, whereas the second panel describes them using changes. In both panels, we also report a line obtained by regressing the state-level saving rates on state-level health expenditure. The two scatter plots indicate that there is a negative relationship between saving rates and medical expenses both in levels and changes: states with higher levels of expenditure have lower saving rates; and states that experience larger increases in health expenditure display larger declines in their saving rate.

To provide more evidence, let $s_t$ and $c^h_t$ be, respectively, the saving rate and the share of health expenditure. Denote with $f_t$ and $f_s$ time and state fixed effects, and with $X_{t,s}$ a set of control variables that vary with time and state. We can then estimate the effect of changes in the share of health expenditure on changes in saving rates for the sample period 1980-2009 by using the following linear equation:

$$s_{t,s} = \alpha_0 + \alpha_1 c^h_{t,s} + \alpha_2 X_{t,s} + f_t + f_s + \epsilon_{t,s}. \tag{2}$$

Standard theories indicate that saving decisions and therefore the saving rate depend on risk preferences, permanent income, and the degree of uncertainty faced by the individual. Variables that are constant over time such as risk preferences are already captured in equation (2) by the state fixed effects. To account for the time-varying variables that may affect the saving rate independently of health expenditure, we include in $X_{t,s}$ the following state-level variables. As proxies for the degree of uncertainty, we include the unemployment rate and the fraction of individuals with college or higher degree. As proxies for permanent income, we include the fraction of individuals with college or higher degree, the fraction of individuals between the ages of 30 and 60, the fraction older than 60, the fraction of African-americans, and the fraction of Hispanics.

Before presenting the results it is important to make two remarks. First, the fixed effect regression described by equation (2) uses the data variation described at the beginning of this subsection: it considers changes over time in health expenses for different states and it relates them to the corresponding changes in saving rates. The coefficient of interest is given by $\alpha_1$, which measures the percentage point change in the saving rate that corresponds to a one percentage point change in the share of health expenditure. We have also experimented with the following specification that uses changes in saving rates and health expenditure:

$$s_{t,s} - s_{t-1,s} = \alpha_1 \left( c^h_{t,s} - c^h_{t-1,s} \right) + \alpha_2 \left( X_{t,s} - X_{t-1,s} \right) + d_t + \epsilon_{t,s} - \epsilon_{t-1,s},$$
A known result is that the two specifications produce identical estimates if only two periods are considered. If the data set contains more than two periods, the results should be similar. We report the estimated coefficients of the regression that uses first differences in the Appendix.

As a second remark, notice that the share of health expenditure enters the right hand side of equation (2) as our main independent variable. At the same time, it also affects our dependent variable. To make this clear, let \( \bar{c}_t \) be the share of household expenditure net of health expenses and observe that the saving rate can be written as follows:

\[
s_t = 1 - \bar{c}_t - \bar{c}_t^h.
\]

In spite of this, regression (2) does not simply captures a mechanical relationship between \( \bar{c}_t^h \) on the right hand side and \( \bar{c}_t^h \) inside the saving rate. When there is an increase in the share of health expenses, consumers can choose to reduce the consumption of other goods if it is optimal for their saving rate to stay at a higher level. If this is the case in the data, the coefficient \( \alpha_1 \) will be estimated to be lower than without a household response. Consumers may also choose to increase the consumption of goods that have some degree of complementarity with health expenses. If the increase is large enough, the coefficient \( \alpha_1 \) will be estimated to be greater than with no reaction by households.

The results of the OLS regression are presented in Table 3. The parameter of interest, \( \alpha_1 \), is estimated to be equal to \(-0.643\). This number implies that a 1 percentage point increase in the share of medical expenditure reduces the saving rate by 0.643 percentage points. The estimated coefficients on the control variables have the expected sign. An increase in the share of middle-aged individuals by a 1 percentage point increases the state saving rate by 0.93 percentage points. The same change in the share of Hispanics increases the saving rate by 0.40 percentage points. The unemployment rate has a positive effect at 0.41, which confirms our insight that it captures the degree of uncertainty in a given state and is consistent with the observation that saving rates increase during recessions. Finally, the share of individuals older than 60, the share of individuals with college or higher degree, and the share of African-americans have no significant effect on the dependent variable. The estimated coefficients obtained using first differences, which are reported in the Appendix, are slightly larger in magnitude, but have similar economic interpretation.

It is important to remark that it is difficult to infer directly from the size of the estimated coefficient \( \alpha_1 \) whether households responded to the rise in health expenditure by reducing the con-
sumption of other goods, since the NIPA definition of the saving rate includes several components that are affected differently by the increase in the share of health expenditure. For this reason, we postpone the discussion of this crucial issue to section 6, where we develop a model that enables us to understand the economic meaning of the coefficient $\alpha_1$ and whether households responded to the increase in medical expenses.

There are at least two reasons related to omitted variables that prevent a causal interpretation of our OLS results. Households tend to migrate to states where there are more employment opportunities and, consequently, to state that have higher disposable income. In addition, most of the migration flows are driven by individuals with high education, who generally have lower medical expenses. If the propensity to save increases with income, these two patterns generate a negative correlation between saving rates and health expenses that could bias our OLS estimate of $\alpha_1$ and make it more negative. If the propensity to save decreases with income, the correlation between our two main variables will be positive and the estimated $\alpha_1$ could be biased toward zero.

A second potential problem is related to adverse economic shocks that are state specific. Generally, negative shocks affect at the same time saving and health expenditure decisions. Depending on whether these shocks create a negative or positive correlation between our two main variables, our estimated OLS coefficient on medical expenses will be characterized by a negative or positive bias. In the OLS regressions, we control for education and unemployment. The effect of migration and economic shocks should therefore be at least partially captured by those variables. However, there is always the possibility that those controls are not sufficient to eliminate the potential bias. To address this possible threat to a causal interpretation of the OLS estimates, we will instrument state-level health expenditure using as an arguably exogenous source of variation the FDA approval of new drugs interacted with the demographic structure of the corresponding state.

### 5.2 Instrumental Variable Strategy

To overcome the endogeneity problem discussed in the previous subsection, we need a variable that is correlated with state-level health expenditure, but uncorrelated with the error term of equation (2). A good candidate for a variable that affects the state-level saving rate only through state-level health expenditure is the FDA approval of new drugs. This variable clearly affects health expenses, since the approval of new drugs has generally a positive effect on them. In addition, it is arguably exogenous to changes in the saving rate after the variation in medical expenditure is
We construct the variable FDA approval of new drugs using data that are publicly available from the FDA website.\(^5\) There are two kinds of approvals: (i) approvals of new molecular entities and (ii) approvals of new drugs composed of old molecular entities.\(^6\) Since new molecular entities are the most likely to increase medical expenditure, we first construct our approval variable using only the first category. We then check whether our results are robust to the inclusion of new drugs in the second group. Even when we include new products from the second group, we do not make use of drugs with a new manufacturer and new indications because they have insignificant effects on health spending. Our state-level health expenditure variable covers the period 1980-2009. We therefore construct our instrumental variable for the same sample period.

Figure 9 illustrates the number of new molecular entities approved each year during the period 1980-2009, which is the variation used in our analysis. For completeness, we also include in the figure the cumulative number approved up to a given year. Figure 10 displays the same two variables when we use the alternative definition of FDA approvals which includes all new drugs. The two figures show that there was a significant number of drugs that entered the market each year. If one focuses on new molecular entities, the lowest number was approved in 1980 when 9 new products entered the market, whereas the highest number was recorded in 1997 with 58 new molecular entities. For new drugs, the minimum was recorded in 1983 at 33 and the maximum in 1997 at 137.

The main limitation of our instrumental variable is that it does not vary across states. Notice, however, that the federal approval of new drugs has different effects on local economies depending on their demographic structure. Everything else equal, states with a larger fraction of older individuals should see a steeper increase in medical expenditure after the approval of a particular drug, since older people tend to have higher demand for medical products. Similarly, states with a higher fraction of college graduates should experience a smaller increase in health expenses if

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\(^5\)The data on drug approvals can be downloaded at http://www.fda.gov/Drugs/InformationOnDrugs/ucm079750.htm. These data were first used by Lichtenberg and Virabhak (2007) as one of the inputs to estimate the effect of drugs approved in different years on post-treatment health. Acemoglu and Linn (2004) also employ those data as one of the variables used to construct market size.

\(^6\)The second category includes drugs having as ingredients new ester, new salt, or other noncovalent derivative, drugs with a new formulation, drugs with a new combination of old molecular entities, drugs with a new manufacturer, and drugs with new indications.
more educated individuals are healthier and, hence, spend less on medical consumption. Using this insight, we construct four state-level instruments by interacting the FDA cumulative approval of new drugs with the following state-level variables: the fraction of individuals that are older than 60; the fraction of individuals with college or higher degree; the fraction of African-americans; and the fraction of Hispanics. Since those four variables are included in the vector of controls \(X_{t,s}\), it is straightforward to show that, if the variable FDA approval is uncorrelated with the error term of equation (2) conditional on \(X_{t,s}\), the four variables we propose as instruments are also uncorrelated with the error term.\(^7\)

We also perform the IV estimation using an alternative set of instruments. New drugs are generally targeted to individuals of particular ages. As a consequence, if we can isolate the new drugs that are developed for a particular age group, we can replace our age-based instrument with new instruments obtained by interacting new drugs approved for a particular age group with the corresponding fraction of individuals in that age bracket. To identify the new drugs for individuals in different age groups, we first construct three age groups: individuals older than 60, individuals between the ages of 30 and 60, and individuals younger than 30. We then use the Medical Expenditure Panel Survey (MEPS) to determine the amount spent by a particular age group on a new drug. Finally, we assign a newly approved drug to a particular age group if the expenditure of this age group on the drug is at least 20% higher than for the other groups. The new set of instruments is then constructed by replacing the FDA approvals interacted with the fraction of individuals older than 60 with the following two new instruments: the approval of a new drug designed for individuals older than 60 interacted with the fraction of the population in a state in that age group; the same interaction for individuals between the ages of 30 to 60.\(^8\)

To obtain the instrumental variable estimates we use a standard approach. In the first stage, we estimate the equation that relates the share of health expenditure to FDA approvals interacted

\(^7\)To see this, denote with \(Z\) the variable FDA approval and with \(W_j, j = 1,..., 4\), the four state-level variables mentioned above. Then, by the law of iterated expectations and \(W^j \in X, j = 1,..., 4\), if \(E[\epsilon Z | X] = 0\) we have,

\[E[\epsilonZW^j] = E[W^j E[\epsilon Z | X]] = 0.\]

Hence, if this condition is satisfied, our instruments \(ZW^j, j = 1,..., 4\), fulfill the exclusion restriction.

\(^8\)We do not include the approval of new drugs for individuals younger than 30 interacted with their fraction in a state because there are too few approvals for this age group.
with state-level variables:

\[ \hat{c}_{t,s}^{h} = \delta_{0} + \sum_{j} \delta_{j} Z_{t} W_{t,s}^{j} + \beta X_{t,s} + g_{t} + g_{s} + \eta_{t,s}, \]

where \( g_{t} \) and \( g_{s} \) are time and state fixed effects. In the second stage, we estimate equation (2) with the share of health expenditure, \( \hat{c}_{t,s}^{h} \), instrumented using the estimates from the first stage. As for the OLS regressions, we have also estimated the parameters using first differences. The estimates obtained using this specification are reported in the Appendix.

The results of the first stage regressions are reported in Table 4. As mentioned above, we consider four different specifications. In the first column, we report the results obtained using only approvals of new molecular entities interacted with the state-level variables. The coefficient estimates, which are for 100 approvals, have the expected sign. The cumulative number of approvals interacted with the fraction of old people has a strong and positive effect on the share of medical expenditure in that state. The approval of 100 new molecular entities increases the share of health expenditure in a given state by 0.043 percentage points relative to a state with a one percentage point lower fraction of older individuals. As expected, the effect of education is negative and statistically significant at \(-0.027\). This means that the approval of new molecular entities in states with a larger fraction of individuals with college or higher degree has a smaller effect than in other states. The fraction of African-americans and Hispanics have a positive and statistically significant effect on the share of medical consumption. The approval of 100 new molecular entities increases the share of health expenditure in a state with a given fraction of Blacks by 0.004 percentage points relative to a state that has a fraction of African-americans that is 1 percentage point lower. For Hispanics, this percentage is 0.005. In the second column, we present the results generated by the second set of instruments which uses approvals for specific age groups for the age-based instruments. The sign of the coefficients and their statistical significance remains the same. But their size increases for the age-based instruments. In this case, the approval of 100 new drugs for older individuals increases the share of health expenditure by 0.13 percentage points in a state with a 1 percentage point higher fraction of older individuals. The coefficient for the middle-aged population is 0.04 percentage points but not statistically significant. In the third and fourth columns, we report the results when we use the approvals of all drugs. The coefficients are generally smaller, but their sign and statistical significance does not change. The F-test to evaluate the strength of the instruments is large in all our specifications, with the smallest statistic
at 76.74 and the highest at 98.92.

The second stage results for our four specifications are reported in Table 5. The effect of the share of health expenditure on the saving rate is similar in our four specifications and also similar to the effect estimated using OLS. The coefficient $\alpha_1$ is estimated to be between $-0.674$ in the first specification and $-0.580$ in the last specification. These results suggest that, after controlling for demographic differences, the bias in our OLS estimates is small. The estimated coefficients obtained using the first difference specification are similar and reported in the Appendix. As mentioned for the OLS estimates, we postpone the discussion on the economic significance of the coefficient estimates for $\alpha_1$ to the model section.

There exists a potential threat to our IV strategy. If pharmaceutical companies have their headquarters and manufacturing plants in some states but not in others, the approval of new drugs may have a direct effect on state-level saving rates, even after controlling for health expenditure, through the following channel. The approval of new drugs may increase employment and income relatively more in states where the headquarter and factories of the pharmaceutical company with the new drug are located. If the propensity to save depends on income, the rise in employment and income will change the saving rate of that state relative to others introducing a bias in our analysis. To address this issue we proceed in two steps. First, we evaluate how serious such a threat can be by documenting the share of workers in the pharmaceutical industry in the U.S. and the share of U.S. GDP generated by that industry. The idea behind the first step is that, if those shares are small, it is unlikely that our IV results are affected by the changes in employment and income generated by the pharmaceutical industry. According to the CPS, from 1980 to 2010, the share of workers employed in that industry fluctuated between 0.15% and 0.34%. In 2010, the share of GDP generated by the pharmaceutical industry was 0.63%. In previous years, it was of similar magnitude. These numbers suggest that the impact of this industry on state-level employment and income should be small. As a consequence, it is unlikely that it generates significant biases in our IV estimates. However, even if unlikely, it is still possible that the shares are small at the national level, but the differences across states are sufficiently large to introduce a significant bias in our estimates. To evaluate this possibility, in the second step we use the CPS to measure the share of workers employed by the pharmaceutical industry in each state. We then re-estimate the IV coefficients after having added this variable to the set of controls. If the approval of a new drug has a direct effect on the state-level saving rate through an increase in employment and income
generated by the pharmaceutical industry, the state-level share of workers in that industry is an
omitted variable and should therefore have a significant effect on the state-level saving rate. The
results for the IV regressions are presented in Tables 6 and 7. As expected, the coefficient on the
state-level share of workers in the pharmaceutical industry is small and statistically insignificant
and the coefficient on the share of medical expenditure has barely changed.

We can now use the estimated coefficient on health expenditure and back of the envelope
calculations to compute the fraction of the decline in U.S. saving rate that can be explained by
the rise in health expenditure. From the beginning of the eighties, the share of medical expenses
has increased by about 9 percentage points. If we use the coefficient on health expenses estimated
by OLS, which is between the highest and lowest estimates obtained with IV, a 9 percentage point
increase in medical costs translates in a decline in the saving rate of about 5.8 percentage points
(0.643×9). From the eighties, the personal saving rate dropped from around 10 percent to around
3 percent, a 7 percentage point decline. The rise in health expenditure is therefore able to explain
about 82.9 percent of the decline in the U.S. saving rate (100×5.8/7).

The main finding of the last two sections is that the steep rise in medical expenses had a
negative and strong effect on the U.S. saving rate. It is difficult, however, to provide an economic
interpretation of this finding without a model of households decisions. This is the subject of the
next section.

6 A Model of Savings and Health Expenditure

The main objective of this section is to develop a simple model that, jointly with the empirical
results of the previous section, can help one understand (i) the economic meaning of the estimates
obtained in the previous section, (ii) whether households changed their consumption decisions
in response to the rise in medical expenditure, and (iii) the relationship between the NIPA’s
measure of the saving rate and the corresponding measure obtained from a standard model of
saving decisions.

Consider an economy populated by two overlapping generations, a young and an old one, which
are governed by an infinitely-lived government. The young generation is composed of working-age
individuals, whereas the old generation includes retired individuals. Each generation lives for two
periods, has a discount factor β, and preferences over a standard non-durable consumption good
c and the current health status h. The corresponding utility function takes the form u(c, h). We make the assumption that preferences are strongly separable between consumption and health status, i.e. \( u(c, h) = v_1(c) + v_2(h) \). The objective of each generation is to maximize its life-time utility. We assume that there is no altruism toward future generations. The significance of this and of the strong separability assumption will be discussed at the end of the section.

In each period t, the health status of a generation is a function of three variables: the technology used to maintain and improve its health \( \theta_t \), the amount of resources spent on health care \( c^h_t \), and a health shock \( \epsilon_t \). If we allow the effect of the three variables to vary across generations, the health status can be written as follows:

\[
h_t = f^j(\theta_t, c^h_t, \epsilon_t) \quad j = y, o.
\]

We will assume that the amount of resources spent on health is a deterministic function of the adopted technology, i.e. \( c^h_t = g(\theta_t) \). As a consequence, the health status becomes simply a function of the health shock and of the technology, i.e.

\[
h_t = f^j(\theta_t, \epsilon_t) \quad j = y, o.
\]

The technology is allowed to evolve over time. Specifically, in each period t the economy is characterized by two technologies that can be used to affect the level of health: a modern technology \( \theta_t^m \) and an outdated technology \( \theta_t^{ou} \). In each period, a third and newer technology becomes available with a probability \( P_\theta \). If it does, the outdated one can no longer be used, whereas the modern technology becomes outdated. At each point in time only one technology can be used. We will assume that, conditional on the health shock, the newer technology guarantees higher levels of health, but it also requires larger health expenses \( c^h_t \).


The health expenses of the old generation are paid using a public health insurance which is provided by the government and funded by a combination of taxes on the young \( \tau_t \) and government debt \( d_t \). The health expenses of the young generation are covered by a private health insurance which is paid partly by the young generation at a premium \( P_t^h \) and partly by their employers through employer contributions to health plans \( E_t^h \). Since our focus is on households’ choices, we will not model firms’ decisions and assume that \( E_t^h \) is exogenously given. To simplify the notation we will include out-of-pocket health expenses in the premium \( P_t^h \).
In each period, the young generation is endowed with an amount of income $y_t$ which is assumed to evolve deterministically. The young generation can save an amount $b_t$ using a risk-free asset with a gross interest rate $R_t$. The only source of income for the old generation is the amount of savings they possess when old. The consumption of the non-durable good is the numeraire. Finally, we will denote with $\omega \in \Omega$ one of the possible states of nature.

We can now describe the decisions of the two generations and of the government. In period $t$, the young generation chooses how much to consume of the non-durable good and how much to save as the solution of the following problem:

$$\max_{c_t, c_{t+1}, b_t} v_1(c_t) + v_2(h_t) + \sum_{\omega=1}^{\Omega} P(\epsilon_{t+1}^\omega, \theta_{t+1}^\omega | \epsilon_t, \theta_t) \beta(v_1(c_{t+1}^\omega) + v_2(h_{t+1}^\omega))$$

s.t. $c_t + P^h_t + b_t = y_t - \tau_t$

$$c_{t+1}^\omega = R_t b_t \text{ for each } \omega \in \Omega$$

$$h_t = f^y(\theta_t, \epsilon_t) \text{ and } h_{t+1} = f^o(\theta_{t+1}^\omega, \epsilon_{t+1}^\omega) \text{ for each } \omega \in \Omega.$$
of the two generations, i.e.

$$\max_{\tau_t, d_t, h_t} \mu^y \left[ u (c^y (\tau_t), h^y_t) + \beta \sum_{\omega=1}^{\Omega} P \left( \epsilon^\omega_{t+1}, \theta^\omega_{t+1} \mid \epsilon_t, \theta_t \right) u \left( c^{\omega,o} (\tau_t), h^{\omega,o}_{t+1} \right) \right] + \mu^o u \left( c^o (\tau_{t-1}), h^o_t \right) $$

s.t. \( \tau_t + d_t = R^I t d_{t-1} + c^h_t \)

\[ h^y_t = f^y (\theta_t, \epsilon_t), \quad h^o_t = f^o (\theta_t, \epsilon_t), \quad \text{and} \quad h^{\omega,o}_{t+1} = f^{\omega,o} (\theta^{\omega}_{t+1}, \epsilon^{\omega}_{t+1}) \quad \text{for each } \omega \in \Omega. \]

We will assume that the government has access to a supply of capital \( d_t \) which is infinitely elastic.

In this model it is straightforward to show that, for any health technology, if \( \mu^y > 0 \) the government will set taxes to zero and will fund the entire cost of health care by issuing debt. To understand why observe that, for any technology, issuing debt has no effect on the old generation. It also has no impact on the welfare of the young generation since the government cannot tax them when they are old. It is also straightforward to show that the government will always choose to adopt the newest technology. The welfare of the old generation increases if the government adopts the new technology since this generation is not affected by the corresponding rise in health expenditure. In addition, remember that for any technology it is optimal for the government to choose \( \tau_t = 0 \) and \( d_t = R^I t d_{t-1} + c^h_t \). As a consequence, the young generation is also better off if the latest technology is adopted since it is paid by issuing debt.

Now that we know the government’s decisions, we can analyze the decisions of the young generation. Since the new technology is funded exclusively by debt, its adoption has no effect on the household budget constraint. Under the assumption that preferences are strongly separable, the expected improvement in health status generated by the adoption of the modern technology has no effect on the consumption and saving decisions of the young generation. Specifically, consumption is determined by the following standard Euler equation:

$$v'_1 (c_t) = \beta R_t v'_1 (c^o_{t+1}).$$

In the Euler equation, there is no expectation on the right hand side because the only uncertainty in the model is about health status and this variable is strongly separable from non-durable consumption.

To simplify the notation we will consider the case in which \( \beta R_t = 1. \)\(^{11}\) The Euler equation

\(^{11}\)For standard utility functions, such as Constant and Relative Risk Aversion utilities, similar results hold if \( \beta R_t \neq 1. \) The only difference is that in this case consumption, and hence the saving rate, are also a functions of the discount factor \( \beta. \)
and the budget constraint of the young generation can be solved for non-durable consumption to obtain:

$$c_t = \frac{R_t (y_t - P^h_t)}{1 + R_t}.$$  \hspace{1cm} (3)

This equation establishes that the young generation consumes about half of the income left after paying the health insurance premiums and out-of-pocket expenses and saves approximately the other half for when they are old.

In our empirical analysis, we have used the saving rate of the household sector as measured by NIPA. It is defined as income of the young minus their expenditure, plus income of the old minus their expenditure, everything divided by income of the young plus income of the old. In our model, the NIPA definition of income for the young generation is given by the exogenous income $y_t$ plus the employer contributions to health plans $E^h_t$, whereas the NIPA definition for the old generation is given by their asset income $(R_t - 1)b_t$ plus the transfers received from the government as payment for health treatments (Medicare and Medicaid). The previous discussion indicates that in each period those transfers are equal to the increase in debt $d_t - R^l_t d_{t-1}$. The NIPA definition of the saving rate takes therefore the following form:

$$s_{NIPA}^t = \frac{y_t + E^h_t - c_t^y - c_t^{h,y} + (R_t - 1)b_{t-1} + d_t - R^l_t d_{t-1} - c_t^o - c_t^{h,o}}{y_t + E^h_t + (R_t - 1)b_{t-1} + d_t - R^l_t d_{t-1}}.$$  \hspace{1cm} (4)

As argued earlier, in our model we have $c_t^o = R_t b_{t-1}$ and $c_t^{h,o} = d_t - R^l_t d_{t-1}$. Hence, if one defines $Y_t = y_t + E^h_t + (R_t - 1)b_{t-1} + d_t - R^l_t d_{t-1}$, the NIPA saving rate can be written as follows:

$$s_{NIPA}^t = \frac{y_t + E^h_t - c_t^y - c_t^{h,y} - b_{t-1}}{Y_t}. \hspace{1cm} (4)$$

This alternative way of writing the NIPA saving rate shows that an increase in health expenditure in period $t$ has two effects on the saving rate at $t$. The first one is the direct effect of increasing health expenses, which is measured by $-\frac{c_t^{h,y}}{Y_t}$. The second effect is the indirect effect, which is generated by changes in household’s income and consumption in response to the increase in health expenditure, $\frac{y_t + E^h_t - c_t^y}{Y_t}$. It is important to remark that, in our decomposition of the effect of an increase in health expenses, we have assumed that the increase has no influence on the share of financial wealth accumulated by the old generation when young, $b_{t-1}$ in the model, this is a good assumption since the old generation does not pay for health expenditure. In reality,
this assumption is consistent with the current discussion in news outlets on the state of health expenditure, which suggests that the steep rise in health-related payments was not expected.

Equation (4) highlights an important feature of the direct effect. Since NIPA includes Medicaid and Medicare payments in disposable income as well as household expenditure, the direct effect is mainly generated by changes in private health expenditure. Medicare and Medicaid can only affect the denominator of the saving rate. In the data, during the sample period 1980-2009, private health expenditure was on average 66 percent of total health expenditure. This implies that a 1 percentage point rise in total health expenditure had the effect of increasing the share of private health expenditure by 0.66 percentage points, as long as the increase was spread evenly across health expenses. As a consequence, without indirect effect, a 1 percentage point increase in total medical expenditure should have generated a 0.66 percentage points reduction in the NIPA saving rate.

We can now interpret the coefficient on health expenditure in the saving rate regression \( \alpha_1 \) estimated in the previous section. Without indirect effect, \( \alpha_1 \) should be approximately equal to -0.66. However, if households chose to respond to the increase in health expenses in a way that makes the indirect effect positive, \( \alpha_1 \) should be estimated to be lower than 0.66 in absolute value. For similar reasons, if the consumers’ response generated a negative indirect effect, the coefficient \( \alpha_1 \) should be estimated to be greater than 0.66 in absolute value. The empirical results presented in the previous section indicate that \( \alpha_1 \) is between 0.58 and 0.67. We can therefore conclude that the households’ response generated a positive but negligible indirect effect.

We will now further explore the finding that the indirect effect was negligible. We will first document that our IV result, according to which the indirect effect is negligible, is consistent with patterns observed in NIPA and CPS data. We will then use our finding to understand whether and by how much household responded to the rise in health expenditure.

To compare our IV results with NIPA and CPS data, observe that, by using the optimal level of consumption \( c_t^y \) derived in equation (3), the indirect effect can be written in the following form:

\[
\frac{y_t + E_t^h - c_t^y}{Y_t} = \frac{y_t + E_t^h - \frac{R_t (y_t - P_t^h)}{1 + R_t}}{Y_t} = \frac{1}{1 + R_t} \frac{y_t + (1 + R_t) E_t^h}{Y_t} + \frac{R_t P_t^h}{1 + R_t Y_t}.
\]

This equation indicates that the indirect effect changes the saving rate only if the increase in health expenditure had the effect of raising the share of disposable income earned by the young
generation, \( y_t + (1 + R_t) \frac{E^h_t}{Y_t} \), or of raising the share of premiums paid for private health insurance plus out-of-pocket expenses, \( P^h_t \frac{Y_t}{Y_t} \).

The evolution over our sample period of the variable \( y_t + (1 + R_t) \frac{E^h_t}{Y_t} \) can be documented using data from the CPS on income jointly with data from NIPA on employer contributions to health plans, and data from SEER on population counts by age groups. Specifically, employing information available in the CPS, we construct per-capita income for individuals younger than 65, \( y_t \), from 1980 to 2009. Then, using SEER data we compute the number of individuals younger than 65 for each year and multiply per-capita income times this number. Finally, using NIPA data, we calculate the employer contributions to health plans \( E^h_t \) and total disposable income for the household sector \( Y_t \) and compute the variable we are interested in \( y_t + (1 + R_t) \frac{E^h_t}{Y_t} \). We used the 1-year rate on treasury bills as our interest rate variable. The evolution from 1980 to 2009 of the variable of interest is documented in Figure 11. During those years, that variable was remarkably constant at around 80% of disposable income. To understand why, in Figure 12 we plot the share of income of the working-age generation and separately the share of employer contributions to health plans. During the period, the employer contributions to health plans grew at a steady rate. But at the same time, the share of income of the working age population declined at about twice that rate. The variable \( y_t + (1 + R_t) \frac{E^h_t}{Y_t} \) therefore fluctuated around a constant share.

We will now describe the evolution of the second part of the indirect effect: the share of health insurance premiums plus out of pocket health expenses. Figure 13 shows that, during the period considered in our cross-state analysis, 1980-2009, this variable remained approximately constant around 4 percent of disposable income. The last two pieces of evidence taken together indicate that our IV results are consistent with the NIPA and CPS data: in both cases the indirect effect of the rise in medical expenses was negligible.

Using the previous discussion and Figure 12 we can now attempt to understand whether households responded to the increase in health expenditure by reducing the consumption of other goods. We have provided evidence that the variable measuring the indirect effect \( \frac{y_t + E^h_t - c^y_t}{Y_t} \) remained approximately constant during the period considered. As a consequence, during those years, the share of household non-durable consumption of the working-age generation should have
evolved approximately according to the following equation:

\[ \Delta \frac{c_i}{Y_t} \simeq \Delta \frac{y_t + E_t^h}{Y_t}. \]  

(5)

In Figure 11, we have also provided evidence that the variable \( \frac{y_t + (1 + R_t) E_t^h}{Y_t} \) stayed approximately constant, which implies that

\[ \Delta \frac{y_t}{Y_t} \simeq -\Delta \frac{(1 + R_t) E_t^h}{Y_t}. \]  

(6)

We can now use this equation to substitute out \( \Delta \frac{y_t}{Y_t} \) from equation (5) and obtain,

\[ \Delta \frac{c_i}{Y_t} \simeq -\Delta \frac{R_t E_t^h}{Y_t}. \]  

(7)

Equation (7) establishes that, during the years considered by our IV regressions, an increase in the share of employer contributions to health plans by a given percentage should have corresponded to a decline in the share of non-durable consumption by the same percentage multiplied by the gross interest rate. From 1980 to 2009, the share of employer contributions to health plans multiplied by \( R_t \) grew by about 1.7 percentage points. This corresponds to an increase of about 0.06 percentage points per year. We can therefore conclude using equation (7) that the increase in health expenditure was associated with a decline in consumption of other goods of about 0.06 percentage points per year. From 1980, the U.S. saving rate has declined by about 7 percentage points, which corresponds to a decline of approximately 0.23 percentage points per year. Hence, had households not reduced their non-durable consumption by 0.06 percentage points per year, the U.S. saving rate would have declined at a rate of 0.29 percentage points per year, which corresponds to a total decline of 8.7 percentage points instead of the 7 percentage points observed in the data.

We conclude this section by discussing the main assumptions that characterize our model. We start by considering the assumption that the old generation does not pay taxes. Without this assumption, a rise in current debt will translate into an increase in the probability that the young generation will pay higher taxes when old. As a consequence, the consumption decisions of the young individuals will be directly affected by the rise in health costs. To evaluate whether this assumption is realistic one can use generational accounts, which compute the present value of the per-capita net taxes that a generation will pay for the rest of its life under a particular fiscal
policy. Gokhale, Page, and Sturrock (1999) compute the generational accounts for a number of U.S. generations and find that net tax payments are negative for men that are 60 or older and for women that are 55 or older. Our assumption is therefore consistent with the findings in the generational accounting literature.

A second assumption that is worth discussing is the strong separability between non-durable goods and health status. The limited empirical evidence on the relationship between these two variables is mixed. De Nardi, French, and Jones (2010)’s results are consistent with our assumption of strong separability, since they find a negative relationship which is statistically insignificant. Finkelstein, Luttmer, and Notowidigdo (2013)’s findings suggest that healthier individuals derive higher levels of utility from non-durable consumption. If that is the case, the adoption of a newer technology and the subsequent improvement in the health status of old individuals would make it optimal for the new generation to increase their savings in addition to what our model predicts to pay for the higher level of non-durable consumption they will demand when old. The households’ response to the rise in health expenses we find should therefore be a lower bound.

The last assumption that we consider is the lack of altruism. This assumption has no effect on our results provided that the supply of capital is not perfectly inelastic for any level of debt. In this case, the government will choose to postpone the payment of the debt indefinitely, which implies that the welfare of future generations will not be affected. This is clearly a strong assumption. Without it, with some degree of altruism households will take into account the effect of an increasing debt on future generations and react to it by increasing savings. If this is the case, the households’ reaction to the increase in medical costs should be larger than what we have estimated.

An implication of our model is that the rise in public health expenditure should not have been financed by raising taxes. The next section provides evidence in support of this hypothesis.

7 How Was the Increase in Public Health Expenditure Paid For?

The main objective of this section is to describe how the rise in public health expenditure was financed. We will provide evidence that public health expenditure was funded by (i) an increase in government debt and by (ii) a reduction in expenditure on other public goods. Taxes were not raised during the period under investigation. In Appendix A.2, we also investigate the source of
funding for private health expenses and provide evidence that they were financed almost entirely through a rise in employer contributions to health plans.

To determine how public health expenses were funded, it helps to divide them in its two main components: Medicare, which covers people older than 65 and disables, and Medicaid, which assists low-income families. In Figure 14 we report the evolution of public health expenditure, and separately, Medicare and Medicaid expenses. According to the data, public health expenditure increased from 1.3% in 1960 to 9.2% in 2009, with both Medicare and Medicaid contributing in a significant way to its growth. From their inception in 1966, the two programs increased at a similar rate, with Medicare and Medicaid reaching, respectively, 4.6% and 3.5% of disposable income in 2009.

We start by discussing the financing of the health expenses related to Medicare. Medicare is composed of four components: Part A, B, C, and D. The original Medicare program consisted only of Part A and Part B. Part A covers only inpatient hospital stays. Part B helps pay for some of the services and products administered on an outpatient basis and not covered by Part A. In 1997, with the passage of the Balanced Budget Act, Medicare beneficiaries were given the option to receive their Medicare benefits through private health insurance plans, instead of through the original Medicare plans A and B. These plans are known as Part C. Medicare Part D was enacted as part of the Medicare Prescription Drug, Improvement, and Modernization Act of 2003 (MMA) and went into effect on January 1, 2006. The objective of this program is to subsidize the costs of prescription drugs for Medicare beneficiaries. Figure 15 shows that Part A is the component of Medicare that grew at the fastest rate, increasing from 0.24% of disposable income in 1966, when it was introduced, to 2.6% in 2009. The rest of Medicare expenses increased at a more moderate rate, going from 0.1% in 1966 to 1.2% in 2005. In 2006 the introduction of Part D generated a jump to 1.5%. In 2009, Part B, C, and D amounted to 2.1% of disposable income.

Given the sharp increase in Part A expenditure, we will start by documenting how this component of Medicare was funded. These health expenses are paid using the Hospital Insurance (HI) trust fund, which is financed for the most part by a Medicare payroll tax. For instance, in 2006 86% of the funds came from it. The second source of funds in order of importance was interest.

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12 Medicare and Medicaid account for a large fraction of public health expenditure. For instance, in 2009 they added up to 88.4% of public health expenses.
The evolution of the Medicare payroll tax, which is paid half by the employee and half by the employer, is displayed in Figure 16. One can see that most of the expansion of Medicare Part A was funded with an increase in the corresponding payroll tax. The tax receipts increased from 0.4% of disposable income in 1966 to 1.8% in 2009. To understand the effect of the change in payroll taxes on household decisions, however, one has to analyze the evolution of the total amount of taxes paid by households. The dynamics of this variable, which is documented in Figure 16, indicates that throughout this period total taxes paid by the household sector as a fraction of income fluctuated around a constant rate of 14%. This result suggests that the increase in Medicare payroll tax was compensated by a reduction in other personal taxes. This evidence is consistence with the prediction of our model that the rise in medical costs should not be funded by raising taxes.

Medicare expenses related to Parts B, C, and D are paid using the Supplementary Medical Insurance (SMI) Trust Fund. This fund is financed primarily through the monthly premiums that all beneficiaries of Parts B, C, and D must pay and general government revenues. For instance, in 2006 general revenues accounted for 76% of the SMI Trust Fund inflow, while beneficiary premiums accounted for 21% of the Trust Fund inflow. Figure 17 describes the evolution of the general revenues allocated to the SMI Trust Fund and of the monthly premiums, both as a fraction of income. At the beginning of the program, general revenues and premiums represented an identical and small fraction of disposable income. They were both equal to 0.12%. With time, however, the two series started to diverge with general revenues accounting for a larger fraction of the inflow to the Trust Fund. In 2009, general revenues amounted to 1.96% of income, while beneficiary premiums were one third of revenues and only 0.58% of income. These results suggest that the majority of Parts B, C, and D expenses are paid with general government revenues, even if personal taxes have not increased in this period, as documented in Figure 16. The beneficiary premium is the only variable related to public health expenses that we have found whose small increase had a direct effect on the within-period budget constraint of families.

We will now turn our attention to Medicaid. Financing of the Medicaid program is shared by the federal government and the states. Unlike Medicare, federal funding for Medicaid comes entirely from general revenues. Funding for the state share of Medicaid costs comes from a variety

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13 The percentages for 2006 have been computed using data from the 2007 Annual Report of the Boards of Trustees of the Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds.
of sources, but at least 40% must be financed by the state, and up to 60% may come from local governments. The main sources of funds are personal income, sales, and corporate income taxes. For instance, the National Association of State Budget Officers reports that in 2006 about 80% of the state share of their Medicaid costs was financed by state general funds, most of which are raised from personal income, sales, and corporate income taxes. Medicaid expenses are therefore paid almost exclusively using tax revenues. But, as suggested above, personal taxes did not increase during this period. One can therefore conclude that the increase in Medicaid expenses was offset by a decline in other expenditures.

The evidence provided so far suggests that the rise in public health costs was not funded by raising taxes on the household sector. The government must, therefore, have funded public health expenditure using one of the following alternatives. The first possibility is that the government chose to reduce the expenditure on other public goods. The second possibility is that the government decided to raise taxes on production and imports, taxes on corporate income, and/or taxes from the rest of the world. Finally, the government might have selected to increase its debt.

Figure 18 shows that, at the time public health expenses increased from 1.5% to 9.8% of disposable income, the share of military outlays declined from 12.1% to 5.7%. The Figure also confirms the previous finding that during the sixties and seventies social security benefits, and more generally government income security expenditure, increased as a fraction of income and that part of the increase was funded by a decline in expenditure in other public goods, namely military expenses. One can therefore conclude that part of the increase in health costs was financed by a reduction in expenditure on other government items. In Figure 19, we describe the evolution of total government revenues and total government expenditure. There are three patterns that are worth discussing. First, total government revenues as a fraction of disposable income fluctuated around a constant rate of 40%. As a consequence the rise in health expenditure was not funded by an increase in other taxes. Second, during the period considered, government expenditure as a fraction of income increased by 12 percentage points to 48.6%. Lastly, from 1970 government expenditure has been above government revenues in all years except for the period 1997-2001. These last two patterns suggest that part of the rise in medical costs was financed by issuing debt.

\[14\] From Figure 18, we left out the items of government expenditure that are either too small to have a significant effect on our analysis or that remained approximately constant during the period considered.
The evidence provided in this section is consistent with our model’s prediction that the increase in medical expenditure was not paid by increasing taxes. There is one pattern in the data that our model cannot explain: part of the increase in health costs was funded by reducing the consumption of other public goods. Adding those public goods to our model is beyond the scope of our paper. But studying substitution patterns across different types of public goods is an interesting topic that we hope to study in future research.

8 Conclusions

In this paper, we study the relationship between the evolution of the U.S. personal saving rate and changes in health expenditure. We find that a 1 percentage point increase in health expenditure is associated with a decline in the saving rate of between 0.58 and 0.67 percentage points. This finding combined with back of the envelope calculations imply that the increase in health expenditure can explain about 83% of the decline in the saving rate. We provide this evidence using first an accounting exercise and then cross-state variation in saving rates and health expenditure combined with FDA approvals of new drugs.

To understand the economic meaning of the empirical results, we develop a model that enables us to evaluate whether households responded to the increase in medical expenses. Using the model jointly with our empirical results, we first show that only the increase in private health expenditure affected the U.S. personal saving rate. We then provide evidence that households responded to the increase in medical costs by reducing their consumption of other goods. Without their response the personal saving rate would have declined by 8.7 percentage points over the last three decades and not by the observed 7 percentage points.

The results documented in this paper present a difficult dilemma for policy makers. They indicate that, if the U.S. intend to increase the saving rate of the household sector, the rate of growth of health expenditure has to be reduced. But the decline in medical costs may have negative consequences for household welfare and innovation as discussed in the introduction. The U.S. will have to choose on which type of capital to invest and the optimal choice may be to invest in health capital. If this is the case, the U.S. economy will have to cope with low personal saving rates for the foreseeable future.
References


Gokhale, Jagadeesh, Benjamin R. Page, and John Sturrock. 1999. “Generational Accounts for


Figure 1: Personal Saving Rate from NIPA

Figure 2: Total Health Expenditure as a Percentage of Disposable Income from NHEA
Figure 3: Health Expenditure and Social Security Benefits as a Percentage of Income, NIPA

Figure 4: Saving Rates and Health Expenditure Net of Social Security Benefits, NIPA
Figure 5: Saving Rates in the Household and Government Sectors, NIPA
Figure 8: State-level Saving Rates and Health Expenditure

(a) Levels

\[ y = 0.504 - 0.728 x + e \]

\[
\begin{array}{cc}
(0.008) & (0.051)
\end{array}
\]

(b) Changes

\[ y = 0.005 - 1.416 x + e \]

\[
\begin{array}{cc}
(0.001) & (0.216)
\end{array}
\]
Figure 9: FDA Approvals and Cumulative Approvals of New Molecular Entities

Figure 10: FDA Approvals and Cumulative Approvals of New Drugs
Figure 11: Share of Working Generation Income Plus Employer Health Contributions

Figure 12: Share of Working Generation Income And Share of Employer Contributions to Health Plans
Figure 13: Share of Health Insurance Premiums and Out-of-Pocket Expenses

Figure 14: Components Of Public Health Expenditures As Percentage Of Disposable Income
Figure 15: Medicare Components As Percentage Of Disposable Income

Figure 16: Personal Taxes and Medicare Payroll Tax As Percentage Of Disposable Income
Figure 17: Revenue Allocated to SMI Trust Funds and Premiums As Percentage Of Disposable Income

Figure 18: Public Expenditure Components As a Share of Disposable Income
Figure 19: Share Of Government Income And Expenditure In Disposable Income
# Table 3: Cross-state Regression

<table>
<thead>
<tr>
<th>Dependent Variable: State-level Saving Rate</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Share of Medical Expenditure</td>
<td>-0.643***</td>
<td>(0.135)</td>
</tr>
<tr>
<td>Share of Old Individuals</td>
<td>0.220</td>
<td>(0.222)</td>
</tr>
<tr>
<td>Share of Middle-aged Individuals</td>
<td>0.933***</td>
<td>(0.241)</td>
</tr>
<tr>
<td>Share with College or Higher Degree</td>
<td>0.062</td>
<td>(0.056)</td>
</tr>
<tr>
<td>Share of Black Individuals</td>
<td>0.182</td>
<td>(0.194)</td>
</tr>
<tr>
<td>Share of Hispanic Individuals</td>
<td>0.404***</td>
<td>(0.093)</td>
</tr>
<tr>
<td>State Unemployment Rate</td>
<td>0.410***</td>
<td>(0.085)</td>
</tr>
<tr>
<td>N</td>
<td>1275</td>
<td></td>
</tr>
<tr>
<td>R-squared</td>
<td>0.845</td>
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</tr>
</tbody>
</table>

State-level saving rates constructed using data from NIPA, Retail Sale Data, and NHEA. Time and state fixed effects are included as regressors. * significant at 10%; ** significant at 5%; *** significant at 1%.
### Table 4: Instrumental Variable Regressions

#### First Stage Regressions. Dependent Variable: Share of Medical Expenditure

<table>
<thead>
<tr>
<th></th>
<th>NME I</th>
<th>NME II</th>
<th>ND I</th>
<th>ND II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Approval * Share Old</td>
<td>0.0429***</td>
<td>0.0165***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0045)</td>
<td>(0.0018)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Approval For Old * Share Old</td>
<td>0.1298***</td>
<td>0.0412***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0137)</td>
<td>(0.0043)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Approval For Middle Age * Share Middle Age</td>
<td>0.0403</td>
<td>0.0155</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0290)</td>
<td>(0.0103)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Approval * Share with College or Higher Degree</td>
<td>-0.0272***</td>
<td>-0.0295***</td>
<td>-0.0099***</td>
<td>-0.0110***</td>
</tr>
<tr>
<td></td>
<td>(0.0030)</td>
<td>(0.0033)</td>
<td>(0.0011)</td>
<td>(0.0012)</td>
</tr>
<tr>
<td>Total Approval * Share Blacks</td>
<td>0.0044***</td>
<td>0.0043***</td>
<td>0.0016***</td>
<td>0.0015***</td>
</tr>
<tr>
<td></td>
<td>(0.0012)</td>
<td>(0.0012)</td>
<td>(0.0005)</td>
<td>(0.0004)</td>
</tr>
<tr>
<td>Total Approval * Share Hispanic</td>
<td>0.0054**</td>
<td>0.0062**</td>
<td>0.0018*</td>
<td>0.0020**</td>
</tr>
<tr>
<td></td>
<td>(0.0027)</td>
<td>(0.0029)</td>
<td>(0.0010)</td>
<td>(0.0010)</td>
</tr>
<tr>
<td>N</td>
<td>1275</td>
<td>1275</td>
<td>1275</td>
<td>1275</td>
</tr>
<tr>
<td>F-test</td>
<td>98.92</td>
<td>78.12</td>
<td>93.82</td>
<td>76.74</td>
</tr>
</tbody>
</table>

All regressions include as control variables the fraction of individuals between the ages of 30 and 60, the fraction older than 60, the fraction with college or higher degree, the fraction of Blacks and Hispanics, and the unemployment rate, time and state fixed effects. * significant at 10%; ** significant at 5%; *** significant at 1%.
### Table 5: Instrumental Variable Regressions

Second Stage Regressions. Dependent Variable: State-level Saving Rates

<table>
<thead>
<tr>
<th></th>
<th>NME I</th>
<th>NME II</th>
<th>ND I</th>
<th>ND II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share of Medical Expenditure</td>
<td>-0.674**</td>
<td>-0.615**</td>
<td>-0.606**</td>
<td>-0.580**</td>
</tr>
<tr>
<td></td>
<td>(0.277)</td>
<td>(0.272)</td>
<td>(0.282)</td>
<td>(0.275)</td>
</tr>
<tr>
<td>Share Old</td>
<td>0.222</td>
<td>0.217</td>
<td>0.216</td>
<td>0.213</td>
</tr>
<tr>
<td></td>
<td>(0.220)</td>
<td>(0.220)</td>
<td>(0.221)</td>
<td>(0.220)</td>
</tr>
<tr>
<td>Share Middle Age</td>
<td>0.931***</td>
<td>0.935***</td>
<td>0.935***</td>
<td>0.937***</td>
</tr>
<tr>
<td></td>
<td>(0.236)</td>
<td>(0.236)</td>
<td>(0.236)</td>
<td>(0.235)</td>
</tr>
<tr>
<td>Share with College or Higher Degree</td>
<td>0.062</td>
<td>0.063</td>
<td>0.063</td>
<td>0.063</td>
</tr>
<tr>
<td></td>
<td>(0.054)</td>
<td>(0.054)</td>
<td>(0.054)</td>
<td>(0.054)</td>
</tr>
<tr>
<td>Share Blacks</td>
<td>0.185</td>
<td>0.179</td>
<td>0.178</td>
<td>0.176</td>
</tr>
<tr>
<td></td>
<td>(0.185)</td>
<td>(0.186)</td>
<td>(0.186)</td>
<td>(0.186)</td>
</tr>
<tr>
<td>Share Hispanics</td>
<td>0.395***</td>
<td>0.412***</td>
<td>0.414***</td>
<td>0.422***</td>
</tr>
<tr>
<td></td>
<td>(0.122)</td>
<td>(0.121)</td>
<td>(0.122)</td>
<td>(0.121)</td>
</tr>
<tr>
<td>State Unemployment Rate</td>
<td>0.416***</td>
<td>0.404***</td>
<td>0.402***</td>
<td>0.397***</td>
</tr>
<tr>
<td></td>
<td>(0.102)</td>
<td>(0.101)</td>
<td>(0.103)</td>
<td>(0.101)</td>
</tr>
<tr>
<td>N</td>
<td>1275</td>
<td>1275</td>
<td>1275</td>
<td>1275</td>
</tr>
</tbody>
</table>

State-level saving rates constructed using data from NIPA, Retail Sale Data, and NHEA. Time and state fixed effects are included as regressors. * significant at 10%; ** significant at 5%; *** significant at 1%.
Table 6: Instrumental Variable Regressions With Share of Workers in Pharmaceutical Industry

First Stage Regressions. Dependent Variable: Share of Medical Expenditure

<table>
<thead>
<tr>
<th></th>
<th>NME I</th>
<th>NME II</th>
<th>ND I</th>
<th>ND II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Approval * Share Old</td>
<td>0.0426***</td>
<td>0.0164***</td>
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<td></td>
<td>(0.0045)</td>
<td>(0.0018)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Approval For Old * Share Old</td>
<td>0.1292***</td>
<td>0.0410***</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(0.0138)</td>
<td>(0.0043)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Approval For Middle Age * Share Middle Age</td>
<td>0.0403</td>
<td>0.0155</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0290)</td>
<td>(0.0103)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Approval * Share with College or Higher Degree</td>
<td>-0.0273***</td>
<td>-0.0296***</td>
<td>-0.0100***</td>
<td>-0.0110***</td>
</tr>
<tr>
<td></td>
<td>(0.0030)</td>
<td>(0.0033)</td>
<td>(0.0011)</td>
<td>(0.0012)</td>
</tr>
<tr>
<td>Total Approval * Share Blacks</td>
<td>0.0044***</td>
<td>0.0043***</td>
<td>0.0016***</td>
<td>0.0016***</td>
</tr>
<tr>
<td></td>
<td>(0.0012)</td>
<td>(0.0012)</td>
<td>(0.0005)</td>
<td>(0.0004)</td>
</tr>
<tr>
<td>Total Approval * Share Hispanic</td>
<td>0.0055**</td>
<td>0.0062**</td>
<td>0.0018*</td>
<td>0.0021**</td>
</tr>
<tr>
<td></td>
<td>(0.0027)</td>
<td>(0.0029)</td>
<td>(0.0010)</td>
<td>(0.0010)</td>
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<td>N</td>
<td>1275</td>
<td>1275</td>
<td>1275</td>
<td>1275</td>
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<tr>
<td>F-test</td>
<td>99.23</td>
<td>78.34</td>
<td>94.19</td>
<td>77.00</td>
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</table>

All regressions include as control variables the fraction of individuals between the ages of 30 and 60, the fraction older than 60, the fraction with college or higher degree, the fraction of Blacks and Hispanics, the unemployment rate, the share of workers in the pharmaceutical industry, time and state fixed effects. * significant at 10%; ** significant at 5%; *** significant at 1%.
<table>
<thead>
<tr>
<th></th>
<th>NME I</th>
<th>NME II</th>
<th>ND I</th>
<th>ND II</th>
</tr>
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<tbody>
<tr>
<td>Share of Medical Expenditure</td>
<td>-0.671**</td>
<td>-0.611**</td>
<td>-0.603**</td>
<td>-0.577**</td>
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<tr>
<td></td>
<td>(0.277)</td>
<td>(0.273)</td>
<td>(0.283)</td>
<td>(0.276)</td>
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<tr>
<td>Share Old</td>
<td>0.223</td>
<td>0.217</td>
<td>0.217</td>
<td>0.214</td>
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<tr>
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<td>(0.220)</td>
<td>(0.220)</td>
<td>(0.221)</td>
<td>(0.221)</td>
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<tr>
<td>Share Middle Age</td>
<td>0.915***</td>
<td>0.920***</td>
<td>0.920***</td>
<td>0.922***</td>
</tr>
<tr>
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<td>(0.237)</td>
<td>(0.237)</td>
<td>(0.237)</td>
<td>(0.237)</td>
</tr>
<tr>
<td>Share with College or Higher Degree</td>
<td>0.057</td>
<td>0.057</td>
<td>0.057</td>
<td>0.057</td>
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<td></td>
<td>(0.054)</td>
<td>(0.054)</td>
<td>(0.054)</td>
<td>(0.054)</td>
</tr>
<tr>
<td>Share Blacks</td>
<td>0.189</td>
<td>0.183</td>
<td>0.182</td>
<td>0.179</td>
</tr>
<tr>
<td></td>
<td>(0.186)</td>
<td>(0.187)</td>
<td>(0.187)</td>
<td>(0.187)</td>
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<tr>
<td>Share Hispanics</td>
<td>0.397***</td>
<td>0.414***</td>
<td>0.416***</td>
<td>0.424***</td>
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<td>(0.122)</td>
<td>(0.121)</td>
<td>(0.123)</td>
<td>(0.121)</td>
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<tr>
<td>State Unemployment Rate</td>
<td>0.408***</td>
<td>0.396***</td>
<td>0.394***</td>
<td>0.389***</td>
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<tr>
<td></td>
<td>(0.102)</td>
<td>(0.101)</td>
<td>(0.103)</td>
<td>(0.102)</td>
</tr>
<tr>
<td>State Share of Workers in Pharma. Ind.</td>
<td>0.0073</td>
<td>0.0073</td>
<td>0.0073</td>
<td>0.0072</td>
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<tr>
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<td>(0.0058)</td>
<td>(0.0058)</td>
<td>(0.0058)</td>
<td>(0.0058)</td>
</tr>
<tr>
<td>N</td>
<td>1275</td>
<td>1275</td>
<td>1275</td>
<td>1275</td>
</tr>
</tbody>
</table>

State-level saving rates constructed using data from NIPA, Retail Sale Data, and NHEA. Time and state fixed effects are included as regressors. * significant at 10%; ** significant at 5%; *** significant at 1%.

### A Appendix

#### A.1 Two Approaches for the Accounting Exercise

In this section, we outline the two alternative methods that can be used to perform the accounting exercise of Section 4. In the computation of the U.S. saving rate, NIPA includes Medicaid and Medicare expenses in total household expenditure as well as in disposable income. They are included in total expenditure as a measure of the consumption value derived by households from those expenses. They are included in disposable income because they represent government’s social benefits to individuals. In addition, NIPA subtracts from disposable income the following transfers from the private sector to the government used to pay for Medicaid and Medicare expenses: the
Medicare payroll tax paid by employees and the part of personal taxes that is used to pay for Medicare and Medicaid. NIPA treats differently the part of Medicare payroll tax that is paid by employers. Since it is considered a source of wage income, it is added to disposable income. Given the way NIPA constructs the U.S. personal saving rate, the hypothetical exercise of Section 4 can be performed in two different ways. One alternative is to first subtract twice from disposable income the part of the Medicare payroll tax paid by employers: once to compensate for the fact that NIPA considers this part of the tax a source of disposable income, which disappears if health expenses are set to zero; and a second time to account for the fact that it is used as a source of funding for Medicaid and Medicare. Then, after all measurable sources of personal funding for Medicaid and Medicare have been accounted for in disposable income, one can perform the hypothetical exercise by setting the share of health expenditure in household expenditure equal to zero without changing the variable disposable income. This is the method used in Section 4.

With this approach, one makes the implicit assumption that, if there is any source of funding that is not accounted for in disposable income, such as an increase in debt or a reduction of other public expenses, this part of funding will be returned to the household sector using tax credits or alternative forms of government subsidies. An alternative way of implementing the hypothetical exercise is to first set equal to some constant the share of health expenses in household expenditure. Then, to set equal to the same constant the share of Medicaid and Medicare in household disposable income as well as the observed transfers from the private sector that the government uses to pay for Medicaid and Medicare expenses. This alternative is problematic because only a small fraction of the private sector’s transfers allocated to Medicaid and Medicare payments is observed. Specifically, as described in details in Section 7, the private sector transfers used to pay for Medicare and Medicaid are composed of two parts: the Medicare payroll tax and personal taxes. The Medicare payroll tax is observed, but it is only a small percentage of the Medicaid and Medicare expenditure. For instance, in 2009 the Medicare payroll tax covered about one fifth of those expenses. The rest is paid using general personal taxes, reductions in other public expenses, and budget deficits, for which we do not observe the part that is allocated to finance Medicare and Medicaid. As a consequence, if one uses this alternative approach, only

\[\text{Since the Medicare payroll tax is a small fraction of disposable income (see Figure 16), the graph obtained using this approach but without subtracting twice the part of the Medicare payroll tax paid by employers is similar to the one presented in this section. That graph is reported in the Appendix as Figure A.2.}\]
the share of the Medicare payroll tax can be set equal to the desired constant. In this case, the implicit assumption is that the personal taxes used to pay for Medicare and Medicaid are employed in alternative ways that do not benefit the household sector. The choice of one approach over the other depends on which assumption is believed to be more realistic. Since we have a slight preference for the first assumption, in Section 4 we have used the first approach. The main graph obtained using the alternative method is reported in Figure A.1. The results are similar. With the alternative approach, the increase in health expenditure can explain around 90 percent of the decline in the U.S. saving rate. In this case, the decline is explained only by the increase in health expenses paid by some form of private insurance and by the reduction in disposable income generated by setting the share of Medicaid and Medicare expenses equal to the desired constant.

A.2 How Was the Increase in Private Health Expenditure Paid For?

We start by providing evidence that the rise in private health expenses, which are defined as expenses paid by consumers or health insurance companies, was of the same order of magnitude as public health costs. Figure A.3 documents the evolution of total, private, and public health expenditure as a percentage of household disposable income. Private health expenditure grew at about the same rate as public medical costs, doubling from 4.9% in 1960 to 10.5% in 2009.

We will now describe how the rise in private health expenses was financed. There are three possible groups of individuals and companies that may have funded it. First, health insurance companies may have paid for the increase through a reduction in their underwriting gains which are defined as the difference between the premiums received and the benefits paid. Second, employers may have funded a portion of the rise by way of an increase in the health insurance premiums they pay as a contribution for their employees. Finally, consumers may have financed part of the rise through an increase in their health insurance premiums and out-of-pocket expenses.

With regard to health insurance companies, it has been documented that in the past several decades private insurers have generally experienced a health insurance underwriting cycle, which is defined as three consecutive years of underwriting gains followed by three consecutive years of losses.\textsuperscript{16} As a consequence, a reduction in underwriting gains could not have financed the increase

\textsuperscript{16}This cycle has been documented, for instance, in Reed, Robert, and Maule (1989), Gabel et al. (1991), and in the executive report prepared in 2003 by the consulting firm Milliman USA (www.aha.org/aha/content/2003/pdf/MillimanReport030410.pdf).
in private health expenditure observed in the past 50 years. Figure A.4 reports the amount of private health expenditure that was paid by consumers and employers. As a fraction of disposable income, the insurance premiums paid by employers increased at a steep rate, going from 0.9% in 1960 to 5.2% in 2009. In contrast, as documented in the previous section, the contributions of consumers remained approximately constant at around 4 percent of disposable income for the entire period. In Figure A.5 we decompose consumers’ payments in out-of-pocket expenses and premiums. The premiums paid by consumers grew at a steady rate throughout the period. During the same period, however, consumers enjoyed a reduction in out-of-pocket expenses that offset the increase in premiums. These results suggest that the rise in private health expenditure was financed almost entirely by an increase in the share of employer contributions to health plans.

It is important to establish who paid for the increase in employer contributions to health plans. In Figure 12, we have provided evidence that the increase in the share of those contributions was associated with a larger decline in the share of income earned by the working generation. As argued in the previous section, this pattern suggests that employers had to increase the employer contributions to health plans in response to the increase in medical expenses of their employees. But this increase in contributions was not paid by employers. It was transferred to workers through a reduction in wages and salaries. It was therefore the household sector that funded the increase in private health expenditure. Had the rise in private health expenses been financed by the corporate sector, the NIPA data would have displayed a smaller decline in the household saving rate.
Figure A.1: Saving Rates and Net Health Expenditure When The Share of Medicare and Medicaid Is Set to a Constant In Disposable Income, NIPA

Figure A.2: Saving Rates and Health Expenditure Net of Social Security Benefits Without Subtracting Employers’ Payroll Tax, NIPA
Figure A.3: Components Of Health Expenditure As Percentage Of Disposable Income

Figure A.4: Contributions By Consumers And Employers To Health Expenditure As Percentage Of Disposable Income
Figure A.5: Decomposing Consumer Health Expenditure As Percentage Of Disposable Income
Table A.1: Cross-state Regression

<table>
<thead>
<tr>
<th>explanatory variable</th>
<th>coefficient</th>
<th>standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes in Share of Medical Expenditure</td>
<td>-0.727***</td>
<td>(0.120)</td>
</tr>
<tr>
<td>Changes in Share of Old Individuals</td>
<td>0.137</td>
<td>(0.243)</td>
</tr>
<tr>
<td>Changes in Share of Middle-aged Individuals</td>
<td>0.530***</td>
<td>(0.138)</td>
</tr>
<tr>
<td>Changes in Share with College or Higher Degree</td>
<td>0.025</td>
<td>(0.058)</td>
</tr>
<tr>
<td>Changes in Share of Black Individuals</td>
<td>0.157</td>
<td>(0.191)</td>
</tr>
<tr>
<td>Changes in Share of Hispanic Individuals</td>
<td>0.304***</td>
<td>(0.062)</td>
</tr>
<tr>
<td>Changes in State Unemployment Rate</td>
<td>0.410***</td>
<td>(0.084)</td>
</tr>
</tbody>
</table>

N: 1224
R-squared: 0.367

State-level saving rates constructed using data from NIPA, Retail Sale Data, and NHEA. Time fixed effects are included as regressors. * significant at 10%; ** significant at 5%; *** significant at 1%.
Table A.2: Instrumental Variable Regressions

| First Stage Regressions. Dependent Variable: Changes in Share of Medical Expenditure |
|-----------------------------------|----------|----------|----------|----------|
| | NME I | NME II | ND I | ND II |
| Δ (Total Approval * Share Old) | 0.0636*** | 0.0237*** | 0.1408*** | 0.0451*** |
|  | (0.0042) | (0.0017) | (0.0137) | (0.0043) |
| Δ (Total Approval For Old * Share Old) | 0.0872*** | 0.0311*** |
|  | (0.0133) | (0.0052) |
| Δ (Total Approval For Middle Age * Share Middle Age) | -0.0272*** | -0.0309*** | -0.0078*** | -0.0114*** |
|  | (0.0030) | (0.0033) | (0.0012) | (0.0012) |
| Δ (Total Approval * Share with College or Higher Degree) | 0.0044*** | 0.0045*** | 0.0019*** | 0.0016*** |
|  | (0.0012) | (0.0012) | (0.0005) | (0.0005) |
| Δ (Total Approval * Share Blacks) | 0.0054** | 0.0069** | 0.0012 | 0.0023** |
|  | (0.0027) | (0.0029) | (0.0010) | (0.0011) |
| N | 1224 | 1224 | 1224 | 1224 |
| F-test | 93.68 | 109.6 | 87.24 | 106.8 |

All regressions include as control variables first differences in the fraction of individuals between the ages of 30 and 60, in the fraction older than 60, in the fraction with college or higher degree, in the fraction of Blacks and Hispanics, and in the unemployment rate. Time fixed effects are included. * significant at 10%; ** significant at 5%; *** significant at 1%.
Table A.3: Instrumental Variable Regressions

Second Stage Regressions. Dependent Variable: Changes in State-level Saving Rates

<table>
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<th>NME II</th>
<th>ND I</th>
<th>ND II</th>
</tr>
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<tr>
<td>Changes in of Medical Expenditure</td>
<td><strong>-0.798</strong></td>
<td><strong>-0.741</strong></td>
<td><strong>-0.710</strong></td>
<td><strong>-0.691</strong></td>
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<tr>
<td></td>
<td>(0.301)</td>
<td>(0.298)</td>
<td>(0.308)</td>
<td>(0.302)</td>
</tr>
<tr>
<td>Changes in Share Old</td>
<td>0.308</td>
<td>0.303</td>
<td>0.300</td>
<td>0.298</td>
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<tr>
<td></td>
<td>(0.239)</td>
<td>(0.239)</td>
<td>(0.239)</td>
<td>(0.239)</td>
</tr>
<tr>
<td>Changes in Share Middle Age</td>
<td><strong>0.930</strong>*</td>
<td><strong>0.931</strong>*</td>
<td><strong>0.932</strong>*</td>
<td><strong>0.932</strong>*</td>
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<td>(0.247)</td>
<td>(0.247)</td>
<td>(0.247)</td>
<td>(0.247)</td>
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<tr>
<td>Changes in Share with College or Higher Degree</td>
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<td>0.053</td>
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</tr>
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<td>(0.055)</td>
<td>(0.055)</td>
<td>(0.055)</td>
<td>(0.055)</td>
</tr>
<tr>
<td>Changes in Share Blacks</td>
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<td>(0.189)</td>
<td>(0.190)</td>
<td>(0.190)</td>
<td>(0.190)</td>
</tr>
<tr>
<td>Changes in Hispanics</td>
<td><strong>0.372</strong>*</td>
<td><strong>0.389</strong>*</td>
<td><strong>0.397</strong>*</td>
<td><strong>0.403</strong>*</td>
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<td>(0.130)</td>
<td>(0.129)</td>
<td>(0.131)</td>
<td>(0.129)</td>
</tr>
<tr>
<td>Changes in State Unemployment Rate</td>
<td><strong>0.423</strong>*</td>
<td><strong>0.411</strong>*</td>
<td><strong>0.405</strong>*</td>
<td><strong>0.401</strong>*</td>
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<td>(0.108)</td>
<td>(0.109)</td>
<td>(0.108)</td>
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</table>

State-level saving rates constructed using data from NIPA, Retail Sale Data, and NHEA. Time fixed effects are included as regressors. * significant at 10%; ** significant at 5%; *** significant at 1%.