Infrastructure Investment and Public Sector Balance Sheets: Evidence from the US States

By Andrew Haughwout* and Robert Inman+

**Abstract**

We argue that the status of the public sector's balance sheet plays an important role in determining the level of infrastructure investment that a government will undertake. The value of long-dated obligations (like pension fund liabilities and long term debt) and short-term liquidity vary with financial conditions and prior policy decisions and past institutional environments. The status of these financial variables may, particularly when filtered through current institutional arrangements, may have important impacts on public investment decisions. The result, from the point of view of the economy, can be investment paths that are overly focused on short-run economic and institutional considerations rather than on maximizing long-run economic growth and citizen welfare.

In this paper, we lay out this argument and explore its implications for investment decisions using a new dataset of balance sheet and spending data from the US. In the US, state governments are crucial players in the development of public capital sticks, and there is considerable heterogeneity over states and time in the behavior of both balance sheet variables like debt and cash on hand, as well as infrastructure investment. Our data capture these data for the 48 contiguous states over the period 1992-2016. We demonstrate that the decision to make public infrastructure investments is closely related to balance sheet measures like pre-existing pension debts, and that this relationship is both highly non-linear and dependent on both political institutions and socio-economic characteristics of the states.

The paper's contributions are in three areas. First, we lay out a new theory of investment decision-making that brings balance sheet considerations into the framework. Second, we describe and construct a new dataset of public sector balance sheets that we believe will be a fruitful approach for future analysis by economists and political and legal scholars. Finally, we document empirically the importance of balance sheet considerations in public investment decisions, which helps to refine our understanding of the determinants of an important component of overall activity and investment.

*Federal Reserve Bank of New York
+Wharton School, University of Pennsylvania and NBER

## I. Introduction

Infrastructure is an important form of wealth in modern economies and public services that infrastructure supports – like transportation services – are a fundamental underpinning for economic growth.[1] According to the IMF, the public capital stock in the United States had a value of over $11.5 trillion in 2015, or about 64% of GDP in that year.[2] In the US, most of the non-defense public capital stock in the US is built, owned and managed at the subnational level – by state and local governments. This is visible in the flows capital spending: of $500 billion (seasonally adjusted at an annual rate - saar) in total nondefense capital spending undertaken by all US governments in the final quarter of 2017, about three-quarters was invested by state and local governments. State and local governments own over 95% of the public highways in the US, with the federal government owning just a small number of roads on federally-owned lands like national parks (CBO, 2016).

Infrastructure affects the economy in two ways. First, the construction of public works is current activity that employs workers and capital assets. The second, and for our purposes more important, way that infrastructure affects the economy is much more long term: public capital assets provide a flow of services that are potentially valuable to firms and households. In the US context, there is significant debate over the strength of the connection between current infrastructure spending and the long term growth of a place that receives the investment. While our focus in the current study is on the determinants of infrastructure

[1]In this paper we will use the terms "infrastructure," "public capital" and "stock of public investment" interchangeably. Here, the terms refer to non-military physical capital held by public sector entities. Prominent examples include roads, schools and sewer systems. In the US, this definition excludes some elements of the capital stock that are sometimes considered infrastructure, but that are typically privately held, such as the electric grid and telecommunications infrastructure.

[2] We will return to the measurement of public capital below.

spending, the returns to infrastructure are part of the equation and we will discuss the relevant findings below.

If infrastructure is indeed a productive form of expenditure, relative to its public and private sector competitors for funds, then it may be valuable for governments to maintain a particular level or growth rate of infrastructure stocks as the economy and population grow. But how do governments decide on the appropriate growth rate of infrastructure? While previous work has emphasized the importance of political institutions and partisan affiliations, in this paper we examine the role of public balance sheets in that process. State governments manage large portfolios of assets and liabilities, of which physical capital – infrastructure – forms just one part. Beyond public capital, components of the public sector balance sheet are financial assets and liabilities, and their value is affected significantly by movements in financial markets. We study the relationships among financial and real, physical investments held by state governments, with an eye to understanding spillovers from short-run financial dynamics into long-run physical investment decisions.

The paper proceeds as follows. In Section II we provide a brief overview of the problem, previous research, and the unique elements in our approach. Section III describes the data and the methods we use to create the measures we will analyze. In Section IV, we present some preliminary answers to the questions we have posed, and Section V concludes.

## II. Background

*Is there an Infrastructure Deficit in the US?*

Infrastructure investment in the US has been the subject of substantial academic controversy, particularly with respect to the measurement and evaluation of its contribution to productivity and welfare. There is considerable dispute among the many different scholars and practitioners who have examined the evidence. The American Society of Civil Engineers (ASCE), for example, assigns the US a grade of "D+" in its 2017 Infrastructure Report Card. ASCE estimates that the US needs a $2 trillion investment plan to bring the stock to a state of good repair and raise the grade to "B".

In economics, where "need" is typically defined in terms of the economic value of additional infrastructure spending, results have been more varied. Turner (2019), for example, focuses attention on highways, which are a very major part of the infrastructure stock, comprising about a third of annual infrastructure investment in the US, in metropolitan areas, where the bulk of population and production are located. Turner, drawing on previous literature including Duranton and Turner (2016) concludes that the state of repair of the road system is improving already, that new investments simply induce more driving, and that any new local activity associated with new roads is largely redirected from other locations.[3] Taken together, these conclusions suggest low marginal productivity of transportation investments for the aggregate economy, and that massive new investments in transportation infrastructure are unlikely to be worth their costs.

CBO (2016) concurs with the evidence on improvements in road quality over time, but concludes that state and local governments do not emphasize economic benefits of investments in their decision-making, helping to explain Turner's (2019) conclusion. CBO's analysis implies that there is significant heterogeneity in the economic benefits produced by the variety of investments in the road system, and that reallocating spending toward projects with high benefit-cost ratios would significantly increase the productive effect of federal

[3] Turner, M. 2019. "Local Transportation Policy and Economic Opportunity," The Hamilton Project Policy Proposal 2019-03, January.

spending. Given what is known about benefits and costs of various types of projects in various places, this change would allocate significantly more resources to increasing spending on major repairs to urban, non-interstate federal-aid highways (CBO, 2016, Figure 2-1).

The variety of returns to different highway investment projects suggests that project selection is a crucial determinant of the overall economic impact of a planned investment, and that there remain, even with respect to the well-developed system of urban highways in the US, opportunities for productive investments. This makes the subject of the level and targeting of infrastructure investment important for overall economic growth.

*State and Local Infrastructure Investment since the Completion of the Interstate Highway System*

A crucial part of the US infrastructure network, the interstate highway system, was begun in the 1950s and substantially completed by the 1990s. This system linked metropolitan areas across the country and provided ready access to urban centers from surrounding suburban areas. Previous research has indicated that it played an important role in settlement patterns, contributing substantially to the decentralization of population from central cities to suburbs (Baum-Snow 2007).[4] Its completion meant that the economic geography of the US urban system was set, bringing to a close the era of large-scale infrastructure system development. As such, state and local infrastructure investment as a percentage of GDP trended down from 2.6% of GDP between 1950 and 1975 to 2.2% between 1976 and the end of the Great Recession, and just 2.0% since 2009. There was a slight uptick in the investment share during the housing boom of the early 2000s, perhaps reflecting substantial new building activity that coincided with

[4] Baum-Snow, N. 2007, "Did Highways Cause Suburbanization?" *Quarterly Journal of Economics* 122: 2, May.

increased housing prices, especially in fringe areas of metropolitan areas in the “sand states”: Arizona, California, Florida, and Nevada. Nonetheless, overall infrastructure investment in the US has been on a slow and slight downward trajectory, at least as a share of overall activity, for a generation.

During this same time period, state and local infrastructure investment has become much more pro-cyclical (Haughwout, 2019), meaning that it now covaries positively with aggregate economic activity. The correlation between employment and infrastructure investment is strongly positive, at about 0.25, for the period after the 1973-75 recession. Allowing for one or two period lags, with investment following employment change, does not change this conclusion. The relationship between real four quarter GDP growth and the change in infrastructure investment is also positive, regardless of the range of postwar data one examines and regardless of whether one accounts for lags. So the recent data suggest that infrastructure investment has become pro-cyclical and may serve to amplify macroeconomic fluctuations.

This behavior of state and local activity may seem puzzling in light of the fact that, as an investment sector, we might expect state and local infrastructure investment to be interest-rate sensitive, and to find that expansionary monetary policy would reduce interest rates and induce additional infrastructure investment at the state and local level. Haughwout (2019), however, demonstrates that this is not the case, and that state and local infrastructure spending growth is in fact *positively* related to interest rates. This is likely due to the fact that only a relatively small share of new investments are debt-financed. Interest rate declines are thus more likely to induce states to refund higher-cost debt issues than to increase their debt-financed spending.

The reduction in state and local infrastructure investment's role in the economy has occurred alongside another important development: the substantial increase in the financial pressures on these governments (Ravitch and Volcker, 2014).[5] A combination of increased expenditure needs for entitlement programs like Medicaid, reduced federal support with elimination of programs like General Revenue Sharing, and narrowed revenue bases, as for sales taxes, have led the US states to a position of chronic fiscal stress, reflected in increased pressure to skirt balanced budget rules and to borrow from future resources. One manifestation of these pressures, we argue, is found in state government balance sheets, where declining assets and increasing liabilities in some, but not all, states may have led to pressure on service delivery, including infrastructure construction.

## III. Data and Measurement

Since our approach to the infrastructure discussion involves new measure of subnational public sector balance sheets, we devote some time to describing their construction. For clarity of exposition, we divide public sector assets and liabilities into three categories, each of which represents a separate area of the governmental balance sheet. We will then discuss adjustments to the basic framework for the current study.

### *A. The Cash Account*

The cash account includes information about both the cash and security holdings owned by state governments and their short term debt liabilities. Governments hold cash and securities for a variety of purposes, ranging from trust accounts earmarked by law for specific purposes to

[5] Ravitch, R. and P. Volcker, 2014. "State Budget Crisis Task Force Report," January.

relatively unencumbered accounts that can be accessed at the discretion of the executive. Cash and security holdings of state and local governments are reported annually in the Census Bureau's *Governmental Finances* series. The financial assets data are categorized as held by either insurance trust, employee retirement, debt offset, bond, or other funds. The figures presented under this section exclude the assets of insurance trust funds administered by state and local governments. We assume that the government's role as trustee for these accounts has no effect on its own real financial position. Trust fund balances differ from the other assets tabulated here in that they represent balances held purely in expectation of future liabilities. By excluding both the liabilities and the financial assets held in their anticipation, we treat such programs (which include unemployment and workmen's compensation at the state level) as if they are fully funded. An important exception to this rule is employee retirement. Since the funding status of employee pensions is known to be a factor in the financial position of state and local governments (Inman 1985), we include, wherever possible, a separate accounting for these funds below.

We are left, then, with three components of cash and security holdings. The first of these is bond funds, which are accounts established for the purpose of holding the proceeds of long-term debt issues. Since long term debt is primarily issued to finance capital investments, and since these investments are generally made over a period of several years, the proceeds of bond sales are often placed into interest-bearing accounts or securities prior to their disbursement. A second kind of account is the debt offset, or sinking, fund. These funds are held for the redemption of long term debt. It is from these accounts that funds are drawn when governments wish to buy back debt and from which they make all refunds to bondholders.

Finally, the Census reports the assets of "Other" cash and securities accounts, which include the assets of governments held for all other purposes. It is in this category where "rainy day" funds and other relatively unencumbered funds are held.

State and local governments may issue short term debt (defined as debt with a maturity of less than one year) for a variety of purposes, but do so primarily to smooth their cash flows during the fiscal year. Since the timing of revenue receipts may not match that of required expenditures, governments may borrow in anticipation of revenues yet to be received. While such borrowings may be classified as Revenue Anticipation Notes (RANs), Tax Anticipation Notes (TANs), or Bond Anticipation Notes (BANs), their defining characteristic is a maturity of less than one year. *Governmental Finances* annually reports the par value of short term debt outstanding for all states and a sample of local governments. Given their short maturities, these obligations are valued at par in the cash account. All cash account assets and liabilities are deflated using the CPIU described in Appendix A.

*B. The Pension Account*

Like the federal government and many private firms, state and local governments administer pension funds for many of their employees. When the present value of promised pension benefits exceeds the present values of plan assets and future contributions, a pension plan is underfunded. Coverage of these shortfalls generally requires either a reduction in benefits, or a supplemental contribution to the fund by employees or the sponsoring government. Ultimately, to the extent that each government is required to live up to the pension bargain it has struck with employees, these unfunded liabilities are essentially debts owed by the government administering the plan.

Inman (1985) provides an econometric method for estimating the unfunded liabilities state and local government pension plans. The method relates unfunded liabilities to plan parameters (benefit rates, cost-of-living adjustments, the rate at which benefits replace wages, the number of years of service required to receive benefits, and plan integration with the social security system), the plan's current asset and benefit levels, and growth in plan membership. Membership, assets and benefits are reported in the Governmental Finance volume *Finances of State and Local Employee Retirement Systems*, while plan parameters are found in state and city pension laws. More recently, Rauh (2018) provides plan-specific estimates using detailed characteristics and alternative discounting assumptions. Finally, Munnell (2017) provides plan-reported estimates of unfunded liabilities for a longer time-series, covering the years 2001-2016. In the current paper, we adopt Munnel's estimates; in future work we intend to compbine these methods to develop a longer panel of plans' financial status. The pension account values are deflated by the CPIU described in Appendix A.

*C. The Capital Account*

The functions of state and local governments often require the purchase, creation and maintenance of significant physical public assets. The roads, parks, sewer systems and public buildings that these governments construct or purchase are often paid for with the proceeds of long term debt issues. The Census Bureau reports, on an annual basis, the par value of long term debt outstanding as well as new issues and refundings that occurred during the fiscal year. These bonds typically include call options that allows the issuer to buy them back if interest rates decline after the initial offering. In principle, these options can allow the par and market value of the outstanding debt to diverge. However, in the present study we evaluate these obligations at par. These market values are deflated by the CPIU described in Appendix A.

The largest component of state and local government assets is the physical stock of land, structures, and durable equipment owned by these governments. The stock estimates presented here were constructed using the perpetual inventory technique, which has formed the basis of the most widely-cited estimates of capital stocks (see Boskin et al. 1987, Hulten and Wykoff 1981, Munnell 1990). The technique requires the accumulation and depreciation of real investment outlays in each year, and provides estimates of the stock in place for each cross sectional unit in each year. The application of the perpetual inventory technique to our investment data results in the following basic equation for public capital stocks:

$$(1) \quad K_{s,t}^{j} = (1 - \delta^{j})K_{s,t-1}^{j} + I_{s,t}^{j} - A_{s,t}^{j}$$

where *K* and *I* are the real stocks and flows of investment, $\delta$ is the depreciation rate, and *t* indexes time, *s* indexes states, and *j* indexes types of assets. *A* is asset sales, which have become more common in recent years.

Solution of this equation requires a long time series of information on flows of capital spending and asset sales, depreciation rates, and costs. Nominal capital investments and asset sales made by state and local governments are reported in the Census Bureau's *Governmental Finances* series, with state information beginning in 1915, and city information from 1905. Depreciation rates are calculated from BEA (1987) and Hulten and Wykoff (1981). Cost data are calculated from *Engineering News Record*'s Construction Cost series. The deflators used to put the values in real terms are described in Appendix A.

*D. Coverage*

The assets and liabilities included here are those that are controlled by the state or local government indicated. Control in this context has a fairly broad interpretation. Two potential sources of confusion are the treatment of assets and liabilities created with intergovernmental revenues and the treatment of assets owned by related but separate governmental units. Assets created using intergovernmental funds are, for our purposes, the property of the receiving government. A shorthand way of thinking of the definition of ownership is that the government which controls the final disposition of the funds is the owner of the asset. Thus a roadway financed by a combination of state funds and federal matching grants is treated as the property of the state government.

Our treatment of quasi-independent governmental units mimics that of the Census Bureau. As part of the Governmental Structure component of the *Census of Governments* series, the Census Bureau classifies all governmental units as either independent or controlled by another government. The assets and liabilities of the latter group are here classified with the controlling government. Thus, our accounting of the assets of the Southeastern Pennsylvania Transportation Authority, which Census deems a state agency, would be included with the State of Pennsylvania.

### *E. Comparability of the Accounts*

While the perpetual inventory technique is the most widely used method of estimating the value of government's physical capital, it does not provide a figure that is strictly comparable to the other asset and liability series described here. In effect, the cash, pension and long term debt estimates are designed to calculate the total *market value* of governmental assets and liabilities. They answer the question, "If government were to convert its financial assets to cash and pay off its liabilities, what amount (positive or negative) would be left over for each resident?" Since many of the services provided by public capital cannot be priced by markets, these physical assets may have no market value whatsoever. They do, however, provide services that are potentially of value to residents.

The physical capital stock estimates provided by the perpetual inventory technique utilized here measure the *replacement value* of government-owned physical assets. The capital stock estimates thus answer a somewhat different question, "If the public capital stock were to be destroyed, how much would it cost each resident to rebuild it to a level that would provide the same level of service?" In spite of these slight differences in the interpretation of the series, we believe that our methods result in the most consistent accounting of state and local assets and liabilities available.

*F. Adjustments for this Study*

Our interest in the relationship between financial and physical wealth suggests a recombination of the assets and liabilities here into those two categories, with a special focus on the pension component of financial wealth, which has received a significant amount of attention in recent years. We thus present information on the following components of state government assets and liabilities:

1. **Infrastructure.** Real-valued stocks of physical public capital, in aggregates and in per capita terms.
2. **Financial Wealth. R**eal-valued financial net assets, in total and per capita terms.
    a. Cash and security holdings other than insurance trust funds (+)
    b. Short- and long-term debt (-)

c. Net pension wealth (+)

*G. Data for selected states*

In this section we present descriptive analyses of the components of our public wealth measures for selected states. Figures 1-9 present these results for nine states, where each measure is reported in 2017 New York dollars per state resident. In each figure, the left panel shows total wealth and its financial and physical components, while the right panel shows the breakdown of the financial wealth components into cash and security holdings, bonded debt and net pension wealth, defined as the difference between system assets and the present value of pension liabilities. Excluded are the net present value of other insurance trust funds and any other post-retirement benefits promised by the state. The data for 1992-2001 should be interpreted with caution as the pension values are simply straight-line real values for 2001, divided by the state population in the years prior to 2001. We include these for illustrative purposes only; in the regression analysis that follows we focus only on 2001-2015 data.

Figure 1 shows Alabama, a fairly typical, albeit relatively low income, state chosen simply because it is first alphabetically. Nonetheless Alabama illustrates some interesting facts about the data for all states. First, the values are quite consequential. The typical Alabama household in 2015 had an over $6,000 net financial liability on the state's books. That is, of the state were to "cash out" in 2015 it would require each household to contribute about $6,500 – measured in New York 2017 dollars – to satisfy the state's creditors, after the state sold its cash and securities.[6] Primary among the state's creditors are its employees: the state's pension system was unfunded to the tune of approximately $3,500 per capita (about $9,100 per household),

[6] The left panel of Figure 1 shows a net financial liability of about $2,500 per capita and the typical Alabama family has 2.6 members. 2.6*$2,500 = $6,500.

while bonded debt was closer to $2,500 per household ($5,200 per household). The liabilities were partially offset by about $3,500 per capita in cash and security assets. These state financial wealth figures are consequential in the context of Alabama's income statistics. In 2015, the average Alabama household income was $62,307 (this figure is in Alabama 2015 dollars), so the household's net liability was nearly 10% of annual income.

Offsetting this financial liability was the value – measured as replacement cost – of Alabama's physical infrastructure stock. We estimate this value at roughly $34,000 per capita, or $88,400 per household. While these figures are not reflective of what the infrastructure could sell for in a private market, they do represent a public asset that would be very costly to replace. Indeed, the household value of $88,400 is almost of the same order of magnitude as the median home value in Alabama in 2015: $125,500 (again this figure is in Alabama 2015 dollars, so not exactly comparable to the $88,400).

Other states show similarities and differences to each other. In all states, public sector assets and liabilities are consequential compared to incomes and asset values. In some states, for example, Illinois (Figure 4) and New Jersey (8), financial wealth has declined sharply over the period, more than offsetting slowly increasing physical capital stocks. Other states, like Iowa (Figure 5) and Kansas (6) prior to 2009 show a cyclical pattern, saving in recoveries and reducing wealth in recessions. California (2) combines elements of a cyclical pattern with an overall downward trend. Wyoming (9) is the opposite: modest cyclicality combined with a strong upward trend revealing a government whose net worth is rising over time. In addition to these different time trends, the levels are very different across states. In 2015, financial assets in New Jersey are around -$10,000 per capita; in Wyoming they were $35,000 a difference approaching $45,000 per person.

## IV. Infrastructure investment on the Balance Sheet

In this section we tease out more fully some of the relationships suggested by the Figures. In particular, we study how net infrastructure investment changes with the financial wealth of the government in question.

To facilitate our discussion, we rewrite equation (1) as

$$(2) \quad \Delta K_{s,t}^{j} = K_{s,t}^{j} - K_{s,t-1}^{j} = I_{s,t}^{j} - A_{s,t}^{j} - \delta^{j} K_{s,t-1}^{j}$$

Note that depreciation ($\delta^{j} K_{s,t-1}^{j}$) is given to the state by technology; only gross investment ($I_{s,t}^{j}$) and asset sales ($A_{s,t}^{j}$) are choice variables for the government and only they may be affected by variables such as balance sheet considerations. When a government has a large stock of physical assets, it will be an expensive proposition merely to offset the effects of depreciation.

### A. Descriptive statistics

We begin our exploration by noting the fact that, in spite of public discussions of a severe "infrastructure crisis" in the US, real state-owned infrastructure stocks are generally growing even in per capita terms. The replacement value of these stocks grew an annual average of $254 per capita in the average state between 1992 and 2015, or about 1%. Infrastructure stocks ended the period higher than they began in every state, although there were many examples of year-over-year declines in stocks. Indeed, roughly 15% of the state-year stock observations saw declines in infrastructure values. By the same token, 10% of the observations witnessed very substantial growth in stocks – on the order of 2-3% in real per capita terms. Financial wealth, on the other hand, has been on a strong downward trend in the average state, declining about $66 per capita annually, or about 11%.

## B. Hypotheses

The relationship between these two measures – financial wealth and infrastructure growth – can go in two ways. A positive relationship would suggest, as might be implied by the time series, that declining financial wealth puts downward pressure on infrastructure investment – lower wealth is associated with lower infrastructure growth. This would imply that the two forms of assets are somewhat *complementary* – when one is reduced the other is reduced as well.[7] Such a result would be consistent with press accounts of state and local governments facing chronic budget pressures and having them be reflected in reduced activity across the board. Another mechanism would be pension problems that result from, for example, poor stock market performance spilling over onto infrastructure investment.

A second possibility is that the two are negatively related. This result would imply that the governmental decision makers manage of assets and liabilities as somewhat *substitutable* across types: increases in financial wealth are associated with reduced infrastructure investment, and vice versa. As we will discuss, there are some mechanical reasons to expect this to occur. For example, a debt-financed public works project would produce simultaneous increases in infrastructure and a decrease in financial wealth (the increase in debt, cet. par.), resulting in no net change (in the short run) in public wealth overall.

## C. Financial wealth and infrastructure investment

[7] Substitutes and complements are used roughly here: a proper definition would rather focus on cross-price elasticities.

Table 2 shows the results of our descriptive regression analysis. Recall that our dependent variable is the change in real per capita infrastructure stocks, which is generally positive but with a significant left tail of negative values. Infrastructure stock growth requires gross investment in excess of asset sales, which are endogenous, and depreciation, which in each time period is a function of previous investment decisions and technical factors and is thus exogenous to the state decision-maker.

The first column of Table 2 shows the simplest specification, in which the current growth (in 2017 New York dollars) of infrastructure is regressed on lagged changes in state population, lagged changes in state financial wealth, and state fixed effects. The coefficient of interest is -0.05, which while strongly statistically significant ($t$=-3.22) is economically small. This suggests that a dollar increase in financial wealth is associated with a small ($0.05) reduction in infrastructure growth. Inclusion of the current period financial wealth change [column (2)] increases the total effect somewhat, to about $0.086, with each piece of the lag being statistically significant. Nonetheless, it seems fair to call this a relatively small spillover.

In column (3), we replace the current period growth in financial wealth, which is plausibly endogenous to the process we are examining, with current period growth in the Standard and Poor's 500 Index, a measure of US equity market values. This index is plausibly exogenous to the behavior of the states, but may affect their infrastructure investment decisions. S&P has a statistically significant negative effect on infrastructure investment, but the coefficient on the state lagged financial wealth growth is unaffected relative to the competing specification in column (1). We thus do not see endogeneity as the key driver of the weak negative relationship between financial wealth and infrastructure investment.

To confirm this conclusion and in order to further understand the mechanisms at play, we adopt an instrumental variables approach in columns (4) and (5). Our instrument is the S&P variable from specification (3). The instrument strongly predicts current and lagged values of financial wealth growth (F>100), and produces second stage estimates that are quite similar in value to those found in columns (1) and (2), although the standard errors are larger. Thus while endogeneity plays a role in the significance of the results found above, the basic conclusion that the spillovers from financial to physical capital are small appears to be robust to controlling for endogeneity in a simple way.

## V. Conclusion and Directions for Further Research

In this paper, we develop new asset and liability measures for the US states, and show that they are differentiated in the level, composition and dynamics of the balance sheets. Our discussion of the relationship between financial and physical capital growth indicates that while there are statistically significant relationships between the behavior of the two kinds of assets, they are fairly small economically. This work has looked for linear responses, whereas it may be fruitful to look for non-linearities and threshold effects. When a state’s financial assets decline by a large amount, or reach some critical threshold this could command more attention and perhaps affect capital investment or other spending more strongly. Future work will emphasize these effects, along with additional control variables and measures of risk exposures, mechanical costs and returns, and cash flows versus market value changes and accruals.

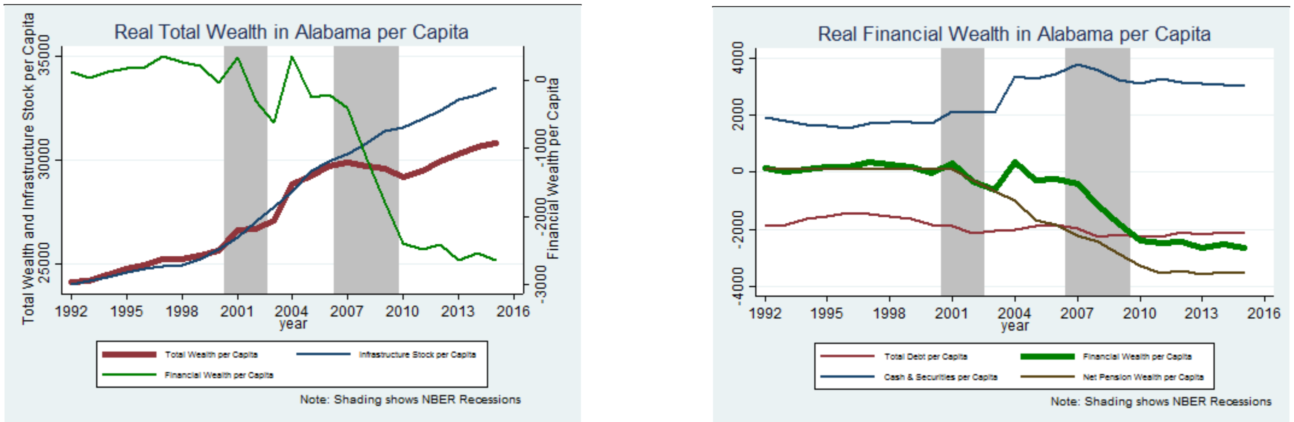


Figure 1: Total Wealth and Financial Wealth in Alabama

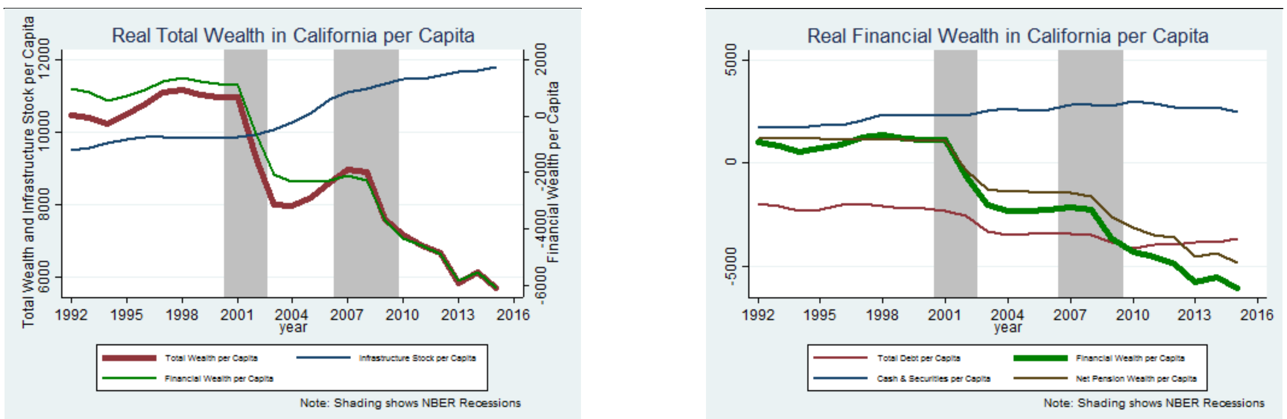


Figure 2: Total Wealth and Financial Wealth in California

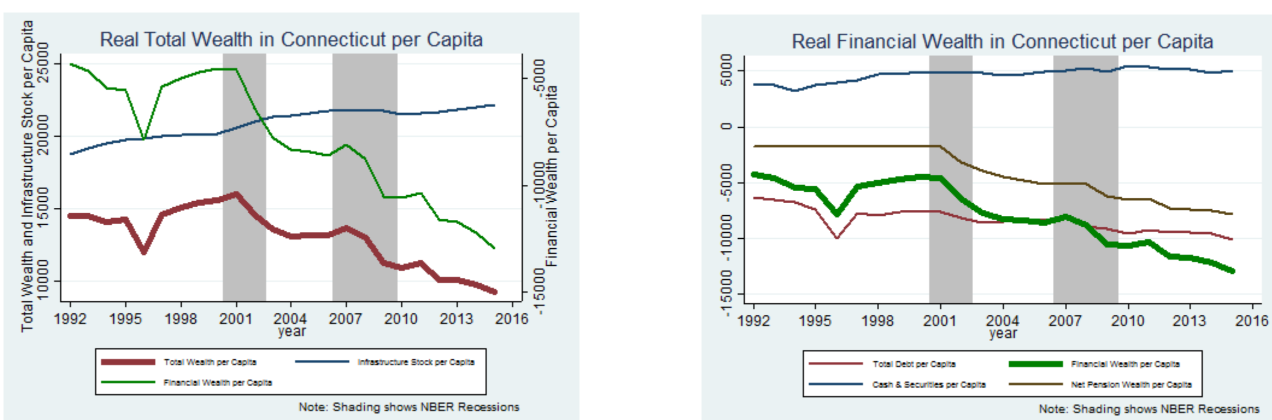


Figure 3: Total Wealth and Financial Wealth in Connecticut

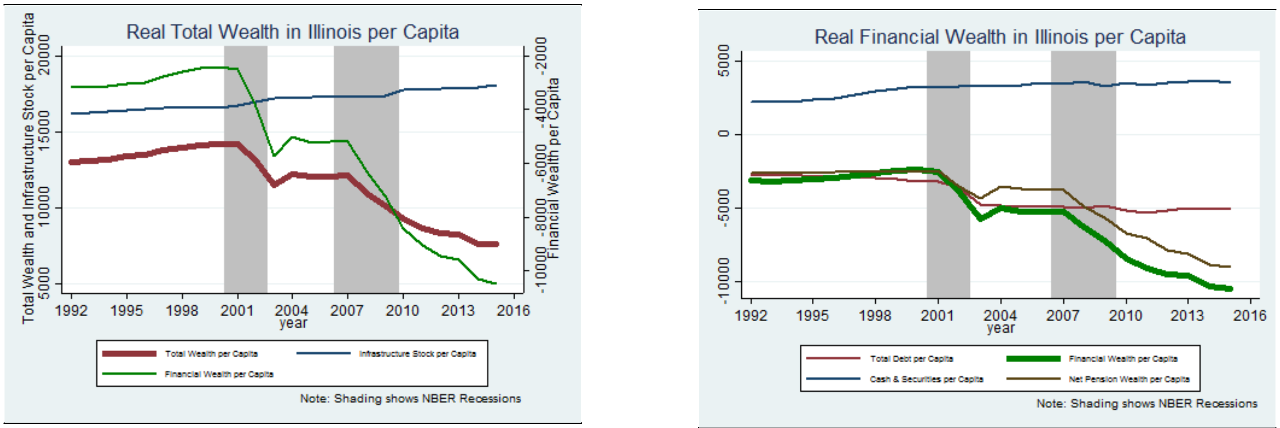


Figure 4: Total Wealth and Financial Wealth in Illinois

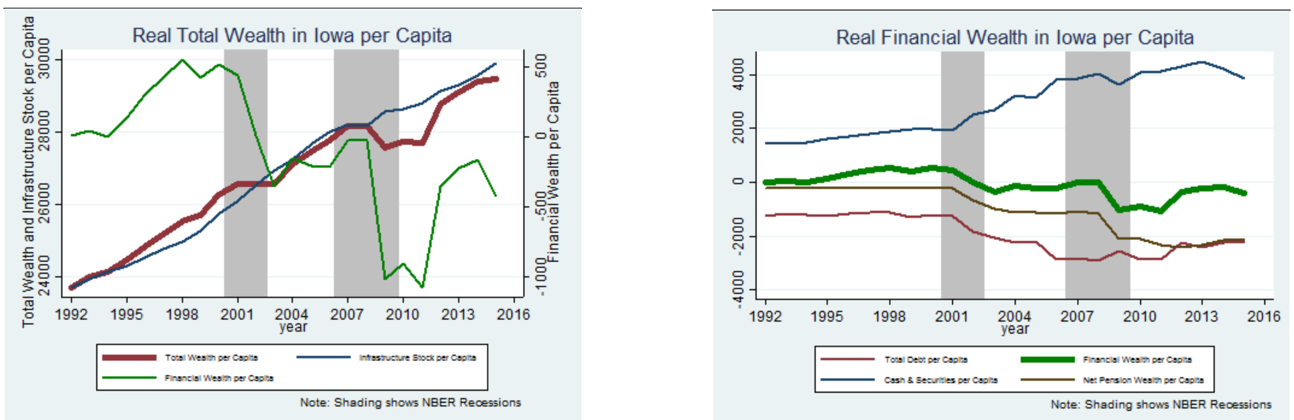


Figure 5: Total Wealth and Financial Wealth in Iowa

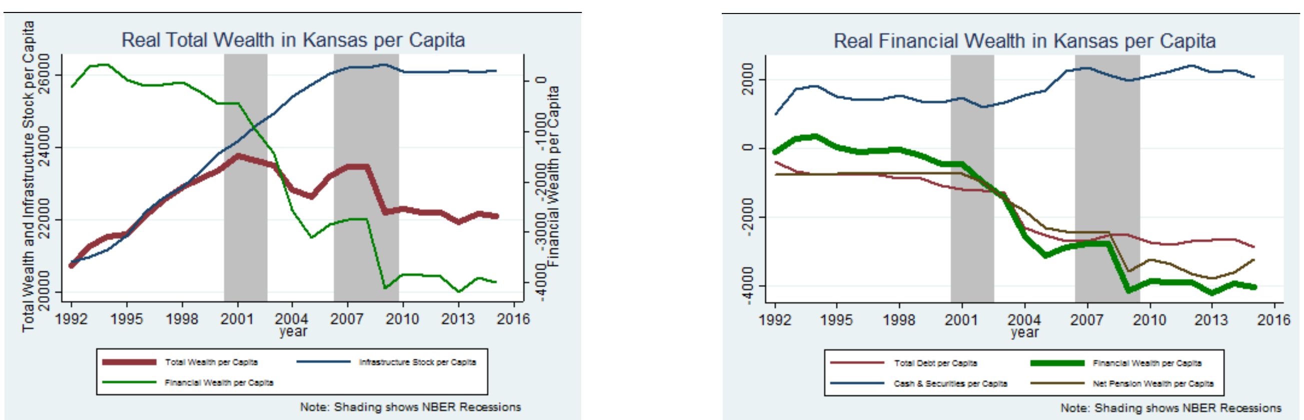


Figure 6: Total Wealth and Financial Wealth in Kansas

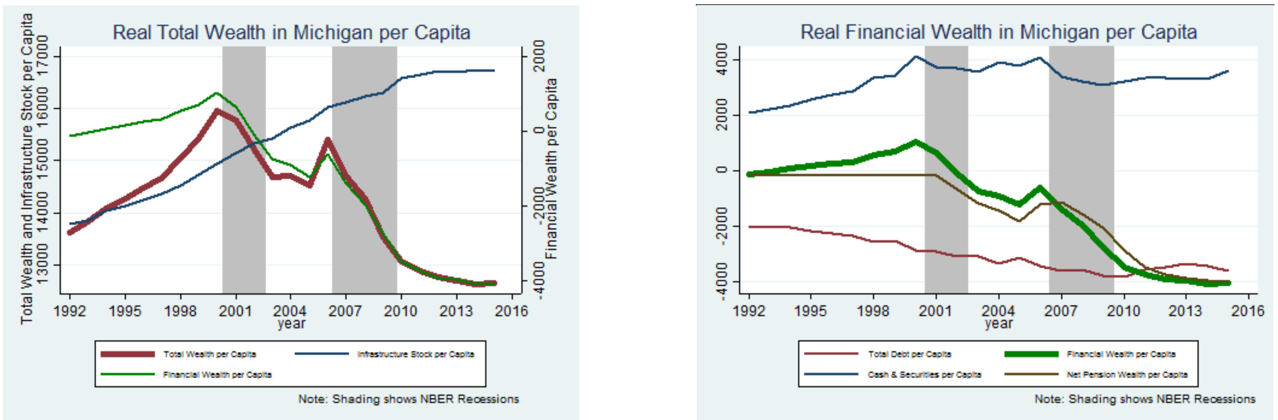


Figure 7: Total Wealth and Financial Wealth in Michigan

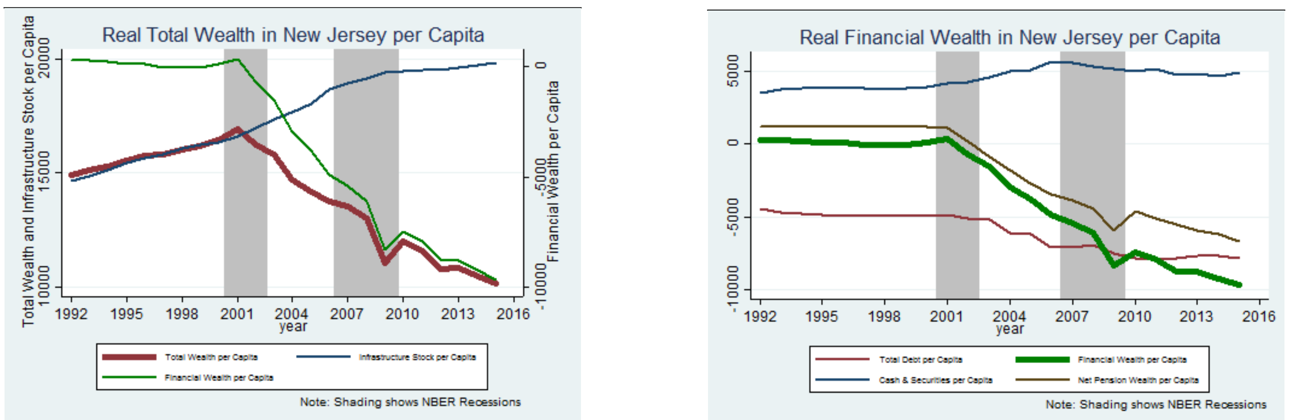


Figure 8: Total Wealth and Financial Wealth in New Jersey

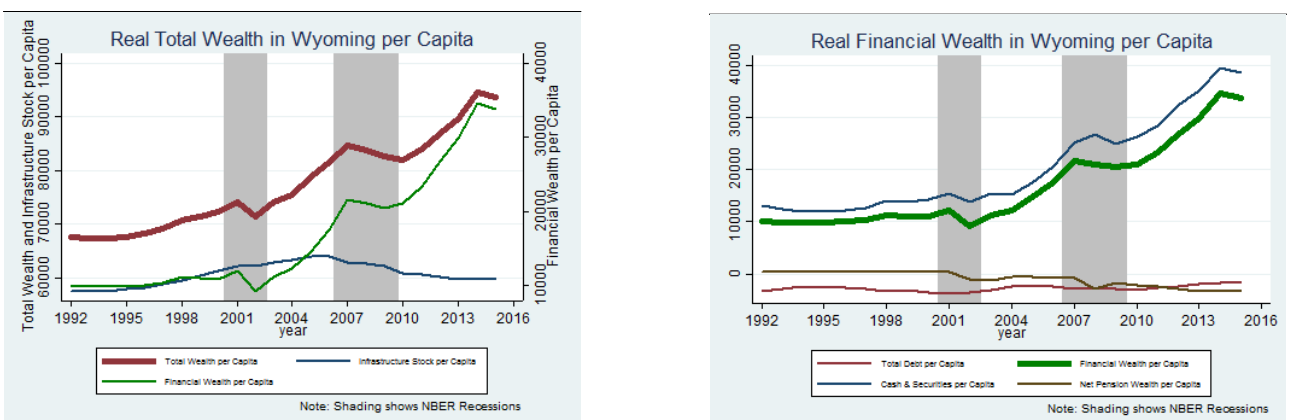


Figure 9: Total Wealth and Financial Wealth in Wyoming

## Table 1: Summary Statistics

| VARIABLE | MEAN | STANDARD DEVIATION | $10^{TH}$ %ILE | $90^{TH}$ %ILE |
|---|---|---|---|---|
| $K_{S,T}$ | $25,858 | $9,405 | $16,576 | $38,486 |
| $\Delta K_{S,T}$ | 253.7 | 308.2 | -46.3 | 634.6 |
| **FINANCIAL WEALTH PER CAPITA** | -593.6 | 4,186.4 | -4,600 | 1,948 |
| **CHANGE IN FINANCIAL WEALTH PER CAPITA** | -66.4 | 683.7 | -752.8 | 435.8 |
| **S&P 500** | 6655.3 | 2446.4 | 2687 | 10380 |

Table 2: Results

| Dependent Variable | $\Delta K_{s,t}$ (1) | $\Delta K_{s,t}$ (2) | $\Delta K_{s,t}$ (3) | $\Delta K_{s,t}$ (4) | $\Delta K_{s,t}$ (5) |
|---|---|---|---|---|---|
| **Method →** | OLS | OLS | OLS | IV | IV |
| **Ind. Variable** | | | | | |
| **Constant** | 213.1*** (13.58) | 211.1*** (13.53) | 234.4*** (13.89) | 209.8*** (12.58) | 205.0*** (11.91) |
| **Change in Financial Wealth** | -- | -0.049*** (-2.87) | -- | -- | -0.047 (-1.12) |
| **Change in Financial Wealth (t-1)** | -0.051*** (-3.22) | -0.036** (-2.21) | -0.052*** (-3.32) | -0.066* (-1.68) | -0.057 (-1.44) |
| **Change in S&P 500** | -- | -- | -0.257*** (-3.27) | -- | -- |
| **3 lags of population change?** | Y | Y | Y | Y | Y |
| **Year FE?** | N | N | N | N | N |
| **State FE?** | Y | Y | Y | Y | Y |
| **Observations** | 624 | 624 | 624 | 624 | 624 |

Notes: Data are 2001-2015 for 48 states. S&P changes vary only by year, not by state.

## Appendix A: Price and depreciation measures

1. Consumer Price Indexes. We update the method of Craig and Inman (1982) which introduces a cross-sectional variation into a standard CPIU for states. The resulting indexes are set to 100 for New York in 2017. This CPIU is used to deflate all of the financial wealth components.
2. Infrastructure price indexes. We use the *Engineering News Record's* Construction Cost Indexes, supplemented with ENR's estimate of the dollar cost of the index's components in each of the 20 covered cities. The indexes are assigned to states depending on proximity. All the indexes are set to 100 for New York in 2017.
3. Infrastructure depreciation assumptions. We follow see Boskin et al. 1987, Hulten and Wykoff (1981), Munnell 1990 in setting annual depreciation rates at 2% for structures, 12% for equipment and 0% for land. Using the additional assumption that structures represent 80% of the value of land and existing structures, we depreciate this category of asset by 1.6% per year. Ideally we would use cross-sectionally sensitive depreciation assumptions (as roads may depreciate more slowly in more temperate climates, for example), but these are not available.