Fiscal Triumvirate: Analyses of Crowding Out from Deficit Spending, of Domestic Migration from State Taxes, and of the Irrelevance of Credit Ratings on Municipal Debt Yields

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ABSTRACT

FISCAL TRIUMVIRATE: ANALYSES OF CROWDING OUT FROM DEFICIT SPENDING, OF DOMESTIC MIGRATION FROM STATE TAXES, AND OF THE IRRELEVANCE OF CREDIT RATINGS ON MUNICIPAL DEBT YIELDS

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The crowding out theory originally predicted substantially large effects from government activity in a market, including the impact of deficit spending on the price of loanable funds, namely, interest rates. Initial empirical testing in the twentieth century showed these effects to be quite small but consistent, while later testing suggested that the theory was wrong entirely and that a phenomenon of “crowding in” is observed during periods of large deficit spending by governments. This dissertation contributes to the existing literature by accounting for the supply side of the loanable funds market. Incorporation of a measure of global savings saves the crowding out theory and indicates that deficit spending by government does indeed have a positive and statistically significant effect on the following interest rates: 3-month Treasury bill, 3-year Treasury note, and 10-year Treasury note.

This dissertation also attempts to address the claim that residents of high-tax states are fleeing to low-tax states. Panel data on the 50 states of the Union are compared over the decade from 2010 to 2019, observing the rates of various taxes, cost of living, population growth rates, and labor market conditions, among other factors. The theory that people ultimately vote with their feet is supported by survey data, but the regression results offer only limited evidence that this is the case. Theoretically, higher tax rates, of any kind, cause state residents to move to states
with lower taxes, *ceteris paribus*. Empirical estimations are attempted for the marginal effects of personal and corporate income, sales, property, and gasoline tax rates. Survey data from the last decade makes it clear that people have tended to move to states with lower income taxes, despite often facing relatively high sales taxes in the process. Two possible explanations for this curiosity are deliberated. As people become more mobile (lower transportation costs, work flexibility, etc.) and as the penalty of high state taxes increases (limited SALT deductions), the shift in domestic migration to low-tax states is expected to continue its acceleration.

The issuer of virtually any debt obligation can pay an NRSRO (Nationally Recognized Statistical Ratings Organization) to assign a debt or credit rating for that bond. While the actual calculations used to assess a credit rating on a sovereign, corporate, or municipal bond or other financial instrument are unknown, it is clear that certain widely available data play heavily into those credit ratings, but those data are already known to investors. While ratings agencies have a relatively poor track record with commercial paper, they are still looked to by investors, but not for simpler municipal bonds. Panel data of all 50 states over the last decade are used with a fixed effects estimator to demonstrate that a state’s credit rating does not greatly impact investors’ decision as to what yield they will demand on a municipal security issued by that state. Instead, their evaluation of default risk appears to be based largely on widely available data including the real debt per capita and real income per capita ratios of a state, the cost of servicing outstanding debt as a percentage of the state’s revenue, and the real interest rate on U.S. Treasuries.
FISCAL TRIUMVIRATE: ANALYSES OF CROWDING OUT FROM DEFICIT SPENDING, OF DOMESTIC MIGRATION FROM STATE TAXES, AND OF THE IRRELEVANCE OF CREDIT RATINGS ON MUNICIPAL DEBT YIELDS

BY
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A DISSERTATION SUBMITTED TO THE GRADUATE SCHOOL IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE DOCTOR OF PHILOSOPHY

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DEDICATION

To the man who first taught me the value of a dollar, and of people more so – thanks, Pop
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CHAPTER 1

I: INTRODUCTION

It is always good practice to begin by defining one’s terminology. Crowding out can mean many things to many economists in different contexts. It can refer to public employment crowding out private employment, public purchases of goods crowding out private purchases, and even taxes for public welfare programs crowding out their private counterpart of donations to charitable organizations. In short, crowding out is the economic theory that the entrance of government activity into the economy can have the effect of excluding some private activity that existed previously. For the purposes of this research, the focus is upon the crowding out of private investment by government deficit spending, with an increase in that public spending causing a rise in interest rates.

According to N. Gregory Mankiw, the crowding out effect takes place not because government borrowing increases the demand for loanable funds, but because it decreases the supply of loanable funds. This is because he defines the loanable funds market as the “flow of resources available to fund private investment.” However, he also acknowledges that under the framework of defining loanable funds as including private and public borrowing together, crowding out would then be an increase in demand as opposed to a decrease in supply. More importantly, the end result on the market remains the same: the interest rate rises. While the

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1 Unless otherwise noted, “government” as used throughout this chapter refers to the United States federal government.
equilibrium quantity would clearly change, it is merely a semantic difference since this chapter’s focus is on the interest rate.

Absent any government spending, then, some private individuals will save money while others borrow from them, after agreeing on a price. The price for these loanable funds is the interest rate. Like any price, it conveys an important piece of information, telling individuals how valuable savings are and how costly borrowing is, relative to the alternative uses for their money and time. Prices are of the utmost importance because they are necessary for the economical allocation of scarce resources.³ Loanable funds are among these scarce resources. This gives credence to the idea that the government must compete in the loanable funds market alongside all others who wish to borrow, including corporations, households, and lower levels of government.

According to the crowding out theory, large amounts of government deficit spending cause the government to borrow more, and this borrowing increases the interest rate on loanable funds. The higher interest rate effectively makes borrowing prohibitively expensive for borrowers near the margin, whose consumer surplus was previously relatively small but is now non-existent as the marginal cost of borrowing rises above their marginal benefit. Those borrowers, therefore, no longer seek loans, and private investment is “crowded out” of the marketplace by government borrowing. The foundational economic principle of scarcity indicates that this effect should be taking place and that the theory is on sound footing.

³ The fact that loanable funds have a price, the interest rate, indicates that they must be scarce. By definition, they would not have a price if they were not bound by scarcity. Crowding out is an example of the decades-old economic aphorism: there’s no such thing as a free lunch.
That foundation is jeopardized, however, if the data surrounding the loanable funds market does not consider the supply side of the equation. In the next section, this consideration is conspicuously absent from nearly all the previous empirical literature. Section III of this chapter develops an empirical model centered around the concept of including both the supply and demand for loanable funds and section IV describes the data to be used in that model. The results of the regression analysis are then detailed in section V, including the results of excluding the supply dynamic from the regressions. Section VI contains a summary and ideas for future research while the final section contains conclusions and policy implications.

II: LITERATURE REVIEW

There has been a long history of both theoretical and empirical literature on crowding out, specifically crowding out due to government deficit spending, with John Stuart Mill likely being the first to suggest such a relationship in 1862. Likewise, this literature has extended to examining many different time periods, not merely confining the study to recent history. There is empirical research of Great Britain’s economy during the eighteenth century, for instance, including both war and interwar periods. Black and Gilmore (1990) concluded that high war spending to fight the French raised nominal and real interest rates by using a model with lagged rates. Heim and Mirowski (1987) had come to just the opposite conclusion when studying different data in Great Britain from the exact same century. Instead of merely measuring

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government debt, they included measurements for all debt and found that there were periods of high government deficit spending that coincided with low interest rates.

Stefan Oppers (1993) made an important contribution to the previous examinations of this time period in British economic history. He found that for about five decades in the middle of the eighteenth century, the Dutch were very willing to buy British war debt and at very low interest rates, presumably out of confidence in the quality of the bonds being issued. After 1780, the Dutch continued to hold already purchased British debt, but rather abruptly ceased buying new foreign sovereign debt. As a result, the end of the eighteenth century was marked by increasing interest rates in Britain as the government attempted to attract more loanable funds for deficit spending. More specifically, the interest rates in Britain in those later years were found to be much more sensitive to government deficit spending and the necessary government borrowing that accompanied it.

The literature has examined many different periods in various countries, including an issue which should hit particularly close to home today: the Trump tax cut, the more frequently used name for the Tax Cuts and Jobs Act of 2017. While a decrease in tax rates does not necessarily lead to a decrease in tax revenue, some models did in fact predict tax revenues would decline, which in turn would lead to more borrowing to finance increased government deficit spending. Under these predictions, some empirical analysis predicted crowding out would diminish GDP growth from the Trump tax cut due to increased interest rates. Conversely, in the

8 Opper’s development represents a key improvement to previous work and this research aims to improve upon it by including an aspect of the entire global financial market, not just the Dutch.
framework of a Laffer curve, the lower tax rates would increase revenue if the nation is on the downward sloping portion of the curve. This would result in lower deficits, less government borrowing, and lower interest rates from less crowding out, spurring economic growth.

Most of the more recent empirical research indicates that government deficit spending actually causes little to no increase in the interest rate. The investigations of late have tended to find that crowding out is much smaller than the theory predicts, if it is even statistically significant, which much of the research indicates it is not. In fact, one of the first pieces of research to extensively use empirical models to test the crowding out theory (Hoelscher, 1983) concluded that there was no significant crowding out on short-term rates from government deficit spending. Instead, other macroeconomic factors, such as the level of economic activity, unemployment, expected inflation, and monetary policy were the key determinants of interest rates. Again, this ignores the supply side of the equation and the global nature of the loanable funds market.

Frenkel and Razin (1985) developed a theoretical model that did take into account global interest rates, but they used government spending, not government deficit spending in their analysis. They concluded that increased government spending would raise interest rates and decrease consumption, both domestically and internationally, indicating a crowding out effect. However, because their data examined government spending in its entirety, making no

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distinction between what was financed with taxes versus financed with borrowing, it is more difficult to draw conclusions on the loanable funds market from their research.\textsuperscript{12}

Historically, some very prominent economists have been firm believers and promoters of the theory of crowding out, despite more recent empirical results that appear to have stacked considerable evidence against the theory. Milton Friedman noted in his research and theoretical work that government deficit spending might cause a temporary increase to GDP, but it would certainly also increase interest rates. Frank Knight also supported the crowding out theory and produced work demonstrating that investment levels are very elastic in terms of the interest rate. Likewise, Robert Barro, of Ricardian fame, also subscribed to the theory. Even John Maynard Keynes believed that government deficit spending would increase interest rates, albeit only if the economy was nearing full employment. Ironically, many Neo-Keynesians might disagree entirely.

Not only has the empirical evidence of the last few decades been fairly consistent in minimizing the theory of crowding out, but the last decade in particular has produced empirical work showing the exact opposite of the theory. In the case of the Great Recession, there appears to have been what Paul Krugman is fond of calling “crowding in,” and not crowding out.\textsuperscript{13} In his 2011 article, “The Profession and the Crisis,” he does not mince words citing the “complete ignorance” of economists who believe the crowding out theory.\textsuperscript{14}

\textsuperscript{12} Frenkel and Razin do make an important contribution by taking a model to the global level, but they only examine the global effects, not the global causes. Incorporating global savings levels can be seen as an extension of their work as well.
The phenomenon of interest rates hitting a price floor, e.g., the nominal interest rate reaching its lower bound of zero at the end of 2008, is the subject of a growing body of literature. Empirical work has incorporated this oddity into DSGE (Dynamic Stochastic General Equilibrium) models, and while the government spending multiplier is ordinarily less than one, a binding zero lower bound can theoretically change that. Instead of causing any crowding out, this can possibly cause crowding in because any increase in inflation while nominal rates remain at zero results in a decrease in the real interest rate. This has the effect of encouraging consumption and investment since the alternative would be to hold on to liquid cash which would be diminishing in real purchasing power.

In the case of a so-called “liquidity trap,” an IS-LM model has a nearly, if not perfectly, horizontal LM curve. In this case, increasing government deficit spending does not drive up nominal interest rates but does increase output. Conversely, if the LM curve is more vertical, then the rightward shift of the IS curve caused by government deficit spending will increase interest rates while having little to no effect on output. In the former case, with a horizontal LM curve, monetary policy may be totally ineffective, while in the latter case, a vertical LM curve would likely respond much more positively to monetary policy. Within Richard Cebula’s very large body of work examining crowding out is a theoretical model aimed at determining when the LM curve is horizontal, vertical, or somewhere in between. He concludes that the slope of the LM curve is essential to determining if crowding out will in fact take place.

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Conversely, Milton Friedman argued that the slope of the LM curve was actually irrelevant to the issue of crowding out.\textsuperscript{16} The Nobel laureate posited that any fiscal expansionary efforts will have initial effects and long-term effects. It is the long-term effects which he believes are contradictory to the initial and expansionary effects. Interest rates may not rise initially, therefore, but they will rise eventually, irrespective of the LM curve’s slope.

Just as the Great Depression and the stagflation of the 1970s posed new economic challenges to conventional thinking, so did the Great Recession. Both Heterogeneous Agent New Keynesian (HANK) models and Representative Agent New Keynesian (RANK) models have been inadequate in fully explaining the combination of economic phenomena that occurred in the Great Recession, including this apparent crowding in. Another Nobel laureate, the previously mentioned Paul Krugman, promoted one of the original Keynesian ideas, namely that this recession was one of excess wherein consumption had fallen below production of consumer goods. According to Krugman, the solution of government deficit spending should, in those circumstances, cause no increase in the real interest rate.\textsuperscript{17}

In the aftermath of the housing and financial collapses at the end of the decade of the 2000s, the government ran record deficits and doubled the national debt in less than eight years. During that same time, private individuals and corporations kept record amounts of liquid cash and were unwilling to invest or borrow, presumably because they were uncertain of future economic prospects and government regulations.\textsuperscript{18} The result was a glut of savings that made it

\begin{flushright}
\textsuperscript{16} Keith M. Carlson and Roger W. Spencer, “Crowding Out and Its Critics.” St. Louis Federal Reserve, December 1975.  \\
\textsuperscript{18} From 2009 to 2016, federal regulations, as measured in the Federal Register, grew by more than 25,000 pages, an increase of 22\% in just eight years.
\end{flushright}
very inexpensive for the government to borrow, and so the record levels of borrowing failed to put any upward pressure on interest rates. Beginning in the recession, the total savings deposits at depository institutions in the United States increased sharply and continued that higher trend almost uninterruptedly until the end of 2016.19 Similarly, gross private savings saw a dramatic rise during, and for several years after, the recession followed by more erratic growth since then.20

The former Federal Reserve Chairman, Ben Bernanke, seems to have struck a chord when he pointed out that the government was able to run record-breaking deficits while paying record-low interest rates on sovereign debt specifically because there was a savings glut, not just in the United States, but globally.

This chapter proposes that there are two key reasons why the crowding out effect has often been empirically shown to be very small, statistically insignificant, or both. First, the business cycle counteracts the crowding out theory. In an expansion, increased tax revenue drives down deficits while interest rates also rise. In a recession, decreased tax revenue drives up deficits while interest rates tend to fall. The effects of government deficit spending on interest rates can therefore be masked by the normal business cycle. This first idea is not in any way original, having been proposed previously. However, the second key reason is quite new, namely, that government is not limited to selling its sovereign debt to its domestic citizens and institutions. Global financial markets allow international debt sales, and a AAA-rated United States Treasury bond is easily transferred on the international stage.

19 Board of Governors of the Federal Reserve System (US), Total Savings Deposits at all Depository Institutions [SAVINGS], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/SAVINGS.
20 U.S. Bureau of Economic Analysis, Gross Private Saving [GPSAVE], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/GPSAVE.
Existing empirical literature has dealt with changes in the business cycle and fluctuations in the demand for loanable funds to varying degrees, and this chapter’s empirical work will incorporate this element as well. Where this chapter makes its contribution is by building on existing models to incorporate not only the effects of changes in GDP on interest rates, but the effects of changes in the global savings rate as well. Furthermore, removing the measure of global savings from the analysis yields results which imply government deficit spending has no statistically significant impact on interest rates.

III: STRUCTURAL EMPIRICAL MODEL

Inflation ordinarily increases nominal rates at roughly a one-to-one ratio. The empirical analysis, therefore, begins with a linear inflation model framework. However, the other elements that this analysis seeks to incorporate are the representatives of the supply and demand of loanable funds, curves which do not necessarily have constant price elasticities. This would call into question the viability of the classical linear regression model. Nevertheless, the descriptive statistics in the next section demonstrate that these independent variables stay within a relatively narrow window of their respective maximum ranges. In other words, there is not much movement along the “curves” of supply and demand. As the data occupies a reasonably limited portion of the overall length of the curves, the degree of curvature in question is quite small. Consequently, there is little change in price elasticity over the observed ranges of the data. A linear relationship can still accurately approximate the change in interest rates relative to the change in the quantity supplied of loanable funds.

Loanable funds are supplied entirely through the private sector, but they are demanded by both the private and public sectors. The following model reflects this reality:
\[ t = \beta_1 \pi + \beta_2 \sigma + \beta_3 \delta + \beta_4 \xi + \epsilon \]

where \( t \) are nominal interest rates, \( \sigma \) is the supply of loanable funds (savings), \( \pi \) is inflation, \( \delta \) is the public demand for loanable funds (the net deficit), and \( \xi \) is the private demand for loanable funds (investment), while \( \epsilon \) is a normally distributed idiosyncratic error term with mean of zero and uncorrelated with the other variables. The coefficients are expected to have the following values:

\[ \begin{align*}
\beta_1 & \approx 1 \\
\beta_2 & < 0 \\
\beta_3 & > 0 \\
\beta_4 & > 0
\end{align*} \]

\( \beta_2 \) and \( \beta_3 \) are of particular interest because this investigation seeks to show that increasing the supply of loanable funds lowers interest rates while increasing government deficit spending raises interest rates. The magnitude of \( \beta_3 \) will indicate the size of the crowding out effect, which is important since the goal is to obtain causal effects of deficit spending on interest rates.

Before this framework can be applied to U.S. data for analysis, a few more stipulations should be made. First, both components of the demand for loanable funds are partially dependent upon interest rates. Changes in interest rates will affect private demand for loanable funds since borrowers are constrained by profit incentives. While public borrowers do not have this same consideration, financing a deficit is an additional cost. Higher interest rates mean higher financing costs on a gross deficit, which in turn yield a larger net deficit. These relationships will require instrumenting both aspects of the demand for loanable funds.

The supply of loanable funds is global and theoretically impacted by interest rates in the U.S., including U.S. Treasuries which are the means of financing the deficit. However, the
measure of annual U.S. government borrowing averages about 2% of the measure for the supply of loanable funds for the period in question.\textsuperscript{21} In the same way that perfect competition assumes a multitude of buyers and sellers with low market share and no market power among market participants, so too is the supply of loanable funds exogenous with respect to interest rates on U.S. Treasuries.

Lastly, because inflation increases nominal interest rates by roughly a commensurable amount, $\beta_1$ should be about 1. Large deviations in $\beta_1$ away from this value may indicate problems with the empirical estimates.\textsuperscript{22} The data chosen to best represent inflation, the supply and demand for loanable funds, and the interest rate are all detailed in the next section.

\textbf{IV: DATA}

Data for the analyses in this chapter were compiled from the Federal Reserve Bank of St. Louis, Bureau of Economic Analysis, International Monetary Fund, the Federal Reserve Bank of Minneapolis, the World Bank, and the Federal Reserve Bank of Chicago. While most of the data are available in either quarterly or monthly intervals, certain data are only available annually. As an additional curiosity, some data are only available from 1975 onward, and others were last reported for 2016 at the time of this writing. Consequently, the dataset is limited to 42 observations, from 1975 to 2016. While the ideal situation would obviously be to have data that were reported more frequently, giving more observations, the dataset is still large enough to

\textsuperscript{21} Prior to the Great Recession, U.S. government borrowing averaged only about 1.5% of global savings. The gross deficit actually averages a surplus for the entire 42-year period; less interest payments, the federal budget would conceivably contribute to global savings.

\textsuperscript{22} For this reason, $\beta_1$ can be thought of as keeping the empirical models “honest” in that it can possibly detect certain effects being attributed to the wrong variable when its own value strays too far from 1.
maintain confidence in the asymptotic normality and consistency property of Ordinary Least Squares (OLS).

Ultimately, the data points which were used in the final regressions were the interest rates for the 3, 36, and 120-month U.S. Treasuries; global savings as a percentage of gross national income (global savings rate); inflation; the net deficit as a percentage of GDP; real wage growth; and real net private domestic investment as a percentage of GDP. The inflation data is calculated by the Federal Reserve Bank in Minneapolis, based on price indices. The gross deficit is the amount of annual government spending greater than annual tax receipts. The net deficit is the gross deficit plus the interest costs of financing the national debt.

Treasury rates are used as the dependent variables for several specific reasons. First, they have consistently received the highest investment-grade rating (AAA) and so their interest rates are less subject to fluctuations from a ratings change. Investors have long considered U.S. Treasuries to be the gold standard when it comes to risk avoidance. Conversely, this means Treasury rates may be more impacted by the market’s taste for risk, causing rates to fall when risk is perceived to be high. This is largely accounted for by incorporating measures of savings. As risk aversion increases, savings also increases. Thus, there is a correlation between savings levels and a desire to buy Treasury bills, bonds, and notes. The interest rate of those Treasuries should therefore be inversely related to both the demand for Treasuries and the savings rate, with both flight to quality and flight to security being captured quite well by the rate on Treasuries.

---

23 While M2 can at times be an excellent forecaster for inflation, it is often inaccurate during periods of robust economic growth, and there is no need for a forward-looking measurement in this aspect of the analysis.

24 So correlated are Treasury rates with risk aversion and savings rates that including a measure for risk aversion via an index (Nation Financial Conditions Index) will result in all other explanatory variables lacking statistical significance, in part because such an index is also a function of so many macroeconomic factors.
The second reason for using Treasuries as the dependent variable is the ease with which they are purchased and sold on the world stage. There exists a deep, liquid, and competitive global market for U.S. Treasuries. Fewer barriers to their exchange, relative to many other investments, mean there are fewer extraneous factors which may affect the price. Third, many other interest rates\(^{25}\) are based on various Treasury rates or are at least evaluated based on the difference between a particular interest rate and a corresponding Treasury rate. Instead of analyzing these rates which have been affected by the rate on a Treasury, simply using the Treasury rate is like cutting out the middleman and going straight to the source.

Fourth, because they are sold at auction, U.S. Treasuries’ rates are set by the market, thus reflecting the interaction of supply and demand. Other rates, like the Federal Funds Target Rate, are exogenously set in an attempt to influence market forces. While the Federal Funds Target Rate is also very important in setting other interest rates, especially the Prime Rate, the occurrence of monetary phenomena, like “pushing on a string,” mean that market rates will not always move in lockstep with the Federal Funds Target Rate, or even the Effective Federal Funds Rate. Consequently, the rates on Treasuries can be a better thermometer for market rates.

Lastly, treasuries are available in various terms, up to 30 years, with their various interest rates capturing investors’ expectations for the short-run and the long-run. This allows for an analysis of not only short-term rates, but longer-term rates as well, with what are otherwise identical investments.\(^{26}\) Most other financial instruments cannot offer such a wide range of terms.

---

\(^{25}\) AAA commercial paper has a strong relationship to Treasuries, although even the safest commercial bonds are considered to have more risk than Treasuries. FDIC insured CDs are almost perfectly correlated with Treasuries as well since the government insurance on them effectively provides the same security as a U.S. Treasury.

\(^{26}\) It is worth distinguishing between Treasury bills, notes, and bonds. Treasury bills (T-bills) are short-term government securities with maturities ranging from a few days to 52 weeks. They are sold at a discount from their face value. The 3-month T-bill is the common name for the 13-week Treasury bill. At maturity, you are paid the par
without introducing distortionary factors that make investments with dislike terms difficult to compare. With this in mind, utilizing Treasuries with three different terms (3, 36, and 120 months) allows this analysis to observe the effect of the deficit on short, medium, and long-term rates.

The 3-month T-bill is the secondary market rate while the 3-year T-note and 10-year T-note rates are based on current sales directly from the Treasury, known as the primary rate. The secondary rate is used for the 3-month T-bill in part because it helps to smooth out the daily fluctuations in the primary rate. The longer-term 3-year T-note and 10-year T-note rates typically do not have as relatively large fluctuations. Also, the secondary market for 3-year and 10-year notes includes the trading of notes that were issued in years past and therefore the yields observed will be influenced by previous rates as well as investors’ expectations of rates in the future. Future rates are a consideration for those looking to purchase these Treasuries since market rates can fluctuate much more over the life of the bond as compared to a 3-month T-bill.

In terms of the parameter of interest, it is anticipated that very-long-term bonds will not be affected by more temporary changes in the deficit, being much more dependent upon long-run macroeconomic factors, so the rate on the 30-year Treasury bond is not used.\(^{27}\)

To account for the supply of loanable funds, this research uses global savings, which are measured as a percent of GNI. It is essentially a weighted average of savings as a percentage of GNI in each country. Equivalently, it is the amount of world savings divided by world income,
expressed as a percentage. Due to the incredibly high correlation between GDP and GNI, and the fact that world GDP is theoretically equivalent to world GNI, there is no reason to suspect that using this measure for savings will cause any issue in a model where other terms are expressed as a percentage of GDP. Since income is either spent or saved, savings for each country are calculated by

\[
\frac{GNI - consumption}{GNI}
\]

and these percentages are then weighted based on the size of each country’s GNI, yielding a global savings rate. While not every country is reported in the worldwide data, those not included are primarily from the third world, where savings levels are very low relative to the world average. Additionally, their GNI per capita is relatively so low that even if they had a high savings rate, their contribution to the loanable funds market would very likely be negligible. Using the savings rate instead of a nominal savings level serves to prevent the need for taking a log of savings since the dollar value of total savings around the globe has grown at an exponential rate.

Real net private domestic investment represents the private demand for loanable funds. Using real, as opposed to nominal, investment helps to protect against multicollinearity since inflation is also a right-side variable and inflation would likely have a linear relationship with nominal investment. Adjusting for inflation ahead of time alleviates this concern. Net investment is the increase in the capital stock from gross investment less capital depreciation over the same period. It excludes any government investment. Real net private domestic investment is expressed as a ratio to real GDP

\[
\frac{investment}{GDP}
\]
which also serves to prevent the need for taking a log of investment, as was the case with savings. Additionally, the interpretation of the coefficients is greatly simplified by every variable on both sides of the equation being expressed as a percentage.

Real wage growth, then, is also expressed as a percentage. It is the nominal growth in wages adjusted by the Consumer Price Index for All Urban Consumers. This CPI was chosen in part because the prices included in the index represent the buying habits of about 88 percent of the population.

\[
\text{nominal wage growth} \ (\%) = \text{change in CPI} \ (\%)
\]

The net deficit is expressed as a ratio. While the net deficit is often expressed as a negative value, this chapter expresses a deficit with a positive value and a surplus with a negative value. As such, the method of calculating the net deficit to GDP ratio is trivially changed to

\[
\frac{\text{government expenditures} + \text{financing costs} - \text{tax receipts}}{\text{GDP}}
\]

and is distinguished from the gross deficit to GDP ratio, which excludes the financing costs of the net deficit and is expressed as

\[
\frac{\text{government expenditures} - \text{tax receipts}}{\text{GDP}}
\]

The data span a time period that includes six recessions, global supply shocks, several overseas conflicts, periods of both robust and anemic growth, deficits and surpluses, as well as bouts of severe inflation. While 42 years is not a terribly long time, it is long enough to include a

---

variety of macroeconomic conditions and observe how each variable behaves in those conditions.

The measure for global savings has a negative kurtosis (platykurtic) indicating that there are fewer observations in the tails of its distribution relative to the normal distribution. The coefficient of variation (relative standard deviation) is quite small compared to the other variables at just 0.07, but the range is more than 20% of the maximum observed savings rate. Additionally, the data intersection shown in Figure 1.1 illustrates that the savings rate is hardly static, but instead displays variation over the 42 years of observation, even though the observations occupy just 6% of the theoretical maximum range of the savings rate.\textsuperscript{30} Lastly, beginning in 1983, the savings rate begins an erratic upward trend while interest rates begin a downward trend, indicative of an inverse relationship between the two.

The deficit to GDP ratio remained positive until the late 1990s, at which point the government ran a surplus until 2002. The deficit peaked in 2009 amid record-setting bailouts in the Great Recession, as interest rates continued to fall to near zero. At the same time, the investment to GDP ratio briefly turned negative as more capital wore out than was replaced. This singularity aside, investment to GDP was always positive, indicating an increasing capital stock.

\textsuperscript{30} Another observation worth noting from Fig. 1 is that real net private domestic investment decreased so dramatically from 2006 to 2009 (falling almost $1 trillion in chained 2012 dollars) that in the latter year, it turned negative, the only time in the 52 years of observations that this occurred. Real gross private domestic investment was still positive that year, totaling nearly $7.8 trillion in chained 2012 dollars.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Mean</th>
<th>Std. dev.</th>
<th>Median</th>
<th>Min.</th>
<th>Max.</th>
<th>Obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$3mo\ T\ rate_t$</td>
<td>Interest rate on the 3-month T-bill, secondary market</td>
<td>4.52</td>
<td>3.56</td>
<td>4.68</td>
<td>0.03</td>
<td>14.03</td>
<td>42</td>
</tr>
<tr>
<td>$3yr\ T\ rate_t$</td>
<td>Interest rate on the 3-year T-note</td>
<td>5.53</td>
<td>3.68</td>
<td>5.40</td>
<td>0.38</td>
<td>14.46</td>
<td>42</td>
</tr>
<tr>
<td>$10yr\ T\ rate_t$</td>
<td>Interest rate on the 10-year T-note</td>
<td>6.29</td>
<td>3.23</td>
<td>5.95</td>
<td>1.80</td>
<td>13.91</td>
<td>42</td>
</tr>
<tr>
<td>$Savings_t$</td>
<td>Global savings as a percent of GNI</td>
<td>23.65</td>
<td>1.56</td>
<td>23.61</td>
<td>20.73</td>
<td>26.53</td>
<td>42</td>
</tr>
<tr>
<td>$Net\ deficit_t$</td>
<td>Deficit as a percent of GDP</td>
<td>3.12</td>
<td>2.45</td>
<td>3.02</td>
<td>-2.30</td>
<td>9.78</td>
<td>42</td>
</tr>
<tr>
<td>$Gross\ deficit_t$</td>
<td>Deficit, less financing costs, as a percent of GDP</td>
<td>-0.50</td>
<td>2.69</td>
<td>-0.65</td>
<td>-5.75</td>
<td>7.32</td>
<td>42</td>
</tr>
<tr>
<td>$Inflation_t$</td>
<td>Annual inflation rate</td>
<td>3.87</td>
<td>2.88</td>
<td>3.10</td>
<td>-0.4</td>
<td>13.5</td>
<td>42</td>
</tr>
<tr>
<td>$Investment_t$</td>
<td>Real net private domestic investment as a percent of GDP</td>
<td>4.61</td>
<td>1.51</td>
<td>4.73</td>
<td>-0.18</td>
<td>7.11</td>
<td>42</td>
</tr>
<tr>
<td>$Wage\ growth_t$</td>
<td>Annual real wage growth, percentage</td>
<td>2.07</td>
<td>3.07</td>
<td>2.71</td>
<td>-5.56</td>
<td>7.04</td>
<td>42</td>
</tr>
</tbody>
</table>
Figure 1.1. Data intersection, 1929–2018.
V: EMPIRICAL RESULTS

Lags were used in the models for four reasons. First, certain economic factors, such as changes in monetary policy, can take two years to have their full effect. A change today cannot be expected to have its full impact, or even its maximum impact, until sometime in the future.

Since monetary policy is very often based upon not future but current data, today’s macroeconomic conditions can affect interest rates for years into the future. Second, not only can it take two years for the full effect to be felt in the real world, but, because some of the dataset is composed of annual averages, certain data points may not line up well. As an example, the year 2007 started off with a boom and ended with a bust, but certain averages for the year may have been robust while others were weak, depending on the exact macroeconomic indicators in question. Not every aspect of the economy collapsed in unison. Therefore, as an additional curiosity of the available data, the observer can more clearly see the impact of the macroeconomic factors from one to two years ago on interest rates today.

Third, many macroeconomic factors are not known until sometime in the future. For example, the Bureau of Economic Analysis releases estimates for quarterly economic growth and price indices, but these numbers are repeatedly revised as additional data becomes available. Even the first estimate is not available until sometime after the period in question has ended since the data needs to be gathered and calculated before it can be disseminated. Individuals may change their behavior based upon the initial and revised estimates so that events from today may very well impact financial conditions for the next one to two years. Additionally, as people adjust their saving habits and alter the quantity of available savings, it takes time for those savings to work their way through even the most modern financial markets. Money may be
transferred instantly through electronic means, but it takes some time before a pattern of increased savings develop and market participants notice those trends.

Finally, the lags provide some protection to the model in that there is a case to be made for temporal causality. All the independent variables are lagged by two years so that the comparison being made is between the interest rate of today and the annual average of the macroeconomic indicators from two years ago. The first model is an OLS regressing the interest rate on inflation, the savings rate, the deficit to GDP ratio, and the investment to GDP ratio:

\[
\text{Interest rate}_t = \beta_0 + \beta_1 \text{Inflation}_{t-2} + \beta_2 \text{Savings}_{t-2} + \beta_3 \text{Net Deficit}_{t-2} + \beta_4 \text{Investment}_{t-2} + \epsilon_t
\]

By comparison, failing to account for global savings would yield the following model:

\[
\text{Interest rate}_t = \beta_0 + \beta_1 \text{Inflation}_{t-2} + \beta_3 \text{Net Deficit}_{t-2} + \beta_4 \text{Investment}_{t-2} + \epsilon_t
\]

The coefficients on the deficit and investment have been left unchanged in this second model to avoid any confusion. The forthcoming results from this model show a lack of statistical significance on the deficit, even producing a negative coefficient for the deficit. As was previously mentioned, however, there is an immediate concern that these OLS models will suffer from significant issues, such as positive feedback loops. That is to say, there could be simultaneity for two of the independent variables: the deficit and investment. While increases in the deficit should increase interest rates, those rising interest rates impact the cost of all borrowing, including both government borrowing and private debt financing. The rising costs of
government borrowing will further grow the deficit and put additional upward pressure on interest rates. Previous empirical research has found evidence for this two-way causality between gross deficits and real interest rates.\textsuperscript{31} Similarly, an increase in domestic investment would also increase interest rates as the demand for loanable funds rises. However, if interest rates rise due to some other factor, that puts downward pressure on domestic investment, which is again indicative of two-way causality. As a further illustration, the independent variables could, and according to the theory in fact should, be affecting one another. As just one example, an increase in global savings would drive down interest rates while encouraging additional domestic investment. The end result would be not only a new value for global savings and the interest rate, but for domestic investment too.

To deal with the endogeneity present in the OLS model, it is necessary to perform a two-stage least squares (2SLS) regression, utilizing instruments for both the net deficit and the level of domestic investment.\textsuperscript{32} Since real wages rise with the marginal product of labor, which is highly correlated with capital investment, the change in real wages serves as a good instrumental variable for investment. More precisely, the statistic used is the percentage change in real wage growth. Since the net deficit is explicitly calculated using the gross deficit, and since financing costs are a relatively small portion of the net deficit, the net and gross deficit are highly correlated. The gross deficit is strictly the product of how much Congress spends in a year and

\begin{footnotesize}
\begin{itemize}
\item\textsuperscript{32} The temporal case for one-way causality introduced by using lags, while it does add some protection against endogeneity, is not robust by itself. This is especially true when the variables tightly follow a predictable pattern of growth. However, the lags and 2SLS together make a very strong case that the two-way causality has been removed.
\end{itemize}
\end{footnotesize}
how much less Congress collects in taxes. Hence, there is no longer any reverse causality between the deficit measure and the interest rate.

The obvious downside to using the gross deficit is that any change to the interest rate which results from a change in the cost of financing the debt due to a previous change in interest rates is not represented explicitly; therefore, it is left to be captured by either the error term or mistakenly attributed to another independent variable. Ironically, this disadvantage is precisely the result that was desired because it removes the positive feedback loop and, consequently, the reverse causality. That being said, this change likely biases the effect of the deficit downward, giving confidence that the true effect of the deficit on interest rates is at least as large as estimated by the regressions.\(^{33}\)

The following model is used to perform 2SLS regressions on each of the three Treasury rates:

\[
\begin{align*}
\text{Interest rate}_t &= \beta_0 + \beta_1 \text{Inflation}_{t-2} + \beta_2 \text{Savings}_{t-2} + \beta_3 \text{Net Deficit}_{t-2} + \beta_4 \text{Investment}_{t-2} \\
&\quad + \epsilon_t
\end{align*}
\]

Once again, by comparison, failing to account for global savings would produce an altered model:

\(^{33}\) Since the gross deficit is always less than the net deficit, there may appear to be a concern that the new values for the deficit produced by the first stage of the 2SLS will universally be smaller and this will result in larger coefficients on the deficit. In fact, 29 of the 42 the observations for the deficit became negative after this change, which is indicative of a surplus. Previously, only 4 of the 42 observations were negative. If smaller values were the source of artificially larger coefficients, then the standard errors would be increasing, not decreasing, since the many negative observations would be impacting the equation in the wrong direction. A higher R-squared indicates the model has been made more accurate, so it is safe to say this fear is allayed.
(4) 

\[ \text{Interest rate}_t = \beta_0 + \beta_1 \text{Inflation}_{t-2} + \beta_3 \text{Net Deficit}_{t-2} + \beta_4 \text{Investment}_{t-2} + \epsilon_t \]

As in the case of the OLS, the deficit will lose its statistical significance without the inclusion of savings. The results for both the third and fourth models are presented in Tables 1.2 and 1.3, with each regression being performed on the interest rates for the 3-month T-bill, the 3-year T-note, and the 10-year T-note. Each model, consequently, has a set of results for each Treasury rate. All regressions use HAC robust standard errors.

The 2SLS model with savings produces coefficients that are statistically significant for each of the independent variables. The first observation from these results is that world savings negatively impacts interest rates, affirming the intuition that an increase in savings means an increase in loanable funds. When global savings rise and the supply of loanable funds increases, the Treasury Department can offer bonds at a lower rate during its auctions. A 1 percent increase in the world savings rate decreases the 3-month T-bill rate by 116 basis points, the 3-year T-note rate by 127 basis points, and the 10-year T-note rate by 113 basis points.

The deficit, inflation, and investment all have positive coefficients and, therefore, an increase in any of these will increase interest rates. The parameter of interest for the crowding out theory shows that deficits do indeed increase the interest rate. A 1 percent increase in the deficit to GDP ratio increases the 3-month T-bill rate by 96 basis points, the 3-year T-note rate by 83 basis points, and the 10-year T-note rate by 63 basis points.

The expectation that inflation increases nominal interest rates by roughly one-to-one is corroborated with these results. A 1 percent increase in inflation increases the 3-month T-bill rate
by 92 basis points, the 3-year T-note rate by 99 basis points, and the 10-year T-note rate by 90 basis points, each result being close to an expected 100-basis-point increase.

Table 1.2

*Estimation Results [2SLS] (3)*

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>3mo T rate$_t$</th>
<th>3yr T rate$_t$</th>
<th>10yr T rate$_t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>17.7745***</td>
<td>22.4872***</td>
<td>22.8025***</td>
</tr>
<tr>
<td></td>
<td>(5.9880)</td>
<td>(5.8127)</td>
<td>(4.5133)</td>
</tr>
<tr>
<td>Inflation$_{t-2}$</td>
<td>0.9248***</td>
<td>0.9878***</td>
<td>0.9047***</td>
</tr>
<tr>
<td></td>
<td>(0.1084)</td>
<td>(0.1017)</td>
<td>(0.0741)</td>
</tr>
<tr>
<td>Savings$_{t-2}$</td>
<td>-1.1580***</td>
<td>-1.2702***</td>
<td>-1.1293***</td>
</tr>
<tr>
<td></td>
<td>(0.2892)</td>
<td>(0.2657)</td>
<td>(0.1859)</td>
</tr>
<tr>
<td>Net Deficit$_{t-2}$</td>
<td>0.9600**</td>
<td>0.8289**</td>
<td>0.6293***</td>
</tr>
<tr>
<td></td>
<td>(0.3567)</td>
<td>(0.3087)</td>
<td>(0.2027)</td>
</tr>
<tr>
<td>Investment$_{t-2}$</td>
<td>2.3916***</td>
<td>2.0960***</td>
<td>1.5195***</td>
</tr>
<tr>
<td></td>
<td>(0.6935)</td>
<td>(0.5931)</td>
<td>(0.4351)</td>
</tr>
</tbody>
</table>

Table 1.3

*Estimation Results [2SLS] (4)*

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>3mo T rate$_t$</th>
<th>3yr T rate$_t$</th>
<th>10yr T rate$_t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-6.0723**</td>
<td>-3.6700</td>
<td>-0.4529</td>
</tr>
<tr>
<td></td>
<td>(2.5182)</td>
<td>(2.2660)</td>
<td>(1.7905)</td>
</tr>
<tr>
<td>Inflation$_{t-2}$</td>
<td>0.8603***</td>
<td>0.9172***</td>
<td>0.8419***</td>
</tr>
<tr>
<td></td>
<td>(0.0927)</td>
<td>(0.0824)</td>
<td>(0.0750)</td>
</tr>
<tr>
<td>Net Deficit$_{t-2}$</td>
<td>0.4653</td>
<td>0.2862</td>
<td>0.1469</td>
</tr>
<tr>
<td></td>
<td>(0.3178)</td>
<td>(0.3104)</td>
<td>(0.2360)</td>
</tr>
<tr>
<td>Investment$_{t-2}$</td>
<td>1.6253***</td>
<td>1.2555**</td>
<td>0.7722*</td>
</tr>
<tr>
<td></td>
<td>(0.5405)</td>
<td>(0.4969)</td>
<td>(0.4107)</td>
</tr>
</tbody>
</table>
Of all the explanatory variables, investment appears to be the leading contributor to interest rate levels. A 1 percent increase in the investment to GDP ratio increases the 3-month T-bill rate by 239 basis points, the 3-year T-note rate by 210 basis points, and the 10-year T-note rate by 152 basis points. Presumably, the effect of changes to investment levels decreases in magnitude over time because more borrowing is repaid the further removed one is from the initial time of borrowing. As an example, a temporary spike in investment would be represented by a rightward shift in the demand curve for the loanable funds market. These loans are of various terms and, as time passes, an increasing number of these loans are repaid so that the availability of additional loanable funds rises while the demand falls. Consequently, the impact of increased investment is greatest on short-term interest rates and is diminished on longer-term rates.

The effect of the deficit has the same pattern. Since each year’s federal budget is set independent of the previous year, and since tax collections fluctuate from year to year, a deficit last year is no guarantee of a deficit this year. It is perfectly logical that the impact of the deficit in one year will wane with time.

One last observation from this model is that the intercept increases with the term of the Treasury. This is evidence of the yield curve at work, where investors seek to be compensated with higher yields in exchange for lending their money over longer periods of time. All else being equal then, interest rates tend to be higher on long-term Treasuries. Empirical results that do not reflect this reality would possibly be biased.

When savings are excluded from the model, it produces very different results, which are actually similar to some of the results found in previous literature. The statistical significance on
the deficit is gone, most notably, and the coefficient is also much smaller for each interest rate. The effect of investment on interest rates, while still significant, has been decreased by roughly 40% for all three Treasury rates. Additionally, inflation is further from its ideal level of 100 basis points. Lastly, the exclusion of savings leaves its effect to apparently be somewhat captured by the intercept, which is now negative for all three Treasury rates. The key piece of information to be gleaned from these results, however, is that the exclusion of the supply side of the loanable funds market renders insignificant the effect of the deficit on interest rates.

For the sake of comparison to the results from the 2SLS models, the results from the OLS models are included in Table 1.4. Since the coefficients from the OLS models are inconsistent, though, the 2SLS results are more reliable. As is the case with the 2SLS, all OLS regressions use HAC robust standard errors.

Even when the OLS models include a measure for the supply of loanable funds, the coefficient for the deficit is negative. This is reminiscent of the recently developed idea of crowding in, but it is not replicated after the endogeneity is removed from the model. In the absence of savings, the deficit has a negative coefficient for two of the three interest rates with the only positive coefficient being very small. In all six cases, the impact of the deficit on interest rates is not statistically significant.

Investment has a much larger impact on interest rates in the 2SLS models than the OLS ones. Furthermore, investment was less significant in the OLS models, with four of the six coefficients failing to achieve statistical significance at the 10% level. Whether with the OLS or the 2SLS, the coefficient on inflation deviates further away from 1 with the exclusion of savings. This is another indication of misspecification in those models.
Table 1.4  
Estimation Results, Comparison

<table>
<thead>
<tr>
<th></th>
<th>[OLS]</th>
<th>[2SLS]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variable</strong></td>
<td>3mo T rate_t (1)</td>
<td>3yr T rate_t (1)</td>
</tr>
<tr>
<td><strong>Intercept</strong></td>
<td>18.7155*** (6.0308)</td>
<td>23.3514*** (6.0253)</td>
</tr>
<tr>
<td><strong>Inflation_{t-2}</strong></td>
<td>0.9525*** (0.1303)</td>
<td>1.0110*** (0.1101)</td>
</tr>
<tr>
<td><strong>Savings_{t-2}</strong></td>
<td>-0.7638*** (0.2440)</td>
<td>-0.9244*** (0.2470)</td>
</tr>
<tr>
<td><strong>Net Deficit_{t-2}</strong></td>
<td>-0.0673 (0.1582)</td>
<td>-0.0592 (0.1529)</td>
</tr>
<tr>
<td><strong>Investment_{t-2}</strong></td>
<td>0.0991*** (0.0413)</td>
<td>0.0778* (0.0384)</td>
</tr>
</tbody>
</table>

|                   | 3mo T rate_t (3) | 3yr T rate_t (3) | 10yr T rate_t (3) | 3mo T rate_t (4) | 3yr T rate_t (4) | 10yr T rate_t (4) |
| **Intercept**     | 17.7745*** (5.9880)         | 22.4872*** (5.8127)       | 22.8025*** (4.5133) | -6.0723** (2.5182) | -3.6700 (2.2660) | -0.4529 (1.7905) |
| **Inflation_{t-2}** | 0.9248*** (0.1084)         | 0.9878*** (0.1017)       | 0.9047*** (0.0741) | 0.8603*** (0.0927) | 0.9172*** (0.0824) | 0.8419*** (0.0750) |
| **Savings_{t-2}**  | -1.1580*** (0.2892)         | -1.2702*** (0.2657)       | -1.1293*** (0.1859) |                   |                 |                  |
| **Net Deficit_{t-2}** | 0.9600** (0.3567)          | 0.8289*** (0.3087)       | 0.6293*** (0.2027) | 0.4653           | 0.2862           | 0.1469           |
| **Investment_{t-2}** | 2.3916*** (0.6935)         | 2.0960*** (0.5931)       | 1.5195*** (0.4351) | 1.6253*** (0.5405) | 1.2555** (0.4969) | 0.7722* (0.4107)  |
When global savings rates are not included in the model, or when endogeneity is present, crowding out appears to not exist, and the interest rates are primarily a function of inflation, and sometimes investment. The deficit is not statistically significant, and it has a very small coefficient which is even negative in five of the six OLS regressions. These results are like those found in previous research which stem from other equations that similarly do not account for the supply of loanable funds.

While additional tests were conducted, they returned poor results. One such trial involved the use of a Hodrick-Prescott (HP) filter. The HP filter helps to isolate long-term trends and remove large oscillations resulting from the normal business cycle. The results were coefficients that were several times larger than the previous results displayed above, and lower significance levels. The poor results of using the HP filter may be caused by three of the independent variables already being expressed as a percentage of GDP, which is already helping to isolate the long-term trend. Other tests included using lags of many more years, but the significance levels of the variables and the R-squared of the regressions only decreased.

The relationship between deficits and interest rates should be present in any country, not just the United States. Future research may include adapting the empirical models to other countries, where the data is available. Sub-investment grade sovereign debt would be particularly interesting to study, in part because the flight to quality and flight to security aspects of purchasing U.S. Treasuries would not apply. Because many governments do not receive a AAA rating for their sovereign debt, it is likely that this future research will need to include a term

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34 At least one recent investigation has cast doubt on the HP filter, in part because of the inaccuracies it can produce.
accounting for this detail since interest rates for a security are directly affected by the security’s rating and perceived default risk.

Further research may also relax the linearity assumptions previously proposed and investigate the possibility of nonlinear relationships between the independent variables and the dependent variable. Expanded data that extend over more years could potentially increase the observed ranges of the variables, which would help to establish if there are in fact changes in elasticity. Since the data are all percentages and the exponential growth trends have already been removed, logarithmic functions may not produce valuable results, but perhaps other functional forms may.

This research has focused on the impact of crowding out on rates ranging from 3 to 120 months, under the assumption that long-term rates, such as a 30-year fixed mortgage, would be determined nearly exclusively by long-term macroeconomic trends. While at least one other piece of research has indicated even short-lived deficits have an impact on long-term rates, it is worth applying a model with global savings to further test those findings. In this case, an empirical model would likely need to include moving averages to capture the long-term trends that so heavily affect long-term rates.

Since interest rates today are known while the independent variables from today are unknown and will remain unknown until that data can be collected, tabulated, and disseminated, it would be interesting to replace the independent variables with their expected values, so that inflation would be replaced with expected inflation, and so on. This may provide a more accurate, and more practical, predictor of interest rates since rates are in part set by lenders and

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borrowers’ expectations, as opposed to being based on data that is not yet available. Expected inflation would also likely have a coefficient consistently closer to 1 for all interest rates.

Lastly, it would be interesting to combine several years of data into a single equation by regressing an interest rate on the previous two or three years of data. Similarly, autoregressive moving average models (ARMA) could potentially be developed for each of the independent variables, and the moving averages then used in the regressions. While it has been argued here that a deficit in period one is no guarantee of a deficit in period two, it is often the case that government spending appropriated in a single budget is dispersed over a period of several years so that there may be several years of deficits in the future. Similarly, some increases in government spending, and thus increases in the deficit, are permanent, so that the appropriations do not cease unless a future budget directly removes them. Conversely, isolated events, such as the financial and housing bailouts in the late 2000s, can have a strictly temporary effect on the budget deficit. Separating out temporary versus recurring government expenditures would likely make these models more accurate. These ideas are also left to future research.

VI: SUMMARY

Crowding out is a sound economic theory. Previous investigations have largely accounted for only the demand of loanable funds and ignored the supply side of the equilibrium. When an estimation accounts for both elements of the relationship, the effect of deficit spending becomes clearer.

The deficit, the parameter of interest in this chapter, has the largest effect on shorter-term rates and a reduced effect on longer-term rates. Since the deficit can vary substantially from year to year due to transitory spending increases or temporarily lower tax revenue, it is logical that
longer-term rates are less sensitive to a short-term fluctuation in the deficit level. A 1 percent increase in the deficit to GDP ratio this year will, in two years, increase the 3-month T-bill rate by 96 basis points, the 3-year T-note rate by 83 basis points, and the 10-year T-note rate by 63 basis points.

World savings has a more consistent effect across all interest rates. This is a logical finding since world savings levels tend to not adjust abruptly and are very stable over time as fluctuations in the world savings rate tend to happen more slowly than changes to the deficit. The effect on interest rates of a 1 percent increase in the global savings rate varied by only 14 basis points across all three Treasury rates. A 1 percent increase in the global savings rate reduces future interest rates between 113 and 127 basis points.

Similar to the deficit, investment levels are subject to relatively large annual fluctuations during the business cycle and, consequently, the effect of changes in investment on interest rates is heavily dependent upon the term of the treasury in question. A 1 percent increase in the investment to GDP ratio increases the 3-month T-bill rate by 239 basis points, the 3-year T-note rate by 210 basis points, and the 10-year T-note rate by 152 basis points.

VII: CONCLUSIONS AND POLICY IMPLICATIONS

Lower interest rates decrease the cost of borrowing to finance investment and therefore investment would predictably increase with less government deficit spending. Increases in investment are associated not only with higher economic output in the present, but with higher future growth rates as well. This is due to an increase in the capital stock along with increased innovation and technological advancements. These three factors all create higher real wages and incomes while using scarce resources more efficiently. The policy implication is clear: the ideal
amount of government deficit spending is zero. The question of whether an existing deficit should be eliminated through higher taxes or reduced spending, or maybe even a combination thereof, is less clear. While other research has shown a correlation between higher taxes and higher levels of government spending with lower growth rates, the definitive answer to that question is outside the scope of the present study. Regardless of the method, reducing the deficit by $229 billion in 2019 would have reduced short-term interest rates in 2021 by 100 basis points. Eliminating the 2019 deficit entirely would have reduced those same rates by 480 basis points.

At this point, one rather persistent fallacy should be dispelled: that the reduction of investment from crowding out is simply equal to the increase of government spending, and the multiplier effect of that government spending adds more to the economy than the reduction in investment. This ignores three important factors. First, private investment also has a multiplier effect, which is being foregone. Second, there is no reason to assume that the crowding out effect is less than the increase in government borrowing since it could be a one-to-one relationship. A $1 trillion deficit may crowd out $1 trillion of private borrowing. Third, there is no reason to believe that public borrowers will use resources as economically as private borrowers will use them, so that public deficit spending may very well produce less than if those resources were left

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36 The clarity of this policy implication is admittedly obfuscated by the reality that ceteris is rarely paribus. All else being equal, no deficit is preferable to a deficit. However, this is not always viable given the constraints of the time. There was likely no way to successfully fight World War II without running massive deficits. Additionally, there is the further consideration that a government surplus would further decrease interest rates by actually adding to the loanable funds market instead of subtracting from it. The concept of national savings in place of a national debt is considered novel today, having not occurred since President Andrew Jackson’s tenure in 1835. Nevertheless, it is dubious that government bureaucrats would be as responsible lending out other people’s money as individuals would be lending out their own, casting doubt on the efficacy of government surpluses as an efficient means of lowering interest rates. Lastly, there is some merit to the idea of government running surpluses during economic expansions to prevent running deficits during economic contractions. Such a schema mirrors the concept of an individual saving a portion of his or her income in a so-called rainy-day fund, in case future income is temporarily reduced.
in private hands. The second issue of the crowding out effect competing with the multiplier effect could conceivably be tested empirically, but that is left to future research.

Instead, this investigation has been aimed at the question of whether the crowding out theory is salvageable. In the realm of the loanable funds market, the answer is clearly yes. To be accepted as legitimate, any economic theory should be sound according to both logic and data. With the inescapable reality of scarcity, the crowding out theory is perfectly logical and in line with the foundational principles of economics. When data are used that accurately reflect the multiple factors at play in the market, the data support the theory as well.
Milton Friedman often proclaimed that people “vote with their feet,” so that the ultimate approval or disapproval of a policy can be measured by how many people choose to subject themselves to it and taxes are no exception. The Federalist system enjoyed here in the United States provides an opportunity to observe some of the many methods by which government funds can be collected. The differences among the myriad of tax structures subsequently allows for comparisons between these methods. Comparing one state to another within a Federal framework helps to control for many extraneous factors as well.

Attempting to compare the tax structures of different countries requires accounting for a plethora of other factors. Comparing places within the same country, however, relieves much of this concern. Much of the Constitution of the United States serves to guarantee that liberties are protected in all states and that state governments are forbidden from certain infringements upon their residents. In this way, life can be little changed moving from one state to another.

States are, however, free to generate revenues, via whatever method they choose, to meet their respective expenses. In this vein, the states have taken quite different avenues. The highest sales tax in the country is found in a state with no income tax, while another state with no sales tax has one of the highest overall tax burdens. Those tax burdens range from 6.5% to 12.7%, demonstrating that both the total amount of taxation and the methods of collection are quite
varied between the states. Whereas there are certain aspects of American life that are maintained throughout the states, tax rates are anything but homogenous.

Another variation between states is their respective population growth rates. Over the last decade, there has been a wide disparity in population growth among the states. The fastest growing states swelled by 15% or more while others experienced anemic growth of a fraction of 1%, or even a decline. The chief cause of these growth rate disparities is not birth and death statistics but domestic migration, and the fuel behind that movement appears to be taxes. A review of Census data clearly shows a pattern: people are moving from relatively high tax states to relatively low tax states. Furthermore, people seem to prefer paying sales taxes to income taxes, especially those people with higher earned incomes.

Despite all belonging to the same Union, the states are still quite different, aside from their tax structures. There is not much in common between living in Alaska and living in Hawaii, at least in terms of climate. Similarly, one cannot find the vast desert expanses of Arizona or New Mexico in any of the Northeast states. It has been the case for decades that many people choose to retire in Florida, due in part to the reasonable guarantee which that state provides its residents of never having to shovel snow or risk slipping on ice ever again.

But just as one person may prefer a particular climate to another, each individual has other preferences, including matters of regulation and other state policies. One person may prefer that drug use remain criminalized and that the open carrying of firearms be permissible. Another person may prefer the opposite. There are seemingly innumerable such policy matters besides taxes that could affect a person’s choice of where to live. The innumerable other factors, only a handful of which have been mentioned, are largely qualitative, not quantitative, and will differ
from person to person. Therefore, they are mostly excluded from this analysis. Taxes, on the other hand, create near universal agreement: the lower, the better. Indeed, taxes play a significant role in determining where a person decides to live and, unlike immutable factors such as climate, tax policy can change frequently and quickly.

A person’s mobility in the United States, that is, their ability to move from one state to another, has changed over time. Transportation costs have fallen dramatically in real terms while both the quality and speed of transportation have increased. Communications have demonstrated the same pattern. Many new industries are populated with jobs that allow employees to work remotely, including hundreds, or even thousands, of miles away from a corporate office or headquarters. Similarly, many industries have spread from their birthplaces in one state to many others, so that the same jobs are available in many locations around the country. As business activity trends away from brick-and-mortar sales and towards online sales, the physical location of a business has become less impactful as to the customer base that business is able to serve. This increased mobility of people is essential to determining their tax preferences.

As the assorted roadblocks to mobility continue to decay, the remaining factors affecting the choice of where to live become more pronounced and weigh more heavily in the decision-making process. Taxes are one of those factors whose effects have not been diminished with time, but rather have been amplified. The weather in states like California, Connecticut, Illinois, New York, and Vermont has not changed much at all since their respective founding, and yet there is ample domestic migration evidence that people have only more recently begun fleeing those state for places like Texas, Florida, and Utah, among others. The common thread is tax rates.
For the six years from 2014 to 2019, Illinois had a net loss of population every year.\textsuperscript{37} The evacuation was so large that it put the Land of Lincoln in the red for the decade in terms of population growth. From 2010 to 2019, the state lost over 168,000 residents, the largest decline of any state for the decade. Only West Virginia experienced a larger percentage-based decline. Vermont lost almost 2,000 residents over the decade and Connecticut said goodbye to almost 14,000 while New York state gained fewer than 54,000 people, an increase of less than 0.3%. Florida has grown by 14\% over the same time, which is about 47 times faster than New York’s lackluster growth rate. The result is that Florida has supplanted New York as the third largest state by population. Similarly, Pennsylvania has edged out Illinois for the fifth largest spot. Like Florida, Nevada also grew at 14\% but Texas outpaced them both, achieving a growth rate of almost 15\%. Utah did even better, growing at a blistering rate of more than 15.5\% in just ten years. Once again, the common thread is tax rates.

Domestic migration patterns show that residents of high-tax states are leaving for low-tax states.\textsuperscript{38} New York residents are leaving for Florida and Pennsylvania. California residents are leaving for Texas and Nevada. In each of these examples, relocating results in a lower total tax bill. States with a progressive income tax saw a net domestic migration loss of over 309,000 people whereas states with no income tax had a net domestic migration gain of more than 371,000 people. Besides official Census Bureau data, there is a plethora of anecdotal and survey evidence pointing to this trend. Each year, United Van Lines conducts a study observing to and


\textsuperscript{38} U.S. Census Bureau, https://www.census.gov/data/tables/time-series/demo/geographic-mobility/state-to-state-migration.html.
from which states their customers are moving. New Jersey, Illinois, New York, and Connecticut were the top outbound states in 2019 and have been among the top outbound states for years.39

If one assumes that most people prefer warmer climates, it may make sense that people would move from a relatively cold state like Illinois or New York to a warmer state like Florida or Texas for reasons based entirely on the weather, but that fails to explain other trends, like why Illinois is experiencing annual net losses of population to all five of its neighboring states, including Wisconsin which is further north. Illinois has had roughly as many people moving away as dying. The publication *Rich States, Poor States* places Illinois, Vermont, and New York in the 48th, 49th, and 50th worst spots, respectively, among all 50 states for economic outlook, due in large part to the high total tax burden of those three states.40 Those with higher incomes have more to lose from higher tax rates and they simultaneous have, on average, more disposable income, making it easier to move. While Illinois is losing residents from every income bracket, those with annual earnings of $200,000 or more are leaving the state at about twice the rate of the average Illinoisan.41

For those wealthier individuals, the costs of high tax rates have been exacerbated by the Tax Cuts and Jobs Act (TCJA), signed into law on December 22, 2017 by President Trump and going into effect on January 1, 2018. One of the notable changes was a reduction of nearly every personal income marginal tax rate along with a limitation on state and local tax (SALT) deductions. The maximum SALT deduction for federal income tax purposes was capped at

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$10,000 for a calendar year. A SALT deduction is effectively a federal subsidy for those living in high-tax states and paid for by those living in low-tax states. Capping the SALT deduction greatly reduces this subsidy and makes the cost of higher state taxes more palpable to taxpayers in high-tax states. This is particularly true for higher-income individuals and helps explain why domestic migration from high-tax to low-tax states accelerated in the last two years of the previous decade.

There is clearly a pattern that people prefer to pay less in taxes than more, and that people are moving in accord with that preference. However, the issue becomes more complicated with the consideration that states can levy more than just one type of tax. While Texas has no income tax, it currently has the seventh highest effective property tax rate. Tennessee has no income tax (except on interest and dividends) but has the highest sales tax in the nation. Similarly, Pennsylvania has a flat and relatively low 3.07% income tax, one of the lowest rates, but it charges the second highest gasoline tax, not even two cents a gallon less than what California charges.

43 Kaplow (1996) points out that, for a variety of reasons, deductibility is a very inefficient subsidy as compared to a simple direct subsidy to certain states. Louis Kaplow, “Fiscal Federalism and the Deductibility of State and Local Taxes under the Federal Income Tax.” Virginia Law Review 82, no. 3 (1996): 413-92.
44 Burman and Phaup (2012) explain that, as many policy analysts have long agreed, spending is very often hidden in the tax code as a “tax cut” but is quite often a kind of entitlement program. This pattern leads to higher tax rates on the people still paying taxes, larger government spending, and larger government deficits. Additionally, those most likely to receive these pseudo tax cuts are higher income families. SALT deductions can be viewed in the same vein. Leonard E. Burman, and Marvin Phaup. “Tax Expenditures, the Size and Efficiency of Government, and Implications for Budget Reform.” Tax Policy and the Economy 26, no. 1 (2012): 93-124.
45 It is ironically this increased vertical competition between the federal and state governments that amplifies the horizontal competition between state governments. Howard Chernick and Jennifer Tennant. “Federal-State Tax Interactions in the United States and Canada” Publius 40, no. 3 (2010): 508-33.
46 The complexity of comparing two taxes that are dissimilar, not only in their respective rates but the type of tax, has proven to be a conundrum for decades. Alan S. Donnahoe. “Measuring State Tax Burden.” Journal of Political Economy 55, no. 3 (1947): 234-44.
In other words, each state can be considered a very mixed bag when it comes to overall taxation levels. That fact notwithstanding, some states have a substantially lower overall tax burden than others do. In 2019, the lowest overall tax burden as a share of residents’ incomes was 6.5% in Alaska. The highest was 12.7% in New York, almost twice Alaska’s overall tax burden. Since this measure relies in part on the incomes of taxpayers, it does not explicitly say how much more New Yorkers paid than Alaskans since their incomes are very different. While the overall tax burden as a share of income in Alaska is about 51% of New York’s burden, New Yorkers actually paid well over twice the per capita tax burden as Alaskans. The total tax burden per capita was lowest in Mississippi at $2,742 and highest in Connecticut at $7,869.\textsuperscript{49} When observing state population growth rates in conjunction with either overall tax burden as a share of income or tax burden per capita, there is clearly a connection between lower tax levels and higher levels of population growth.

While lower taxes may be preferred to higher taxes, there is still a question of precisely how strong this preference is, namely, whether it can motivate people to move. Moreover, this does not address the issue of the type of taxes in questions. In other words, given that a certain level of revenue must be raised to meet certain state expenses, would residents of a state prefer to pay that revenue in the form of income taxes or sales taxes? What about property or wealth taxes? Would residents prefer corporate income taxes instead? And how many people will move if tax rates change? Since people ultimately vote with their feet, empirical analysis of tax rates and state population growth rates, which have been fueled by domestic migration patterns, can potentially reveal what people’s preferences truly are.

The proceeding segments of this chapter are organized into six additional sections. The pertinent empirical literature is reviewed in Section II and the data that will be analyzed is first examined in Section III. Section IV develops a theoretical model and Section V explains the model choice for regression analysis and interprets the results. The penultimate section is a summary of the chapter’s findings and ideas for future research. Section VII concludes with policy implications.

II: LITERATURE REVIEW

There is a large body of research demonstrating the negative economic effects of higher tax rates. Similarly, there have also been many investigations into the phenomenon that some economists have called “the race to the bottom” wherein competing governments repeatedly lower their respective tax rates to undercut one another, attempting to acquire the entire tax base. Since the 1970s, there has also been research conducted to try and determine if various tax rates are on the “wrong side” of the Laffer curve, where a lower tax rate would yield more revenue. However, the literature on the competitive nature of taxation far predates Dr. Arthur Laffer’s conversation with President Gerald Ford. Reed (1949) asserted that the states must compete with each other in terms of tax rates. Simply raising rates will not necessarily increase revenue since it will cause changes in economic behavior within a state and the higher rate will also prompt some people and businesses to leave in order to avoid it.

Saez, Slemrod, and Giertz (2012) are among many who have tried to estimate precisely where different tax rates fall on the Laffer curve, and how people respond to changes in tax

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rates. While the Laffer curve is based more on economic activity than mobility, the latter can prove to be just as important of a factor in tax collection. If economic activity leaves one state and goes elsewhere, for the purposes of tax collection in the vacated state, that economic activity no longer exists, and tax revenue from it falls to zero. In that sense, the effects of mobility are indistinguishable from the effects of disincentives due to higher tax rates. Therefore, to help ensure that tax revenue is generated as expected and the tax is not simply avoided by the relocating of the tax base, the mobility of that tax base should be considered just as much as the negative incentives which the higher tax rate will have on the immobile portion of the tax base.

The degree to which a person or capital is mobile is dependent upon the costs of relocating and one of the inputs in the cost of relocating is distance. The shorter the distance to be moved, the lower the costs, both financial and personal, tend to be. It is not only more expensive to drive 1,000 miles instead of 10, but it is also much more difficult to visit family and friends after relocating a great distance away. When the distance needed to move in order to escape high taxes is very short, people are more likely to flee to the tax haven of their choice. If elected officials do not take this into consideration when developing tax policy, they risk not only a diminishing tax base, but they also risk their jobs. Case (1993) found that states are less likely to raise taxes when they have low-tax neighboring states and more likely to raise taxes when they have high-tax neighboring states. Governors who sign tax rate increases while having low-tax neighboring state are likely voted out of office at the next election. Wilson (1993)

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commented on Case by pointing out that factor mobility provides a check on excessive taxation since people will ultimately leave if they are able to avoid high tax rates. As tax rates in certain states creep upward, the lengths to which people are willing to go, literally and metaphorically, to escape those higher tax rates increases.

Another consideration of higher tax rates within a competitive framework is the final tax incidence that is observed after some of the tax base has fled. Those individuals with lower incomes and those firms with lower profit margins are, all else being equal, less able to absorb the temporary costs of relocating as well as whatever long-term costs might be associated with that relocation. Devereux, Griffith, Klemm, Thum, and Ottaviani (2002) found that more profitable firms tend to become more mobile over time relative to less profitable firms. This is presumably because larger profit margins more easily cover relocation costs when moving to a jurisdiction with lower tax rates. The higher tax rates then fall upon those left behind.

One of the consequences of higher taxes on a shrinking tax base is lower economic growth from less investment, less risk-taking, and lower income growth over time. Bruce and Deskins (2012) analyzed state level panel data and found that higher individual income tax rates reduce entrepreneurial activity in a state while Dye and Feiock (1995) examined a forty-year period of state tax levels and found that “the adoption of an income tax had a significant negative effect on state personal income.”

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burden, Wildasin (1993) calculated that those who are able to move to avoid taxes will do so and this creates an even larger excess burden on those who remain.\(^{57}\) Mertens and Ravn (2013) observed large negative effects on output in the short run as a result of tax increases.\(^{58}\) Again, these negative outcomes are borne not by those who have fled the high tax rates, but by those who remain. Since, as was said before, high-income households are more likely to leave than low-income households, the tax incidence of a rate increase may be more regressive than originally conceived.

A recent example of a tax rate increase which did not produce the outcome its authors were expecting was the 2012 tax rate increase in California. One provision of the change was an increase of the tax rate on high-income households by 3 percentage points. Rauh and Shyu (2019) observed that this caused an additional 0.8% of the total number of high-income households to leave the state, primarily going to states with no income tax. That out-migration was above and beyond the previously existing trend of that same group fleeing the state. Between out-migration and behavioral responses of those in the highest-income bracket, the supposed windfall California was to receive from the tax rate increase turned out to be 45.2% less than expected.\(^{59}\) Considering that California “draws about half its income tax revenues from roughly 150,000 tax returns,”\(^{60}\) the loss of just a few of those tax returns causes a noticeable dent in the state’s budget. This is a modern-day example of what has been seen in the past. When


analyzing top-income earners of the interwar period, Romer and Romer (2014) found the expected conclusion that higher marginal income tax rates provided a disincentive to work and that they had a negative impact on business formation. More interesting is their conclusion that the simplicity of the tax code, with few options for income shielding, and immobility of the tax base, relative to today, meant that the effects of higher marginal rates were small although very robust.

Just as firms can form cartels to circumvent the normal erosion of economic profit that occurs in competition, so too can governments collude to prevent the erosion of a tax base that follows in the presence of tax rate differentials. Nechyba (1997) pointed out that if local governments seek to increase tax revenues, they must collude with one another to jointly increase their respective tax rates and thus prevent out-migration from their communities while raising revenue. This is true not just on the small scale of local government, but on the world stage as well, where nations compete for a corporate tax base. As noted by Kiss (2009), if countries do not collude in setting minimum corporate tax rates, they will seek to undermine one another by lowering their tax rates. A tax rate even just slightly lower than the competition can potentially yield a windfall in tax revenue to the “lowest-bidder” nation as the corporate tax base is syphoned off from higher-tax nations. This was an explicit goal of lowering the national corporate income tax rate in the U.S. from 35% to 21% for 2018, aiming to reduce tax inversion and encouraging corporate repatriation.

Additionally, not only are lower tax rates very attractive to individuals and firms, but so are tax amnesty plans. Alm and Beck (1991) determined that states which offered some kind of tax amnesty plan that reduced penalties and interest on unpaid taxes had significantly higher revenues from those firms that owed taxes. In the same way, lower costs of compliance in terms of the tax code tend to increase tax revenue, and lower tax rates tend to decrease tax avoidance and tax evasion since the latter two activities are by no means cost-free. In short, compliance becomes less expensive than noncompliance.

The issue of mobility circumventing higher taxes is not limited to personal and corporate income tax rates and the movements of households and firms. Sales and excise taxes can cause consumers to travel further in order to make purchases in low-tax municipalities and states. Agrawal (2015) found that when neighboring states have different sales tax rates, consumers are willing to travel further to make the same purchases but in the low-tax state. This effect is considerable, so much so that local tax rates tend to fall in high-tax states and rise in low-tax states to partially compensate for the state sales tax differential. Failing to do so risks either losing more of the tax base in fewer sales from having too high of a sales tax rate, or missing out on potential revenue from having too low of a sales tax rate. This arrangement offers an illustration of the aforementioned Laffer Curve.

The pattern of mobility counteracting tax rate increases is quite clear and consistent. Beard, Gant, and Saba (1997) found that excise tax differentials on alcohol caused people to

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simply travel further to buy their alcoholic beverages at the location with lower taxes. Greater tax differentials encourage smuggling of larger quantities of alcohol, not just for personal consumption but also to be resold later. These results are hardly unique and the taxation of alcohol can be considered somewhat archetypical for other cases in which government seeks to levy a tax not only to raise revenue, but also to discourage what government officials deem is suboptimal behavior. Kotakorpi (2009) examined paternalistic taxes and found the effect of the tax to be greatly diminished when consumers have the ability to travel and make those purchases elsewhere. And, as before, the higher the tax rates, the greater the extent to which consumer are willing to go in order to avoid them.

While the literature overwhelming supports the admittedly trivial conclusion that people prefer low tax rates to high tax rates, there has not been anywhere near the same volume of writings concerning what type of taxes people would rather pay, since some minimum level of government revenue must be raised. Similarly, there has been limited research done on what types of taxes, in practice, are the most efficient in terms of maximizing revenue generation while minimizing negative economic impact. Korneychuk (2017) determined that indirect taxation, like sales taxes, can yield higher revenue than direct taxation, like income taxes, with

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67 Paternalistic taxes are those which governmental authorities impose, not with the primary purpose of raising revenue, but to change people’s behavior, which the governmental authorities have determined to be detrimental to those people or others.


lower tax rates and less economic harm. This lends credence to the idea that state residents would prefer a state sales tax to a state income tax. Analogously, Hines (2017) calculated at the time that corporate taxes were not only too high, but they should be replaced with other taxes in order to see net economic gains while not reducing revenue. Since all corporate profits are eventually distributed to shareholders, executives, or other employees, that money can still generate government revenue via a personal income tax or a sales tax.

This chapter contributes to the existing literature on taxes and tax competition by examining what tax preferences people have demonstrated via domestic migration and population growth patterns. Where people move illustrates not only what tax rates they prefer, but what types of taxes as well. Instead of only investigating population growth in relation to a single tax rate or the overall tax burden of a state, this chapter analyzes five tax rates in an attempt to provide empirical support for the survey data of the last decade.

III: DATA

To determine what types of taxes people prefer, the major sources of state tax revenue are examined: personal income tax, corporate income tax, sales tax, property tax, gasoline and energy taxes, and other excise taxes. Tax data is sourced from the American Legislative Exchange Council (ALEC), the Tax Foundation, the American Petroleum Institute, the U.S.

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71 Bruce, Fox, and Tuttle (2006) found that income tax revenues are twice as elastic as sales tax revenues, given a change in income. While citizens may have a preference for sales taxes instead of income taxes, governments too may prefer sales taxes for consistency, although, their research found “that neither tax is universally more volatile.” Donald Bruce, William F. Fox, and M. H. Tuttle. “Tax Base Elasticities: A Multi-State Analysis of Long-Run and Short-Run Dynamics.” *Southern Economic Journal* 73, no. 2 (2006): 315-41.
Energy Information Administration (EIA), Bureau of Labor Statistics, and the Bureau of Economic Analysis (BEA). Since households with higher incomes and firms with larger profit margins are more likely to be mobile in the face of higher tax rates, the highest marginal rates are used for both personal and corporate income tax rates. To include the effects of local taxes, the tax rate from the largest city in each state is also included in the total tax rate for both personal and corporate income taxes. Unfortunately, these two income tax rates have changed very little over the last decade with 34% of the states leaving the personal income tax rate unchanged for all ten years while 38% of the states did not change their corporate income tax rate. This lack of variability poses significant problems that are discussed later in this chapter.

States like West Virginia can be seen as outliers if only tax rates are considered in the analysis. While experiencing the largest percentage population decline over the last decade, it does not have abnormally high taxes relative to the other 49 states, being tied with two other states for the 18th highest overall tax burden. However, the coal industry seems to have been a single point of failure for a large portion of West Virginia’s economy. The closing of coal mines and the departure of jobs has been the main driver of the state’s recent population loss. From December 2011 to July 2016, mining and logging jobs in West Virginia saw a 44.8% decline, fueled almost entirely by the loss of coal mining jobs. In just four and a half years, nearly 9 out of every 20 coal mining jobs evaporated, leaving many residence with few options besides

73 This method was chosen in place of using a weighted average of all local income taxes across each state. Top income earners who will face the highest marginal rates tend to be more concentrated in or near the largest city of each state, as opposed to being spread across the entire state, and, unlike with sales taxes, an individual’s place of residence ordinarily determines the local income tax rate imposed on that individual. Therefore, this estimate is considered a better representation of the true tax rate levied on high-income earners.

leaving the state to find new work.\textsuperscript{75} West Virginia is a prime example, although not the only reason, of why the health of the local labor market should be considered in any analysis of why people move from one state to another.

Initially, employment data was gathered from the BEA and BLS and used to calculate job growth rates. Due to endogeneity concerns, however, unemployment was ultimately used in the final empirical analysis instead. Since there are six different measures for unemployment, a choice must clearly be made on which one to use. The most often cited unemployment statistic is U-3, which is a summation of U-1 (those unemployed 15 weeks or longer) and U-2 (those who have been fired, laid off, or have completed temporary work). An unemployed person is defined by the BLS as those who “do not have a job, have actively looked for work in the prior 4 weeks, and are currently available for work.”\textsuperscript{76} In contrast, U-4 includes those in U-3 plus discouraged workers. Discouraged workers are those who are no longer trying to find work due to “a job-market related reason,”\textsuperscript{77} such as having previously searched for an extended period and found no jobs in their field. U-5 includes all the aforementioned categories plus all other persons who are marginally attached to the labor force, meaning all those unemployed who, while not currently looking for work, have done so within the last year. The distinction between U-4 and U-5 is that discouraged workers are a subset of those who are marginally attached to the labor force; a discouraged worker is a marginally attached worker who has given up job searching only for certain job-market reasons. The final group that can be considered unemployed are those with

\textsuperscript{75} Residents in neighboring Kentucky and Pennsylvania also saw many coal mining jobs evaporate, but these states did not experience the same exodus. Even Wyoming, the only state that produced more coal than West Virginia, has not shed so many jobs and people, perhaps because Wyoming is not competing against the natural gas trend in the Marcellus Shale of the Appalachians, which has also provided a jobs boon in Pennsylvania.


part-time jobs for economic reasons. In other words, these individuals would prefer full-time employment, but they are unable to find such work. The addition of this last group to U-5 is known as U-6, sometimes called the real unemployment rate, as opposed to U-3, the most commonly cited statistic.

U-6 offers the broadest measure of those who could be considered dissatisfied with the labor market. Following the Great Recession, recovery in the labor market proved anemic. While unemployment, as measured by U-3, was 9.9% in 2010, U-6 was much higher at 17.2% at that same time. This disparity was largely due to so many people dropping out of the labor force in the preceding two years. In fact, the labor force participation rate (LFPR) had one of its steepest declines ever during the last decade.78 As previously unemployed workers became discouraged workers, or as they were forced to take part-time jobs in lieu of full-time work, U-3 was driven down in many states while U-6 took far longer to experience any significant decline. For the purposes of this analysis, the best measure for the health and vigor of a labor market is the annual level of U-6 for each state, expressed as a percentage.

Sales tax data was retrieved from the Tax Foundation. The sales tax rate in each state is calculated by adding the state-level rate to a weighted average of the local-level rates. Each county, city, or other municipality is weighted based on population. Similarly, the American Petroleum Institute uses a weighted average based on population to determine the average tax per gallon of gasoline, in cents. These figures do not include the federal excise tax on gasoline of 18.4 cents. Because California, Connecticut, Illinois, Indiana, Michigan, and New York apply part or all of their respective state sales taxes to gasoline, the tax per gallon in those states

changes with the price of gasoline. In these cases, the price of gasoline in each state is observed once a month and these observations are averaged together into an annual price. The tax, in cents per gallon, is then calculated from that average price. What is referred to here as the “gasoline tax” in each state also includes other taxes and fees, besides the explicit excise tax on gasoline, that are charged per gallon or on the price of a gallon, including storage tank taxes and environmental fees. The property tax rate for each state is calculated by first adding together all property taxes paid in a year on owner-occupied housing in a state. (It does not include taxes paid by landlords on rental properties.) The total amount of property taxes paid is divided by the total value of the owner-occupied housing, giving an effective statewide property tax rate.

Many other factors besides taxes affect the costs of production. Anything not made in Hawaii must be shipped thousands of miles to the islands and this significantly adds to the costs of consumer goods. Similarly, New Jersey is the most densely populated state in the country and there is more intense competition for land on a statewide basis. These costs should also be taken into consideration since they occupy such a large part of the consumer’s budget. To account for the disparities in the cost of living between states, Regional Price Parities (RPPs) from the BEA are incorporated into one of the empirical models. As with many large indexes, these are somewhat of a black box. While it is possible to contact the BEA in Washington, D.C. and gather some details as to what factors are contained in the indexes for each state, it is not possible to access all the data and calculations which yield the final value for each state.

The RPPs measure the cost of living and, as such, they explicitly include all sales, gasoline, energy, and other excise taxes since the RPPs are based off the final purchase price of goods and services. Housing costs are measured by rental prices which implicitly contain
property taxes since those taxes are rolled into the rental costs of a dwelling along with mortgage payments, costs of repairs, etc. Therefore, apart from personal and corporate income taxes, all the remaining state taxes are effectively contained within the RPPs. While it is clear that the RPPs are increasing in each of these taxes and, therefore, higher taxes result in a higher cost of living, the magnitude of these marginal effects is unknown. The RPPs are calculated relative to a national average which is priced at 100. Values below 100 indicate a cost of living cheaper than the national average while values above 100 indicate a cost of living more expensive than the national average. Ideally, all taxes could be separated out of the RPPs since including both the tax rates and the RPPs together in the same regression will effectively count those taxes twice and, therefore, could produce biased estimates. Whether or not to include the RPPs in the regression analysis is discussed later.

It is well known that some people choose their retirement location based largely upon climate. This research does not deal with that factor for several reasons. First, it is an entirely subjective matter. While there are various indexes that may rank the climate of each state, they are inherently subjective, requiring the author of the index to not only subjectively determine which weather outcomes are preferential, but to subjectively weight each factor based on relative importance. Obviously, one person may value a factor like warm weather far more or less than another, making this a poor metric. Second, many people choose to retire in a certain state for reasons other than warm weather. More than a quarter of those moving to Vermont in 2019 did so for retirement.79 Despite the annual influx of retirees, Vermont still lost population in 2019 and for the entire decade. Additionally, many states are large enough to have varying weather.

Annual snowfall, for instance, varies wildly between New York City and Buffalo. Rainfall in San Diego is a fraction of that in San Francisco. The humidity in Houston can differ drastically from that in El Paso, and so on. Statewide evaluations of weather, or even simply temperature, are impractical here. For these and still other reasons, climate data are not considered in this research.

Since the goal of this chapter is to examine what effect, if any, taxes have on people’s decision of where to live, the response variable is the domestic migration rate. This is a measure of net domestic migration in and out of a state; it includes only those who move within the US, from one state to another. Foreign immigration is excluded, as is anyone moving to or from a U.S. territory. Population and migration data are sourced from the U.S. Census Bureau. Negative rates indicate domestic outmigration levels greater than domestic migration, and all rates are a percentage of the state population.

It is possible for taxes to affect population growth in ways that are not observed by domestic migration. Since higher taxes lower disposable income, they make it more difficult to afford raising additional children. While couples can certainly move to a lower-tax state to raise a family, and some do, those couples can also remain where they are and have fewer children. In the former case, domestic migration captures the movement of the couple. In either case, domestic migration would not capture the differential in the number of births from one state to another.

Alternatively, state population growth rates could be used as the response variable as it includes all migration as well as birth and death rates. This, however, presents at least two additional problems. First, it seems unlikely that foreign immigration would be affected
substantially by state tax rate differentials. In other words, more pressing issues, like the location of available work, would likely be a greater concern to foreign immigrants than which state has the lowest income tax. Similarly, someone leaving the country is likely not doing so because of the taxes in a single state. It is, therefore, advantageous to exclude foreign immigration for the purposes of this analysis.

Second, using state population growth rates as the response variable would require including the national population growth rate as one of the explanatory variables. The national population growth rate would vary only across time, and not across the states for a given time period. Since federal tax law changed significantly during the decade in relation to state tax deductibility, it is highly desirable to include time dummies in the empirical analysis to capture this change. Time dummies, however, preclude the use of variables that vary only with time, since those variables can be expressed as a linear function of the dummies. Domestic migration is a better choice for observing the effects that this analysis is investigating.

These data are combined for all 50 states for the years from 2010 to 2019, inclusive. While many other bodies of data were collected in the course of this research, they were ultimately left unused in the final regressions and so, for the sake of brevity, they are not detailed here. The resulting balanced panel dataset has 500 observations (50 states over 10 years) and includes domestic migration rates, the top marginal personal income tax rate, the top marginal corporate income tax rate, the sales tax rate, the effective property tax rate, the gasoline tax rate, the U-6 rate, and the RPPs for each state in each year.

It is worth mentioning, in some detail, the characteristics of the dataset, especially the variability of the explanatory variables. During the decade in question, a minority of states
changed their tax rates. Most of the changes seen in the data are a consequence of local tax rate changes or changes in local populations which caused different local tax rates to be weighted differently. Taking personal income as the first example, there is considerable between-unit variation but very limited within-unit variation (see Figures 2.1–2.4). The between-unit range is 13.3% for most of the decade, while 34% of the states had no within-unit change at all. Another 22% of the states had income tax changes of 5% or less during those ten years. That is not a 500-basis point change, but rather 5% of the tax rate. In other words, a 10% tax rate would increase or decrease by only 50 basis points, yielding either 10.5% or 9.5%. In fact, no state changed its personal income tax rate by more than 300 basis points during the decade.

Corporate income taxes show a similar pattern. The between-unit range is at least 15.95% every year but there is considerably less within-unit variation. 38% of states did not change their income tax rates while another 32% changed the rate by 20% or less. 78% of the states had within-unit ranges of 200 basis points or less while the largest within-unit range was just 440 basis points.

Sales taxes, meanwhile, have more within-unit variability. Just 22% of the states had no within-unit variation and more than half the states had variations of 10% or more. The between-unit range was at least 9.43% each year (see Figures 2.5 and 2.6).

Nearly every state’s property tax rates changed each year, with every state experiencing a change at least 5 of the 10 years. This is primarily due to the authority of local governments to assess property and levy the tax on it. The changes, although frequent, tend to be quite small, so that there is still somewhat limited within-unit variation. 58% of states experienced changes of 10% or less across the decade and 94% of the states experienced changes of 20% or less. The
Figure 2.1. Within-unit total variation in personal income tax rate.

Figure 2.2. Pooled personal income tax rates.
Figure 2.3. Within-unit total variation in corporate income tax rate.

Figure 2.4. Pooled corporate income tax rates.
Figure 2.5. Within-unit total variation in sales tax rate.

Figure 2.6. Pooled sales tax rates.
largest within-unit variation was only 59 basis points. The between-unit variation was at least 170 basis points each year (see Figures 2.7 and 2.8). As was the case with sales taxes, 22% of states had no within-unit variation of gas taxes. 60% of the states had a within-unit variation of 15% or less. The between-unit ranges were at least 47.7 cents per gallon each year (see Figures 2.9 and 2.10). Table 2.1 contains the descriptive statistics for the dataset.

IV: THEORETICAL MODEL

The following theoretical framework is proposed. There is an economic agent, with unique preferences, living in one of two regions, A or B, for only two time periods. At the end of the first period, the agent may choose to stay where he/she is, or to move to the other region. The agent’s utility is derived from a simple difference between total benefits and total costs, both of which are based entirely on the region in which the agent resides. An event, which impacts either the benefits or costs of one or both regions, happens at the end of period 1, at which point the agent reassesses his/her choice to maximize utility according to:

\[ u = \text{benefits} - \text{costs} \]

Benefits include financial and nonfinancial factors. The only financial benefit is employment, which is binary and assumed to be inseparable from a region. Costs also include financial and nonfinancial factors. Financial costs are taxes and costs of living. What, then, belongs to the nonfinancial categories? These broad categories can include such factors as the climate of a region or the presence of other family members within a region. Assuming that the agent begins in region A, at the end of period 1, the agent must assess if he/she will stay in region A or move to region B. The choice is to stay (A) or leave (B) and the respective utilities are expressed thusly:
**Figure 2.7.** Within-unit total variation in property tax rate.

**Figure 2.8.** Pooled property tax rates.
Figure 2.9. Within-unit total variation in gasoline tax rate.

Figure 2.10. Pooled gasoline taxes.
Table 2.1

Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Mean</th>
<th>Std. dev.</th>
<th>Min.</th>
<th>Max.</th>
<th>Obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$DomMigRate_{it}$</td>
<td>Net domestic migration as percent of state population</td>
<td>0.0142</td>
<td>0.0510</td>
<td>-0.147</td>
<td>0.252</td>
<td>500</td>
</tr>
<tr>
<td>$(\delta_1)Pers\ Inc_{it}$</td>
<td>Top marginal personal income tax rate <em>anti</em> tax reform</td>
<td>0.0565</td>
<td>0.0332</td>
<td>0</td>
<td>0.133</td>
<td>400</td>
</tr>
<tr>
<td>$(\delta_2)Pers\ Inc_{it}$</td>
<td>Top marginal personal income tax rate <em>post</em> tax reform</td>
<td>0.0563</td>
<td>0.0339</td>
<td>0</td>
<td>0.133</td>
<td>100</td>
</tr>
<tr>
<td>$Corp\ Inc_{it}$</td>
<td>Top marginal corporate income tax rate</td>
<td>0.0707</td>
<td>0.0316</td>
<td>0</td>
<td>0.1723</td>
<td>500</td>
</tr>
<tr>
<td>$(\delta_1)Sales_{it}$</td>
<td>Weighted average state and local sales tax rate <em>anti</em> tax reform</td>
<td>0.0639</td>
<td>0.0233</td>
<td>0</td>
<td>10.02</td>
<td>400</td>
</tr>
<tr>
<td>$(\delta_2)Sales_{it}$</td>
<td>Weighted average state and local sales tax rate <em>post</em> tax reform</td>
<td>0.0654</td>
<td>0.0240</td>
<td>0</td>
<td>10.02</td>
<td>100</td>
</tr>
<tr>
<td>$(\delta_1)Property_{it}$</td>
<td>Average property tax rate, owner-occupied housing <em>anti</em> tax reform</td>
<td>0.0106</td>
<td>0.0047</td>
<td>0.0018</td>
<td>0.0238</td>
<td>400</td>
</tr>
<tr>
<td>$(\delta_2)Property_{it}$</td>
<td>Average property tax rate, owner-occupied housing <em>post</em> tax reform</td>
<td>0.0106</td>
<td>0.0047</td>
<td>0.0030</td>
<td>0.0221</td>
<td>100</td>
</tr>
<tr>
<td>$Gas_{it}$</td>
<td>All state taxes on gasoline, cents per gallon</td>
<td>28.5934</td>
<td>9.4575</td>
<td>8</td>
<td>60.6</td>
<td>500</td>
</tr>
<tr>
<td>$RPP_{it}$</td>
<td>Regional Price Parity Index</td>
<td>97.1626</td>
<td>8.1133</td>
<td>85.7</td>
<td>119.2</td>
<td>500</td>
</tr>
<tr>
<td>$U6_{it}$</td>
<td>Unemployment, including all marginally attached and part-time workers</td>
<td>0.1093</td>
<td>0.0366</td>
<td>0.047</td>
<td>0.236</td>
<td>500</td>
</tr>
</tbody>
</table>

$\delta_1 = 1$ when \( t < 2018 \), 0 otherwise  

$\delta_2 = 1$ when \( t \geq 2018 \), 0 otherwise
\[ u(A) = \text{current benefits} - \text{current costs} \]
\[ u(B) = \text{alternative benefits} - \text{alternative costs} \]

where “current” benefits and current costs are incurred by remaining in region A and “alternative” benefits and costs are incurred by moving to region B. If \( u(A) \geq u(B) \), then the agent will remain in region A for period 2. Conversely, if \( u(A) < u(B) \), then the agent will move to region B. Consider the following four examples of possible events at the end of period 1, all of which result in the agent moving to region B.

I. Taxes increase in region A, increasing current costs sufficiently enough that \( u(A) < u(B) \).

II. The agent becomes unemployed in region A, greatly reducing current benefits. He/she can take a job in region B, becoming employed again. Assuming the agent values employment highly enough, this scenario yields \( u(A) < u(B) \).

III. The demographics of region A change sufficiently that the agent becomes very unhappy with his/her surroundings, increasing current costs by an amount greater than the period 1 difference between \( u(A) \) and \( u(B) \), so that now \( u(A) < u(B) \).

IV. The agent enters retirement, relaxing the assumption that employment is conditional upon location. Now, with income guaranteed irrespective of region, the only benefits evaluated by the agent are nonfinancial ones. Once more, this yields \( u(A) < u(B) \).

The first case deserves a little more attention here. While taxes increased in region A, a decrease in region B could produce the same result. Furthermore, there are additional assumptions about taxes that can be added to the model. The first is that taxes \((T)\) contribute to costs via some function:
where \( f'(T) > 0 \) and \( f''(T) > 0 \)

indicating that taxes increase costs at an increasing rate, reflecting taxable income elasticity.

Additionally, the components of \( f(T) \) are the following taxes: personal income, corporate income, sales, property, and gasoline. Although the precise structure of \( f(T) \) is unknown except to the agent, \( f(T) \) is known to be increasing with respect to any of these individual taxes. These final assumptions yield a very important fact: since different taxes affect the agent in question differently, the agent may be able to increase his/her utility by paying different taxes, without paying less in taxes.

Now the model can be somewhat generalized. Both the number of regions and the number of agents can be increased. Moreover, the assumptions that employment is both binary and respective to a region can be relaxed. Lastly, the limitation of only two periods is also relaxed. Now, an event that changes the costs or benefits in a region is assumed to occur at the end of every period, at which point each agent reassesses his/her situation and optimizes utility based on not just one, but multiple alternatives. All agents (1, 2, 3, …) now evaluate all regions (A, B, C, …), with their respective utilities denoted as:

\[
u_i(n) = benefits_{in} - costs_{in}\]

where \( n \) is the region in question and \( i \) is the agent. The optimal region is denoted with *:

\[
u_i(*) = benefits_{i*} - costs_{i*}\]

If the agent is already in the optimal region, he/she will stay. If not, the agent will move to the optimal region. Additionally, if each agent’s utility function is unique to that agent, then universal events can affect each agent’s decision process differently. Put another way, the same
change that induces one agent to move into a region may prompt another agent to move out of that same region. Case three above is one such example. Political changes in a region could also provoke an agent to move out but a different agent to move in. One effect, however, that is common to all agents, is that tax increases in a region necessarily decrease an agent’s utility derived from living there, although each agent’s utility may be decreased by a different amount. Thus, the following always holds:

\[
\frac{\partial u_i(n)}{\partial T_n} < 0 \quad \forall \, i, n
\]

so that the change in agent \( i \)’s utility in region \( n \) with respect to a change in taxes in that region must be negative.\(^{80}\)

V: Empirical Model and Results

With the aim of estimating the effects of tax rates on domestic migration, the following structural empirical model is proposed:

(1) \[ \text{Dom Mig Rate}_{it} = \beta_0 + \beta_1(\delta_1)\text{Pers Inc}_{it} + \beta_2(\delta_2)\text{Pers Inc}_{it} + \beta_3(\delta_1)\text{Property}_{it} + \beta_4(\delta_2)\text{Property}_{it} + \beta_5(\delta_1)\text{Sales}_{it} + \beta_6(\delta_2)\text{Sales}_{it} + \beta_7\text{Gas}_{it} + \beta_8\text{Corp Inc}_{it} + \beta_9\text{U6}_{it} + \varepsilon_{it} \]

where \( i \) is the state, \( t \) is the year, and

\( \delta_1 = 1 \) when \( t < 2018 \), 0 otherwise

\( \delta_2 = 1 \) when \( t \geq 2018 \), 0 otherwise

---

\(^{80}\) This conclusion requires the assumption that the model does not begin in the extreme case of “no government.” If this were the case, nearly all agents would gladly part with a small portion of their respective incomes in order to fund basic police protection, and courts to adjudicate disputes. An additional assumption is that benefits are equally distributed and not concentrated. If government benefits were concentrated, then a single agent, or a small group of agents, would likely receive more in additional benefits than they would pay in additional taxes. If either of these assumptions is violated, then increases in taxes do not always decrease every agent’s utility.
The reason for the inclusion of dummy variables ($\delta_1, \delta_2$) on three of the tax rates is the change in the tax code affecting federal tax liabilities. Since the deductibility of state personal income taxes, sales taxes$^{81}$, and property taxes were capped beginning in 2018, this makes those tax rates more costly on wealthy individuals who previously used them as an unlimited deduction on their federal returns. So, while the amount of state taxes paid did not increase, the amount of federal taxes paid did. In this way, state personal income taxes, sales taxes, and property taxes had an additional indirect cost beginning in 2018 which they did not have before. The goal of the dummy variables is to capture this dynamic.

Using dummy variables in this way allows for the coefficients on personal income, sales, and property taxes to change after the introduction of tax reform. Simply using dummy variables to adjust the intercept would not capture this effect properly, because the effect is dependent upon the level of taxation. The higher a state’s personal income, sales, and property tax rates, the larger the effect is expected to be on domestic migration. This arrangement allows for the observation of whether tax reform does in fact exacerbate the effect of these three tax rates on domestic migration.

Admittedly, this empirical model only captures some of the numerous financial factors that weigh into the decision of moving from one state to another. Instead, it focuses on the largest taxes that residents pay and unemployment. The model also does not include the

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$^{81}$Although state sales tax can be deducted from federal tax returns, it can only be deducted in lieu of state income taxes. Taking the sales tax deduction involves either keeping all of one’s receipts for the year or using the IRS’s Sales Tax Calculator, which may yield a deduction far less than the burdensome receipt-based method. For these reasons, the sales tax deduction is rarely used, except for people living in states with no income tax. Internal Revenue Service, Credits and Deductions for Individuals, Itemized Deductions: Sales Tax https://www.irs.gov/credits-deductions/individuals/sales-tax-deduction-calculator.
nonfinancial factors mentioned in the theoretical model, leaving those to be captured by the error term. This deserves some explanation here.

Many nonfinancial factors are simply impossible to measure and aggregate into usable data, at least at the moment. While many enjoy warmer climates, some prefer experiencing all four seasons. It is not universal that warmer is always better. Annual high temperatures exceeding 120 degrees in the Southwest can be just as unappealing as the negative 20-degree lows of North Dakota. Since each person’s climate preferences are more or less idiosyncratic, it is impossible to definitively rank climates in terms of universal preferences. Furthermore, many states can have diverse weather simultaneously, as mentioned previously. There is no single climate in California, for instance, where you can ski in the Sierra Nevada in the morning and be at the beach before dinner. Even computing just a single weather variable, like average temperature, is difficult due to the uneven spacing of weather stations around a state. While local climates during the decade were unchanged as to their historical norms, converting those predictable realities into state-wide metrics is unwieldy. More important is the fact that a randomly drawn American will not always prefer a certain climate. Also of note is the fact that while local climates are constant, they are not correlated with the explanatory variables.

One of the most common reasons, according to Census data, for why people move is to be closer to family. Only slightly more common are those who move out of a family home to begin their own nuclear family. Even still, most people who no longer live with their parents still live quite close. The median distance between an American’s home and his or her mother’s is a mere 18 miles, and 80% are within a two-hour drive of their mother’s home.82 So while family

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82 Health and Retirement Study https://hrs.isr.umich.edu/about?_ga=2.5098291.1628447805.1589131011-33620146.1589131011.
considerations loom large when it comes to the decision of moving, there is no correlation between tax rates and a randomly selected American’s extended family’s location. Furthermore, survey data indicate that people who move for family reasons tend to stay within their state.

Politics presents perhaps the largest issue in the error term because politics affects so many issues, both financial and nonfinancial, including issues about which people may have very strong beliefs. People may therefore decide to relocate due to a whole host of various issues that have nothing to do with taxes. The flood of domestic migrants into, say Idaho, could largely stem from politics and not taxes. The issue is that politics is closely correlated with tax rates. The political spectrum can be crudely broken down into conservative and liberal camps, where, according to conventional wisdom, conservative politics favors lower taxes and fewer government services while liberal politics favors higher taxes and more government services. Thus, tax rates can be correlated with a plethora of seemingly unrelated issues ranging from welfare to abortion and unions to firearms.

Trying to quantify the degree to which a state is conservative or liberal is difficult. Even just making relative comparisons between states can prove baffling, the extreme cases notwithstanding. Texas is obviously red, and California is obviously blue, but what about the comparison of Pennsylvania and Michigan? Both states voted for a Republican President in 2016 and have Republican-controlled legislatures, but they both have Democrat governors. Is one governor more liberal than the other? What are the policies in each state by which one can determine the degree to which a state is relatively more liberal or conservative than the other? Pennsylvania and Michigan have different laws regarding firearms, environmental regulations, equal pay laws, etc. Furthermore, given President’s Trump very unorthodox brand of
conservatism, was it even an endorsement of conservative orthodoxy when these states cast their electors for him? These are difficult questions to answer and are inherently subjective since they require applying relative weights to different issues.

Since politics is correlated with tax rates, it needs to be determined if the political makeup of the states has varied over the 10 years in question since it will impact the choice of which estimator is optimal for the data. If judging by elected offices, it does seem that there was marked political change during the decade. To start, Democrats controlled 28 state senates, 32 state houses, and 26 governorships, a majority in each category. Additionally, there were 17 Democrat trifectas\(^{83}\) to only 10 Republican ones. For much of the decade, however, the map of the country shifted red as Republicans picked up seats in state offices, controlling as many as 37 state senates, 33 state houses, and 33 governorships. At the high-water mark, Democrats had 8 trifectas to Republicans’ 26. This was a balance of power so far in favor of Republicans that it had not been seen since the end of the 1920s.\(^ {84}\) On the surface, it would appear that the states were collectively in a decidedly more conservative mood (see Figures 2.11–2.13).

A closer look at elected officials and the policies which they enacted, however, tells a different story. Governors like Lawrence Hogan in Maryland and Bruce Rauner in Illinois were both elected during the decade as Republicans in what were considered blue states. Neither were considered particularly conservative, however, relative to their counterparts in traditionally red states, sometimes earning them the pejorative identification of RINO. Hogan has left-leaning

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\(^{83}\) A trifecta is defined as one political party holding the governorship and majorities in both the state house and the state senate. In Nebraska, with a unicameral legislature, the “trifecta” has been maintained since 1999 by controlling the governorship and just the state senate.

\(^{84}\) To put this in perspective, if a single party controls 38 state legislatures, and remains united, it can pass constitutional amendments at will, without any input from the minority party.
positions on issues including the environment, immigration, abortion, drug legalization, gun control, etc. Rauner had left-leaning positions on issues including abortion, immigration, gun control, the minimum wage, same-sex unions, etc. Both also refused to endorse then-candidate Trump, although some staunch conservatives declined to endorse the President as well.

![State Houses Controlled](image)

*Figure 2.11. State houses controlled.*

There is a long list of Republican governors and legislatures enacting laws during the decade which do not fit the description of typical conservatism. In Pennsylvania, Governor Tomas Corbett signed the largest gasoline tax increase in the state’s history, giving the Keystone state the highest gasoline tax per gallon at the time. If Pennsylvania was supposedly becoming more conservative, this certainly does not reflect that. Similarly, Republicans in Kansas raised income taxes there as well.
Figure 2.12. State senates controlled.

Figure 2.13. Gubernatorial seats.
Overall, the states did not enact new legislation that was overwhelmingly conservative, even if they elected Republican politicians. Either an “R” or a “D” next to a politician’s name was not a guarantee of conservatism or liberalism, respectively. The data seems to indicate that Republicans were elected in blue and purple states not because of a massive change in political climate, but because those Republicans were more moderate than the Republican contenders that preceded them. Historian Victor Davis Hanson noted that the one clear trend during the decade was conservative states becoming more conservative and, correspondingly, liberal states becoming more liberal. However, the unmitigated shift of public opinion on actual policy from blue to red or even purple to red did not materialize in the 2010s. The 2018 election could be seen as evidence for this, as Democrats won back some seats in all categories of state offices. In fact, the President’s party tends to lose political representation not just during midterm elections, but for the entire tenure of the President’s time in the White House. The trends displayed in the last ten years are, therefore, not out of the ordinary.

In brief, the conclusion is that, during the decade, the political climates in the states were fairly constant. In fact, more than half of the states have voted consistently for a single party in presidential elections since 1992. However, it is very unclear how many of the states compare to one another during the decade. Ranking the states in order of liberal or conservative politics is not reasonable over a single decade. To judge this accurately and to definitively have variability in politics at the state level, a much larger dataset would be needed. It would have to extend back

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86 No President since Ronald Reagan has left office with his party having at least as much representation as when he entered the Presidency.
more than half a century to when California was reliably Republican and the South was consistently Democrat.

Given the constraints of the data, in particular the relationship between politics and tax rates, it is necessary to use a Fixed Effects estimator. The Fixed Effects transformation will take care of the political problem and any other components of the error term that are both correlated with the explanatory variables and constant over time. Since the data only extend for 10 time periods, it is reasonable to assume that those components which were correlated with the explanatory variables are also constant over time. What remains in the error term are essentially random factors that impact domestic migration. Events like major hurricanes, widespread forest fires, or severe floods tend to produce one-time decreases in domestic migration for the year in which they occurred.

The disadvantage from the FE transformation is that demeaning the data renders any tax rate which is constant over time as a zero. This means that a state with a constant 10% income tax rate is mathematically equivalent to a state with a constant 0% income tax rate. The FE estimator measures only within-unit differences, not between-unit differences, which is a challenge in an investigation that seeks to find the effects of policy differences between states. The variables that are unchanging over time are swept away as collateral damage along with the intended targets in the error term. Ideally then, every state would have changed each tax rate at some point during the decade, but this is far from reality. Consequently, those tax rates which have the least within-unit variability will likely not have statistical significance.

A Random Effects estimator would not demean the time-invariant tax rates to zero, but it requires that the error term not be correlated with the explanatory variables. A middle ground
between the FE and the RE estimators is a Hausman Taylor estimator, which is useful in a situation where there are both time-invariant variables and correlation between the explanatory variables and the error term. Regrettably, it requires that there be at least as many exogenous, time varying regressors as endogenous, time invariant regressors, which is not the case. The nature of the variables in the regression dictates the use of the FE estimator. Finally, since there is reason to believe that the error terms are correlated over time, HAC robust standard errors are used. See Table 2.2.

Table 2.2

Estimation Results (1) [FE]

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.2336**</td>
<td>(0.0958)</td>
</tr>
<tr>
<td>(δ₁)Pers Incₜᵢ</td>
<td>0.0814</td>
<td>(0.5609)</td>
</tr>
<tr>
<td>(δ₂)Pers Incₜᵢ</td>
<td>-0.1224</td>
<td>(0.5145)</td>
</tr>
<tr>
<td>Corp Incₜᵢ</td>
<td>-0.1194</td>
<td>(0.3179)</td>
</tr>
<tr>
<td>(δ₁)Propertyₜᵢ</td>
<td>-0.0733</td>
<td>(1.8364)</td>
</tr>
<tr>
<td>(δ₂)Propertyₜᵢ</td>
<td>-1.4593</td>
<td>(2.1556)</td>
</tr>
<tr>
<td>(δ₁)Salesₜᵢ</td>
<td>-0.0253**</td>
<td>(0.0106)</td>
</tr>
<tr>
<td>(δ₂)Salesₜᵢ</td>
<td>-0.0251**</td>
<td>(0.0102)</td>
</tr>
<tr>
<td>Gasₜᵢ</td>
<td>-0.0002</td>
<td>(0.0008)</td>
</tr>
<tr>
<td>U6ₜᵢ</td>
<td>-0.3698***</td>
<td>(0.1315)</td>
</tr>
</tbody>
</table>
The only tax rate with statistical significance is sales tax and the coefficient is negative, as expected. Interestingly, the coefficient becomes only very slightly smaller after tax reform. The results indicate that, before tax reform, a 1 percentage point increase in state sales tax decreases domestic migration by .02%. The effect is essentially identical after tax reform was enacted. Unemployment had a much larger effect. For each 1 percentage point rise in U-6, a state can expect to lose .37% of its population to other states. It is not surprising that unemployment has a coefficient roughly 14 times larger than that of sales taxes. While a tax takes away a portion of your earnings, unemployment takes away all, or at least most, of it. Even those working part-time, since this is the U-6 measure of unemployment, still face drastically reduced incomes as opposed to if they worked full-time. The actual impact on people’s lives is much greater, hence the considerably larger effect on domestic migration.

While the other tax rates did not have statistical significance, they are worth a cursory look. The effect of property taxes becomes much larger after tax reform. Similarly, the coefficient on personal income taxes is positive before tax reform but negative afterwards. Although these estimates lack significance, it is interesting to note that they still demonstrate the expected pattern of having a more negative impact on domestic migration after the passage of tax reform.

Why, then, is the coefficient on sales tax nearly unchanged, and in fact slightly smaller after the passage of tax reform? If the limited deductibility of state taxes creates a greater incentive to move away, the coefficient should become more negative after tax reform. The survey data may lend a hand in explaining this result. While people have been leaving states with overall higher tax burdens for states with overall lower ones, they are tending to move more
specifically to states with lower income and property taxes, but with sales taxes still higher than the national average. Florida, Nevada, Texas, and Washington are good examples of this trend. They all have no income tax, a sales tax above the national average, and have experienced relatively robust population growth and an influx of domestic migration. They are also not all red states, indicating that it is likely not a blue versus red phenomenon. Tennessee, home to the highest state sales tax in the country\textsuperscript{87} at a rate of 9.52\%, has just a 2\% income tax, on unearned income only, and is also seeing an inflow of domestic migrants. States like California, Illinois, and New York also have high sales taxes, (they are in the top ten for highest sales tax rates) but they have been hemorrhaging people. The difference here is that their overall tax burden is very high – they make up three of the top five highest overall tax burdens in the country.

Insufficient variability in the data likely explains the lack of statistical significance in personal income, corporate income, and property tax rates. Unfortunately, this still limits the conclusions that can be definitively drawn from the regression results. However, the survey data can still help direct one’s thinking. There are essentially two explanations for why people are choosing to move to states with higher than average sales taxes, sometimes even moving from a state that had relatively low sales taxes. First, as outlined previously, income and property taxes could have an equal or larger effect than sales taxes, but the effect has been demeaned out by the FE transformation. Second, people are moving for non-tax reasons that happen to be correlated with the specific combination of high sales taxes and low income taxes. There does not appear to be any reason that would fit this very narrow description. Again, while circumstantial evidence

\textsuperscript{87} In 2017 and 2018, Louisiana had a higher sales tax by 0.5\%, but was lower for the rest of the decade.
certainly supports the first explanation, the empirical results cannot definitively acclaim that account.

One additional investigation is worth consideration here. In the first regression, the cost of living in each state was left to be captured by the error term. This was done to avoid “double counting” of sales, property, and gasoline taxes, all of which contribute to the cost of living measurement. On the other hand, including the RPPs does pull a fairly substantial component out of the error term, and those three taxes make up a relatively small portion of the cost of living in each state. (Neither option is a solution; they are both trade-offs.) The RPPs are added to the regression and the results reported in Table 2.3.

\[
\text{Dom Mig Rate}_{it} = \beta_0 + \beta_1(\delta_1)\text{Pers Inc}_{it} + \beta_2(\delta_2)\text{Pers Inc}_{it} + \beta_3(\delta_1)\text{Property}_{it} + \\
\beta_4(\delta_2)\text{Property}_{it} + \beta_5(\delta_1)\text{Sales}_{it} + \beta_6(\delta_2)\text{Sales}_{it} + \beta_7\text{Gas}_{it} + \beta_8\text{Corp Inc}_{it} + \beta_9\text{U6}_{it} + \beta_{10}\text{RPP}_{it} + \varepsilon_{it}
\]

The change in the intercept after the introduction of the RPPs is noteworthy. The coefficient on RPPs is -0.0070 and the nation-wide average for the RPPs is 100. This implies that the average cost of living decreases domestic migration by 0.70%. The intercept, meanwhile, increased from 0.2336 to 0.8736, an increase of 0.64, which is more than 90% of the effect caused by the average cost of living. The interpretation here is that the results of this regression will more accurately reflect the true effects of tax rates for those states that are above or below the average RPP. In terms of a marginal effect, Hawaii’s high cost of living (an RPP of 118.5) causes 0.83% of residents to leave for other states, while decreasing the cost of living in a state by 1% of the nationwide average would cause about 0.01% more domestic migration to that state.
Table 2.3

*Estimation Results (2) [FE]*

<table>
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<tr>
<th>Intercept</th>
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</thead>
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<td></td>
<td>(0.3695)</td>
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<td>(δ₁)Pers Inc&lt;sub&gt;it&lt;/sub&gt;</td>
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<tr>
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<td>-0.1891</td>
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<tr>
<td></td>
<td>(0.4306)</td>
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<tr>
<td>Corp Inc&lt;sub&gt;it&lt;/sub&gt;</td>
<td>-0.1056</td>
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<tr>
<td></td>
<td>(0.3179)</td>
</tr>
<tr>
<td>(δ₁)Property&lt;sub&gt;it&lt;/sub&gt;</td>
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<tr>
<td></td>
<td>(1.5864)</td>
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<tr>
<td>(δ₂)Property&lt;sub&gt;it&lt;/sub&gt;</td>
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<tr>
<td></td>
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<tr>
<td>(δ₁)Sales&lt;sub&gt;it&lt;/sub&gt;</td>
<td>-0.0197*</td>
</tr>
<tr>
<td></td>
<td>(0.0115)</td>
</tr>
<tr>
<td>(δ₂)Sales&lt;sub&gt;it&lt;/sub&gt;</td>
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</tr>
<tr>
<td></td>
<td>(0.0112)</td>
</tr>
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<td>Gas&lt;sub&gt;it&lt;/sub&gt;</td>
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</tr>
<tr>
<td></td>
<td>(0.0008)</td>
</tr>
<tr>
<td>U6&lt;sub&gt;it&lt;/sub&gt;</td>
<td>-0.3333***</td>
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<tr>
<td></td>
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<tr>
<td>RPP&lt;sub&gt;it&lt;/sub&gt;</td>
<td>-0.0070*</td>
</tr>
<tr>
<td></td>
<td>(0.0041)</td>
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</tbody>
</table>

Unemployment is nearly unchanged from the previous regression. A 1 percentage point increase in the U-6 unemployment rate in a state causes .33% of residents to leave. The coefficients on the sales tax rates, now identical before and after tax reform, are also close to their counterparts from the previous regression. An increase in the state sales tax of 1 percentage point leads to .02% of that state’s population emigrating. The coefficients being so similar in the two regressions implies that sales taxes do not have a large impact on the cost of living. This
corresponds well with the fact that most states do not impose sales tax on anything considered a necessity, including food that is not already prepared, and housing. The majority of states also do not tax most clothing.

Personal income and property taxes show a similar pattern as before, but the results are still not statistically significant. Corporate taxes are also little changed and, likewise, not statistically significant either. The gasoline tax has the same coefficient and is not statistically significant either.

Unlike both types of income taxes as well as property taxes, the gasoline tax has a higher degree of within-unit variability. Therefore, the FE transformation has not demeaned away nearly as much of the data as with personal income taxes. The interpretation here is that gasoline taxes do not have a significant impact on the decision to move to another state.

It is interesting to compare these results with those from a RE model, whose estimates may be inconsistent but do not suffer the negative effects of fully demeaned data. The starkest difference between the results of the two models is that sales taxes are no longer statistically significant, but property taxes are. The relatively large coefficient on property taxes is reasonable since most people own property that is some multiple of their annual incomes. Therefore, even a relatively low property tax rate can still amount to a sizeable tax burden. For 2019, property tax paid per capita in the country was $1,556, which is 44% more than the state income tax paid per capita of $1,083 and 68% more than the sales tax paid per capita of $925. Furthermore, the effect became substantially larger with increased statistical significance after the passage of tax reform, aligning well with the intuition outlined earlier, that state taxes indirectly became more costly after 2017. The effect of personal income taxes also became more negative but, similar to the FE
model, both personal and corporate income tax rates are still not statistically significant, indicating that the lack of within-unit variability is not necessarily the only reason why there was no statistical significance in the FE models. Finally, a Hausman test yields a very low p-value, indicating that the RE model is not consistent, in favor of the FE model (see Table 2.4).

VI: SUMMARY

States compete with one another over mobile tax bases. The chief mechanism for this competition is lower tax rates, but a secondary means of competition are the types of taxes which a state chooses to levy. Census Bureau data\textsuperscript{88} indicates that people prefer states with no, or at least low, income taxes, even if this means paying relatively high sales taxes.\textsuperscript{89} The nature of the dataset and the choice of estimator unfortunately make it very difficult to confirm this empirically. The empirical results do not necessarily contradict the survey data, but they also do not definitively support it either. Instead, the results in this chapter indicate that unemployment is a much greater factor than tax rates for inducing people to migrate domestically. The variability of gasoline taxes makes them more immune to the difficulties encountered with income taxes and property taxes, and so gasoline taxes do not appear to have a significant impact on migration choices.

The effect of tax reform worsening the cost of high state taxes is also not definitively demonstrated by the empirical results. Although personal income and property taxes had


\textsuperscript{89} Several other pieces of survey data have displayed this trend over the last decade, including the United Van Lines annual survey. https://www.unitedvanlines.com/newsroom/movers-study-2019.
Table 2.4

*Estimation Results*

<table>
<thead>
<tr>
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<th>(1) [FE]</th>
<th>(2) [FE]</th>
<th>(1) [RE]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
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<td>0.8736**</td>
<td>0.1076***</td>
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<td></td>
<td>(0.5145)</td>
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<td>(0.2623)</td>
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<tr>
<td>Corp Inc$_{it}$</td>
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<td>-0.1056</td>
<td>-0.2754</td>
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<tr>
<td></td>
<td>(0.3179)</td>
<td>(0.3179)</td>
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<td>(1.4485)</td>
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<tr>
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<td>(0.0106)</td>
<td>(0.0115)</td>
<td>(0.0024)</td>
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<td>-0.0197*</td>
<td>-0.0037</td>
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<tr>
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<td>(0.0102)</td>
<td>(0.0112)</td>
<td>(0.0028)</td>
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<tr>
<td>Gas$_{it}$</td>
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<td>-0.0002</td>
<td>0.0002</td>
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<tr>
<td></td>
<td>(0.0008)</td>
<td>(0.0008)</td>
<td>(0.0005)</td>
</tr>
<tr>
<td>U6$_{it}$</td>
<td>-0.3698***</td>
<td>-0.3333***</td>
<td>-0.2954***</td>
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<tr>
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<td>(0.1315)</td>
<td>(0.1340)</td>
<td>(0.1010)</td>
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<td>RPP$_{it}$</td>
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<td></td>
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<td>(0.0041)</td>
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</tr>
</tbody>
</table>
increasingly negative coefficients after the passage of tax reform, those results were not statistically significant.

All else being equal, increases in the cost of living, sales taxes, and unemployment all will cause domestic emigration. Each 1-point increase in the RPP index for a state causes 0.01% of the population to leave. A 1-percentage-point increase in sales taxes decreases domestic immigration by 0.02% and a 1-percentage-point increase in unemployment (U-6) decreases domestic immigration by 0.33%.

For states with millions of residents, fractions of a percent are not trivial amounts in terms of the number of people that are leaving a state, especially when these numbers are recurring, year after year. For a state like New York, with over 19 million people, a sales tax rate of 8.49% reduces domestic migration by 0.17%, or 33,071 people annually, and more than 330,000 people over the decade. While the exact effects of New York’s high income and property tax rates are not precisely known, they certainly cannot be helping the situation.

It is not surprising that the statistically significant coefficients are all fractions of a percent. There is substantial evidence that most people value family, and proximity to family, very highly. Most people do not want to move away from family and friends and are willing to tolerate a suboptimal financial outcome for the sake of nonfinancial gain. Consequently, the vast majority of people will stomach a tax increase to not uproot their lives. Only those already near the margin, therefore, will relocate for taxes. Even better employment prospects are not always incentive enough for many to leave their hometowns.

As far as the cost of living index is concerned, its inclusion is ultimately a compromise. Ideally, the RPPs, instead of being either included or excluded, could be thoroughly broken
down to only exclude all the innumerable costs of taxation so that those non-tax costs could be isolated and remain in the regression, while the regression would simultaneously but separately still include property, sales, and gasoline taxes, as well as other excise taxes, as their own variables. Eliminating all tax burdens from the RPPs would make those indexes a true measure of the gross cost of living, exclusive of the tax components which, in the current form, give the net cost of living. Such an in-depth enterprise would certainly make this work more precise, since the current inclusion of taxes in the cost of living index causes those effects to be captured twice. The size of this undertaking confines it to future research.

An additional change that might also yield more accurate results, would be to replace the unemployment rate with a labor index for each state, since the exodus of the unemployed can lower the unemployment rate without labor conditions actually improving. An index would account for a state’s industry mix and the nationwide health of each industry. Thus, it would be possible to calculate what sectors in a state’s economy are expanding or contracting and weighting the relative size of each sector in each state would give a more accurate picture of the health of the labor market therein. Of course, this measure does not exist and that lacuna, once again, is likely due to the size of such a venture, also confining it to future research.

One final idea for additional investigation comes from the theoretical model, wherein it was noted that both the first and second derivatives of the cost function with respect to taxes were positive. If this is the case, then it stands to reason that there should actually be a nonlinear relationship between tax rates and domestic migration. A nonlinear model could test this assumption. Ideally though, any future research would also have a larger dataset with more variability. The current decade-long sample is somewhat plagued by this deficiency which limits
the estimators that can be used in regression analysis. As was noted earlier, data extending back seventy years would provide a great deal more of both within-unit and between-unit variability. The size of the dataset here has been limited due to difficulties in collecting older information. Much of the data used in this chapter are weighted averages for each state, derived, in part, from all the local tax rates within a state. Most of these calculations have only been performed for more recent years, making it difficult to gather consistent data from older periods. Hopefully, the government and private institutions which publish these data will eventually provide them for the last 50 years or more.

VII: POLICY IMPLICATIONS

While this research aimed at comparing tax rates and types, it more conclusively shows that unemployment may be far more important of a policy consideration. The implication from the empirical results is that states with low unemployment, including those marginally attached to the labor force, will retain more of their own residents and even attract new residents from other states. It is uncertain whether sales taxes in lieu of income taxes are a winning formula in the long run, although migration patterns show that trend over the last ten years.

It is highly desirable for a state to retain the residents it already has, and to attract new residents from other states. More people in a state means more representation in Congress, which can have far reaching implications on what bills are passed into law and even who is elected President. More representation can also mean more federal funding for a whole host of

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90 270 to Win, a nonpartisan election forecast aggregator predicts, according to Census data, that California, Illinois, and New York will all lose a Congressional seat, and an electoral vote along with it, in the next reapportionment. This will mark the first time California has ever lost a seat. Florida and Texas, on the other hand, will each gain multiple seats, having done so 10 years prior as well. Florida will gain two seats, and “surpass New York in congressional districts, the culmination of a 70-year shift in population,” that began when New York had 45 districts
valuable programs. Policies that reduce unemployment, therefore, should be implemented for
these reasons, in addition to the welfare gains achieved by more people having jobs and,
consequently, an income. As far as taxes are concerned, several other pieces of research\textsuperscript{91} have
found low tax rates highly correlated with robust business and jobs growth. A business-friendly
environment at the state-level can predictably help reduce unemployment in some circumstances.
When the causes of unemployment are macroeconomic factors affecting the nationwide (or even
worldwide) economy, it is unclear what can be done at the state level to alleviate those systemic
causes. The optimal solution in this regard is to have efficient government, defined by providing
the maximum level of public services for the minimal level of taxation. Nothing could be more
appealing to the taxpayer than that.

The empirical work in this chapter was not able to replicate the patterns displayed in
survey data, namely that people are moving not just to states with lower overall tax burdens, but
to states with lower income taxes, specifically. Imposing no personal income taxes with no or
relatively low corporate income taxes, along with relatively low property taxes, has proved to be
a winning formula for states like Florida, Nevada, South Dakota, Tennessee, and Texas. To still
meet necessary revenue needs, these states rely more heavily on sales and excise taxes and
people seem to prefer this system of taxation. Tennessee is a perfect example within this group.
As mentioned previously, Tennessee has the highest sales tax rate in the nation, but no earned
income tax. Among those five states, Texas has the highest property tax rates, but they are still

\textsuperscript{91} Campbell (1996), Saez et al. (2012), Case (1993), Devereux et al. (2002), Dye et al. (1995), Wildasin (1993),
Mertens et al. (2013), Rauh et al. (2019), Korneychuk (2017), Hines (2017), Bruce et al. (2006), etc.

and there were just 6 in Florida. Texas will gain three seats, after having gained four seats in the last
reapportionment. 270 to Win: Projected 2024 Electoral Map Based on New Census Population Data
about a quarter less than the rates in New Jersey, where land also tends to be more expensive. States like New Jersey, Illinois, and Connecticut have imposed property taxes that are among the highest in the nation, and they are also among the highest in terms of overall tax burden.

Recalling that those with higher incomes tend to be more mobile than those with lower incomes, sales taxes are particularly attractive in place of income or property taxes. No income tax allows a person to save and invest more, and while those investments will ultimately be consumed and a sales tax owed in the future, having no income tax today means more can be invested and therefore more can be consumed in the future, even in the presence of a consumption tax. Since those with higher incomes can potentially invest more, this is very appealing. Likewise, certain purchases, like homes, are not subject to sales tax, allowing residents of states with no income taxes to buy and sell a home tax free, no matter how large or expensive the home might be. Furthermore, those with higher incomes are more likely to travel which entails spending some of their incomes in other states or other countries, that may have lower or no sales taxes, in which case those with higher incomes would avoid paying their home state’s sales taxes while away. Since there are costs associated with travel, this is not meant to be a viable strategy for avoiding taxes, but it is a benefit that may have an effect for those on the margin. The empirical results, on the other hand, only demonstrate that domestic migration decreases as sales taxes increase, *ceteris paribus*.

As people become more mobile and as SALT deductions vanish from federal tax returns, the expectation is that people will vote with their feet in greater volumes since the cost of

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92 Washington state does, however, place an excise tax on home sales. Additionally, capital gains taxes can be assessed in certain situations. The vast complexities of the tax code make it impossible to outline here all of the elements of real property taxation, or even to make broad generalizations beyond saying that homes are not subject to general state sales tax.
relocation is decreasing while the cost of staying in a high-tax state is increasing. Hopefully, additional data will allow for better analysis of these trends in order to more completely assess taxpayers’ preferences over not just the level, but the methods of taxation.
CHAPTER 3

I: INTRODUCTION

Investors are unlikely to lend a borrower money when the likelihood of repayment is unknown. If the investor has some degree of reassurance that the borrower, or issuer, will make good on the debt, perhaps from the placement of collateral, then the investor is more likely to purchase debt issued by the borrower. A third-party assessment of the debt being purchased can be very valuable to both the investor and the issuer, since it can eliminate some of the asymmetrical information, resulting in more lending that is beneficial to both the investor and the issuer. A debt rating simply serves as a proxy for the likelihood that the debt will be repaid with interest. Ratings agencies can therefore perform a valuable function in keeping financial markets liquid and free flowing, assuming the assigned ratings are accurate.

The U.S. government has recognized only a handful of companies as NRSROs (Nationally Recognized Statistical Ratings Organizations). Among those companies are Moody’s and S&P, both of whom each command about 40% of the ratings market. Fitch controls another 15% of the market, and these three ratings agencies are commonly called “the big three.” The remaining 5% of the ratings market is divided among the other NRSROs. The big three ratings agencies have been in business for roughly 100 years and they rate various debts, whether issued by corporations, financial firms, federal, state, or local governments, or anyone else.

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Most NRSROs use an issuer-pays model, wherein the debt issuer pays for a rating on that debt, as opposed to the now infrequently used investor-pays model, wherein an investor pays for a rating on debt which the investor is interested in purchasing. Issuer-paid ratings are seen by many as a conflict of interest. At the time of this writing when nearly half of corporate debt is BBB rated, it raises questions as to what explains this clustering oddity. One possibility is coincidence, but a more cynical view is that ratings agencies are giving artificially high ratings to sub-investment grade debt, but only just high enough to push the ratings into investment-grade territory. This is just the latest in a long line of examples of questionable datapoints that many cite as evidence of the conflict of interest that is the issuer-pays model.

While the data on states’ credit ratings come from S&P, they are nearly identical to the ratings of Moody’s, with no state’s rating differing by more than a single “notch” between ratings companies. Fitch’s ratings are also very similar, but Fitch has not consistently rated all 50 states each year. Moody’s has also chosen not to rate Wyoming as recently as 2017. Consequently, the ratings data and nomenclature of S&P for long-term debt is the system chosen for this chapter. A comparison of the three systems appears below. Since all states fall into the investment grade category, that will be the portion in focus here, although the entire ratings schedules are provided for reference. Each ratings agency has 10 equal notches of investment-grade ratings. Table 3.1 shows each ratings agency’s nomenclature and ratings notches while Table 3.2 shows the S&P’s credit ratings for the states over the past decade.

While the big three ratings agencies issue ratings for both short- and long-term debt, Table 3.1 only shows the ratings schema for long-term debt. Typically, long-term issuances are called bonds and have maturities over 1 year while short-term issuances, sometimes called notes,
Table 3.1

*Ratings Agency Nomenclature and Ratings Notches*

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### Table 3.2
S&P Credit Ratings for the States, 2010-2019

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<tr>
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<td>AA+</td>
<td>AA+</td>
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<td>AA-</td>
<td>AA-</td>
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<td>AA</td>
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<tr>
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</table>
have maturities of less than one year. State-level municipal issuances are usually long-term, and their coupon payments are exempt from federal taxes.

When corporate debt ratings are changed, the effects tend to be immediate and palpable for both investors and the corporations in question. The changes in state credit ratings, however, have not in recent years elicited the same response. Instead, ratings agencies seem to have had little impact on states’ costs of financing their debts. This is not to say that the state credit ratings by S&P, Moody’s, and Fitch are wholly inaccurate, but rather, that they seem unnecessary or add little value to the already widely disseminated information which investors have at their fingertips. In contrast, the much more complicated worlds of commercial paper and complex financial derivatives are not so easily understood, nor the data so easily accessible, as to give investors the same level of confidence they seem to exhibit when purchasing state debt.

While a BBB- credit rating for a state is clearly less desirable than a AAA rating, it is not as damaging as it might appear at first glance. A much larger concern for a state would be if its credit were downgraded below investment grade, since, at that point, fiduciaries can no longer recommend those bonds to clients. Instead, clients must specifically ask for a bond that is sub-investment grade. Additionally, some mutual funds would not be able to purchase that debt. The result of such an unprecedented downgrade for a state would likely be significantly higher interest rates on its bonds as the pool of investors dries up. However, no state has yet earned so low a credit rating, and all states are still investment-grade borrowers. The investment-grade spread is greater for corporate debt than municipal debt, so there is a greater risk premium for

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94 This is due, in part, to the legal disclosure and publication requirements that exist for states and not corporations. Instead, some corporate data is provided exclusively to ratings agencies and hidden from potential investors as well as other “interested” parties.
commercial paper. In other words, a change in debt rating has a much greater impact on corporate debt than municipal debt. Consequently, a change in a state’s credit rating does not always cause investors to demand a higher or lower yield. In fact, there is not even a clear pattern between state credit ratings and the interest rates paid by those states on their respective debts.

Ratings agencies usually provide rationale for why they are changing a state’s credit rating, consequently exposing part of their algorithms. Since the ratings agencies themselves have cited specific characteristics, like outstanding debt per capita, this must be a significant factor in a state’s debt rating. It is also one example of data which are easily accessible to all investors. With so much information on the financial health of the states so readily available in this digital age, is that plethora of information enough for investors, or at least fiduciaries and brokerages, to perform their own analyses without the additional insight of ratings agencies? This research aims to test precisely that.

Section II of this chapter reviews the applicable empirical literature and section III examines the data used in the analysis. Next, section IV applies the data to an empirical model and discusses the results. The chapter concludes with a summary of its findings and a brief examination of policy implications in section V.

**II: LITERATURE REVIEW**

NRSROs have historically been considered more accurate in their ratings, and held a higher reputation, than ratings agencies in other countries around the globe. Han, Pagano, and Shin (2012) found that Japanese corporate debt consistently carried a lower yield when it had an NRSRO rating as compared to when that debt had a rating from a Japanese domestic ratings agency. However, the financial crisis that began in 2007 represented a turning point. The yield
difference evaporated and bonds in Japan no longer carried different yields based on which ratings agency provided the debt rating. This provides some empirical evidence that the financial crisis diminished the reputations of NRSROs.95

In the wake of the financial crisis, Gordy and Willemann (2012) put Moody’s and S&P’s models for CPDOs96 (Constant Proportion Debt Obligations) to the test and found the models wanting, just as the MBS (Mortgage-Backed Securities) models had proved catastrophically wrong a few years earlier. While the models for CPDOs were terrible predictors during the volatility that existed after the financial crisis, they were also inaccurate even before the crisis. The kurtosis of the ratings agencies’ models was particularly far from reality and failed to account for the complete and total collapse in the value of these financial instruments that would occur with even a relatively small increase in volatility. They also found that the issuer-pays model provides an incentive for ratings agencies to downplay these risks and, consequently, issue higher ratings.97

At least half of the time, Moody’s and S&P give identical notch ratings on debt, although their nomenclature is different. Ratings divergence of more than a single notch is uncommon and Moody’s was, for about a decade, considered the more conservative of the two before the financial crisis.98 While the tightness of the two agencies’ ratings could be due to similar models

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96 CPDOs are incredibly complex financial derivatives which are constantly updated by a manager to try and achieve the yields associated with junk bonds and the safety associated with the highest investment-grade bonds. Volatility in credit spreads can easily and quickly cause CPDOs to fail.
and standards, it could also be a function of competition between the two firms in a market defined by the issuer-pays model. Corporations that are dissatisfied with a debt rating can “shop around” and pay another ratings agency to rate their debt. The ratings agency that gives the higher rating may have created a long-term customer in that issuer.

The shift from investor-paid ratings to issuer-paid ratings was, by many accounts, a dangerous move, the consequences of which played a vital role in the housing boom and bust, and subsequent financial collapse. An obvious conflict of interest is at work in the credit ratings market. While there are many different groups, with divergent interests, who use the credit ratings from the big three ratings agencies, only one of those groups pays the ratings fee: the issuer. Investors are also very interested in the ratings on commercial paper, or any other debt, just as the issuer’s competitors are likewise very interested in the issuer’s credit rating. However, a ratings agency ultimately does not answer to those latter interest groups, but only to the issuer, who, if not pleased with a rating, is free to pursue a rating from a different ratings agency. Issuer-paid ratings, like those used by Moody’s, are much slower to identify default risk than subscriber-paid ratings, like those used by Egan-Jones, a smaller and less well-known ratings agency.

At first glance, the issuer-pays model only demonstrates one facet of the ratings agencies’ conflict of interest. Bolton, Freixas, and Shapiro (2012) find that the current arrangement is a

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threefold problem. First, the ratings agencies will “understate risk to attract business;” second, issuers have the “ability to purchase only the most favorable ratings;” and third, investors can be too trusting, especially during economic booms. There seems to be little accountability in this market, leaving one to wonder: who is watching the watchers?

The apparent abuse of power by ratings agencies is not exclusively a U.S. phenomenon. In India, and other countries in the developing world, local ratings agencies have used the debt ratings of local governments for political purposes while corporations in those countries have received universally high ratings, which, of course, those corporations paid for.

There is further evidence that the ratings agencies participate in a kind of financial racket that borders on extortion. Fulghieri, Strobl, and Xia (2014) consider three important structures of the ratings industry: “the rating agencies' ability to misreport the issuer's credit quality, their ability to issue unsolicited ratings, and their reputational concerns.” They find that ratings agencies issue unsolicited ratings that are artificially low and this provides a strong incentive for firms to pay the ratings agencies for a credit rating. This also allows for the ratings agencies to charge higher fees from those issuers seeking a rating. Because the unsolicited ratings are lower, it gives the appearance to investors that the ratings agency is not issuing universally high ratings, supposedly demonstrating accuracy and impartiality on the part of the ratings agency.

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Flandreau, Gaillard, and Packer (2011) found that the ratings agencies, as was the case in the housing collapse and financial crisis, failed to react to negative data and did not downgrade risky bonds in the 1920s. Once the crisis that began in the Autumn of 1929 was already underway, the ratings agencies began “implementing massive downgrades,” telling investors what they already knew.\textsuperscript{105} The three researchers are dumbfounded at the fact that the very agencies which had such abysmal records in the period before the 1930s were subsequently used by the government as regulatory tools throughout the Great Depression and beyond.

Even though the big three ratings agencies were essentially asleep at the switch on MBS ratings from 2002 to 2007, Alp (2013) found that, overall, firms experienced tighter standards and thus, lower ratings. In the period from 1985 to 2007, corporate credit ratings experienced an interesting change where investment-grade standards grew tighter but speculative-grade standards became looser. After 2002, because of tighter corporate rating standards across the board, firms experienced a series of downgrades, averaging a drop of between 1 and 2 notches during the subsequent 5 years. The time period also presents strong evidence that lower ratings are correlated with higher default rates and higher credit spreads, or risk premiums, providing further evidence that corporate bond ratings do matter to investors, despite a sketchy record of accuracy for the ratings agencies.\textsuperscript{106}

In the post-crisis world, the pendulum that had been pulled to the far side of laxity with MBS ratings, then swung the other way. After the big three ratings agencies were late to downgrade bonds in the leadup to the financial crisis, they were overzealous in downgrading


commercial paper and municipal bonds in the crisis’ wake, including downgrading debt whose underlying asset or underlying revenue had not decreased in value. In short, the ratings agencies saw all debt as riskier, whether or not the numbers justified that assessment. This leads to another issue affecting the quality of credit ratings. Analysts at ratings agencies do not rely solely on objective data, somewhat out of necessity and somewhat out of arbitrary discretion, but rather the analysts can use a significantly large subjective component in their ratings. It has been found that the actual amount of subjectivity can vary widely with different types of commercial paper, sometimes heavily weighting the personal opinions of analysts. Ratings that should be impartial in the face of fear and excitement are instead steered by these emotions.

Certain objective criteria, however, has been demonstrated to be of great importance in rating debt and in determining default rates. State real debt per capita has a marked impact on state credit ratings. In examining data from 1970 to 1995, Johnson (1999) found that the states’ credit quality nearly universally decreased while the states, also nearly universally, saw their real debt per capita balloon tremendously. Even at the end of the 26-year period, however, the ability of states to repay their debts was still very strong and so their credit ratings remained relatively high, although still downgraded. Additionally, the divergent state credit ratings from the major ratings agencies in 1970 coalesced by 1995 so that a state tended to have the same notch rating irrespective of which ratings agency assigned it. The similarity of the ratings for the big three

ratings agencies continues to be reflected in data from the last decade; nearly all states have the same notch rating from each ratings agency.

Similarly, Robbins and Simonsen (2012) investigated whether increasingly high levels of state debt per capita increased borrowing costs for a state. From 2001 to 2006, they determined there was insufficient evidence to support the claim that investors demanded higher interest rates from states with higher per capita debt burdens, even in cases where a state’s debt was expanding very quickly. Investors did not “pressure [states] to reduce debt issuance” even in the face of lower credit ratings. Unlike for corporate debt, investors do not seem to have the same reliance on ratings agencies when purchasing municipal debt.

There have been numerous calls for regulatory reform and criminal disincentives to be put in place in the wake of the financial crisis. The irresponsibility of the big three ratings agencies is fairly well documented. “It could be structured by cows and we would rate it,” as one S&P analyst infamously said in an email exchange, in which another analyst called the whole MBS market a “house of cards.” In the aftermath of the financial crisis and the subsequent Eurozone credit crunch, and with the realization that the big three ratings agencies produced MBS ratings which were at best irresponsible and at worst fraudulent, the European Union took steps to regulate ratings agencies and attempted to provide some level of accountability when

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111 Robbins and Simonsen (2012) did not include a measure for debt servicing as a percent of total state revenue as will be incorporated here. The regression analysis in this chapter can therefore be seen as an extension of their work and will come to a different conclusion as to the effect that higher levels of state debt per capita have on the bond yields demanded by investors.
ratings proved to be inaccurate, although research has provided no evidence that these measures have been successful.\textsuperscript{113}

With renewed attention on ratings agencies’ conflicts of interest, the Securities and Exchange Commission (SEC) investigated alternatives of the issuer-pays model for credit ratings. Among the proposals by the SEC were changes to an investor-pays model and requiring justification from analysts as to why they made subjective decisions to deviate from quantitative models. Jollineau and Tanlu (2014) experimented with these reforms and found that people in the role of credit analysts issued lower credit ratings when either of these reforms was implemented.\textsuperscript{114}

Many researchers have attempted to develop models that can consistently achieve better predictive results than the models used by ratings agencies. Creal, Gramacy, and Tsay (2014) developed a methodology for rating corporate debt via “survival functions” that they created, and which used real-time prices of traded assets. The methodology was then applied to businesses from 2005 to 2011 and it proved to be a better predictor of default than the ratings issued by S&P.\textsuperscript{115}

Despite a highly imperfect track record and an ethically questionable business model, investors still rely on ratings agencies when investing in corporate debt and financial derivatives, presumably due to their complex nature. However, sovereign and municipal debt tend to be simpler than these other financial instruments, so that investors may not need third-party ratings

in order to assess the default risk of state-level municipal debt. The following analysis will examine if credit ratings have a measurable impact on the yield levels required by investors as compensation for default risk on state bonds, or if those yields are simply factors of other readily available datapoints.

**III: DATA**

Panel data with annual observations of all 50 states over the last decade are used to determine if credit ratings matter to investors. The credit ratings span the 10 investment-grade notches and they are simply converted to numerical values for the purposes of the regression analysis. AAA is assigned a value of 10 and each notch lower is assigned a decreased value, in increments of 1, with BBB-, therefore, being assigned a value of 1.

Real debt per capita and real income per capita are used instead of total debt and total income for each state to provide a more comparable dataset, regardless of each state’s population level. In the same way that an individual’s credit score factors in existing debt and income levels, so too do these measures capture a similar picture of financial health at the statewide level. Higher debt levels make both an individual and a whole state less likely to be able to repay those debts while more income has the opposite effect for both an individual and a state. It is worth noting that the data is in real terms, having been adjusted for inflation. This removes the growth in nominal terms that inflation would cause over the decade. While debt per capita has already been shown to have a significant impact on state debt ratings and possibly on bond yields, it is anticipated that income per capita will weigh heavily on investors’ yield demands.

Investors’ tolerance of risk and the yields which investors demand are partly a function of alternative investments. During a recession, when there are few options to earn a high rate of
return, investors tend to accept lower yields on bonds. The opposite is true in periods of rapid economic expansion. As a kind of baseline for interest rates in general, but also on government debt specifically, the rate on the 10-year Treasury note is also included, as it is an important benchmark. This interest rate captures several key factors. First, it is tax-exempt at the state and local level, so it provides a tax incentive like municipal bonds, although the tax-exemptions are different. Second, some of the flight-to-quality and flight-to-security phenomena that cause lower Treasury yields also cause lower yields on municipal bonds since they are generally considered safer than commercial paper, although not as safe as Treasuries.

The ratio of debt payments to total state revenue is also included to help capture how financially constrained a state is, in terms of repaying its debt. A higher ratio indicates that more of a state’s revenue is devoted to just financing existing debt. During a recession, tax revenue tends to decline but most existing debt obligations do not, and future debt obligations tend to increase in the short run. This causes significant strain on a state budget if debt payments already amount to a relatively large portion of the state’s total revenue. The ratio of debt payments to state revenue is analogous to the utilization ratio of an individual’s debt. If a person has “maxed out” all his or her credit cards, or perhaps has drawn the limit on a home line of credit, then his or her utilization ratio will be very high, and such a person poses a relatively high default risk.

It is surprisingly difficult to attain an accurate measure for the average interest rates on state bonds over the course of a calendar or fiscal year. One complication is the blending of general obligation bonds and revenue bonds.116 The former are backed by the full faith and credit

116 Serial bonds are a subset of revenue bonds which have staggered maturity dates. They are commonly sold to finance infrastructure or other projects that will have a relatively consistent income stream over the following two or three decades. Serial bonds are considered safer than other revenue bonds and tend not to command the same risk premium.
of the issuing state while the latter are backed by a specific revenue source, such as tolls on a particular highway. If the revenue from that source falls short, the bonds may fail, and so they are riskier, and investors demand a risk premium. The state credit ratings are assessments of a state’s general ability to pay back debt and so they are based on both types of bond issuances. However, the data that are currently readily available do not separate out the two types of bonds from the statewide totals, making it especially difficult to compare the average interest rate paid by one state versus another. While general obligation bonds and revenue bonds are very similar, comparing their interest rates is somewhat a comparison of apples and oranges. An oddity of the dataset is that it is unknown precisely what portion of each state’s debt is general obligation bonds or revenue bonds and, therefore, it is unclear how much of the interest paid by a state is due to the issuance of riskier or safer bonds. The divergence between the two is still small relative to the difference between municipal and commercial paper; even most revenue bonds are considered safer than typical high-grade commercial paper.

The dependent variable in this analysis is the effective interest rate paid by a state for the calendar year to make coupon payments on all its currently outstanding debt. This is calculated by taking all debt servicing costs for the year and dividing by the total outstanding debt. It can also be thought of as a weighted average for the interest paid on all bonds that year, although it was not explicitly calculated as such.

The idea that credit ratings are the primary impetus behind state bond yields seems dubious as soon as one sees the relative distributions of the two variables. Of the 500 credit ratings assigned during the decade, 87.8% of them received the top three credit ratings (AA or

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117 The nationwide average of current state-level municipal debt outstanding is about one-third general obligation bonds and two-thirds revenue bonds.
better) and 94.8% of them received the top four credit ratings (AA- or better). This would imply that the vast majority of states were paying very low interest rates, which was not the case. In fact, the interest rate paid by the states has a left-tailed distribution with most of the observations being twice as far from the minimum rate as from the maximum rate. The distributions for all the variables except the 10-year Treasury are shown in Figures 3.1–3.5. Because the Treasury rate does not vary between states each year, it simply has a discrete uniform distribution, so the fluctuations in the rate on 10-year Treasury are shown against time in Figure 3.6. Table 3.3 contains the descriptive statistics of the dataset.

![Effective Interest Rate on State Bonds](image.png)

*Figure 3.1. Effective interest rate on state bonds.*
Figure 3.2. State credit ratings.

Figure 3.3. State debt per capita.
**Figure 3.4.** State income per capita.

**Figure 3.5.** State debt financing costs to revenue.
IV: EMPIRICAL MODEL AND RESULTS

The following empirical model is proposed:

\[ \text{Int rate}_{it} = \beta_0 + \beta_1 \text{Credit rating}_{it} + \beta_2 \text{Debt/rev}_{it} + \beta_3 \text{Debt/cap}_{it} + \beta_4 \text{Inc/cap}_{it} + \beta_5 10\text{yr treas}_{t} + \epsilon_{it} \]

The coefficient on credit ratings is of particular interest. If the ratings by S&P on states’ credit worthiness are important to investors, then \( \beta_1 \) should be a non-zero number, likely negative, and it should have statistical significance. This would be evidence for the inverse relationship between credit ratings and bond yields. If, however, the coefficient is near zero or it is not statistically significant, then state credit ratings likely have a minimal effect on investors’ demands for specific yield levels. Along with credit ratings, this model attempts to account for the measures of a state’s financial health that are accessible to investors and which those
Table 3.3

**Descriptive Statistics**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Mean</th>
<th>Std. dev.</th>
<th>Median</th>
<th>Min.</th>
<th>Max.</th>
<th>Obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int rate$_{it}$</td>
<td>Ratio of annual coupon payments made to outstanding debt</td>
<td>0.041</td>
<td>0.0079</td>
<td>0.0421</td>
<td>0.0103</td>
<td>0.0618</td>
<td>500</td>
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<tr>
<td>Credit rating$_{it}$</td>
<td>Investment rating ranked from 1 (BBB-) to 10 (AAA)</td>
<td>8.608</td>
<td>1.3908</td>
<td>9</td>
<td>1</td>
<td>10</td>
<td>500</td>
</tr>
<tr>
<td>Debt/rev$_{it}$</td>
<td>Annual ratio of debt payments to state revenue</td>
<td>0.0775</td>
<td>0.023</td>
<td>0.0772</td>
<td>0.02</td>
<td>0.153</td>
<td>500</td>
</tr>
<tr>
<td>Debt/cap$_{it}$</td>
<td>Real debt per capita</td>
<td>8155</td>
<td>2671</td>
<td>7741</td>
<td>3272</td>
<td>17973</td>
<td>500</td>
</tr>
<tr>
<td>Inc/capita$_{it}$</td>
<td>Real annual income per capita</td>
<td>45544</td>
<td>7832</td>
<td>44791</td>
<td>30689</td>
<td>76456</td>
<td>500</td>
</tr>
<tr>
<td>10yr treas$_{t}$</td>
<td>Annual average interest rate on 10-year Treasury note</td>
<td>2.4048</td>
<td>0.437</td>
<td>2.3398</td>
<td>1.8034</td>
<td>3.2151</td>
<td>500</td>
</tr>
</tbody>
</table>
investors likely use to assess the default risk of state-level municipal bonds. Like any model, however, it is imperfect and leaves all other factors to be captured by the error term.

When each state compiles and authorizes an annual budget, it does so, in part, by trying to predict future events that will occur during the year. Weather events would be just one illustration of the affairs legislators must try to predict because those events will affect the state’s expenses and revenues. Florida must allocate funds for hurricane relief and cleanup based on the likelihood of a strong hurricane season next year. Likewise, hurricanes mean reduced revenue from the tourism industry. More northerly states try to predict seasonal snowfalls in order to allocate sufficient funds for snow removal each winter. Weather and other unforeseeable events will have an impact on state expenses and revenues and, therefore, on the amount of debt states must issue each year.

As long as the estimates used by states have the same mean as the actual events in the long run, the impact on state budgets should be idiosyncratic and, therefore, these kinds of events properly belong in the error term. Only if a state chronically overestimates or underestimates the occurrence or severity of these events would their costs, or benefits, need to be instrumented.

Similarly, a state essentially faces a random draw of banks and brokerages that have cash available on the exact day the state sells its bonds at auction. Since every purchaser can have a different risk tolerance based upon their intended clientele in the secondary bond market, a state may offer a higher or lower rate based upon who is available to buy the bonds. An auction might also happen to be held on a day when financial markets have more, or less, liquidity than normal. With many bond offerings over the course of a year, each state is likely to have a very broad exposure to buyers and conditions in the municipal bond market, but it is possible to have a year
wherein daily market conditions conspired to slightly alter the borrowing costs for one state or another. In the long run, however, each state can be assumed to face the same market conditions.

Conversely, there are a plethora of economic policies, particular to each individual state, that will affect population and income growth, or politicians’ willingness to borrow from the public purse. These factors can be correlated with the explanatory variables and, given a time frame of only ten years, have likely changed little and had a constant effect. This lends credence to the use of a FE model which will remove these effects on the explanatory variables.\textsuperscript{118} Finally, there is reason to believe that the variance of the error terms may depend in part on the explanatory variables. States that are already heavily burdened with debt, for instance, are in poor financial shape to weather some kind of fiscal shock, thereby exacerbating the effect on bond yields. The regression, therefore, utilizes HAC-robust standard errors.

The state credit rating from S&P not only has a small coefficient but also is not statistically significant. This would indicate that investors do not rely on these state credit ratings when evaluating the yield levels necessary to compensate for the risk of a state’s default. The other factors are all statistically significant, indicating that those data points are likely more closely watched by investors.

The ratio of debt service costs to total revenue is the largest coefficient. It indicates that for each additional percent of a state’s revenue that must be devoted to paying outstanding debt,

\textsuperscript{118} Econometrician Jeffery Woolridge offers the following analysis which is applicable due to the nature of the dataset. “The key issue that determines whether we use FE or RE is whether we can plausibly assume $a_i$ is uncorrelated with all $x_{ij}$. Nevertheless, in some applications of panel data methods, we cannot treat our sample as a random sample from a large population, especially when the unit of observation is a large geographic unit (say, states or provinces). Then, it often makes sense to think of each $a_i$ as a separate intercept to estimate for each cross-sectional unit. … Fortunately, whether or not we engage in the philosophical debate about the nature of $a_i$, FE is almost always much more convincing than RE for policy analysis using aggregated data.” Jeffery Woolridge, \textit{Introductory Econometrics}, 3rd ed. (Mason, OH: South-Western, Cengage Learning, 2006), 498.
investors demand a yield that is 38 basis points higher. This is somewhat equivalent to when an individual pays a relatively high portion of his or her income in finance charges on large credit card balances. If that individual obtains an additional credit card, the bank issuing that card will charge a higher interest rate because that individual is a greater default risk. So too, when a state must allocate an additional 1% of its revenue to paying interest on existing bonds, new bonds will sell with a yield higher by 38 basis points.

Table 3.4

*Estimation Results [FE]*

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.01732***</td>
<td>(0.00305)</td>
</tr>
<tr>
<td>Credit rating&lt;sub&gt;i&lt;/sub&gt;</td>
<td>-0.00011</td>
<td>(0.00016)</td>
</tr>
<tr>
<td>Debt/rev&lt;sub&gt;i&lt;/sub&gt;</td>
<td>0.38346***</td>
<td>(0.01001)</td>
</tr>
<tr>
<td>Debt/cap&lt;sub&gt;i&lt;/sub&gt; (thousands of dollars)</td>
<td>0.37866***</td>
<td>(0.01570)</td>
</tr>
<tr>
<td>Inc/cap&lt;sub&gt;i&lt;/sub&gt; (thousands of dollars)</td>
<td>-0.05028***</td>
<td>(0.00305)</td>
</tr>
<tr>
<td>10yr treas&lt;sub&gt;i&lt;/sub&gt;</td>
<td>0.03958*</td>
<td>(0.02209)</td>
</tr>
</tbody>
</table>

Real debt per capita, while highly significant, has nearly the same impact for every additional $1,000 of debt per person that a state accumulates. Every additional $1,000 of debt per person increases the interest rates on new state debt by 38 basis points. However, the same increase in income on a per capita basis has a much less pronounced effect. An additional $1,000
of income per person decreases the yield demanded from investors by just 5 basis points. This is intuitive from the standpoint of the increased income belonging primarily to state residents with only a small portion of that increased income ultimately going to the state in the form of tax revenue.

Comparing the marginal effects of changes in state debt and state income might be better illustrated in the following example. If a state extracts 10% of its residents’ incomes from all state taxes, then an increase of $10,000 income per capita would yield an increase of $1,000 income for the state, on a per capita basis. The effect on interest rates would be a decline of 50 basis points. From this perspective, equivalent changes to state income per capita can have a greater effect than changes to state debt per capita, depending on the effective state tax rate.

The 10-year T-note is statistically significant at the 10% level. A 100-basis point increase in this security causes state bonds to rise by just 4 basis points. This disparity can be somewhat explained by the differences between state and federal bonds. First, while they are both tax deductible, their deductibility is not equivalent. U.S. Treasuries are not subject to state and local taxes, but they are subject to Federal Income Tax. State municipal bonds are the opposite – they are not subject to federal tax but are sometimes subject to state and local taxes. Depending on each individual investor’s situation, the tax incentives can have a deciding impact on which type of government bond to purchase. Thus, these two types of bonds have structural disparities and should not be expected to have a 1:1 relationship. Additionally, although they both capture a measure of risk aversion, the 10-year is seen as an even safer investment than municipal bonds, even if the municipal bond is AAA. Lastly, there is also the possibility that the small coefficient
on the 10-year Treasury is the result of misspecification, but structural improvements on the model are left to future research.

Before closing this section, a RE estimator is also used on the same data. The results from both the RE and FE estimators are shown in Table 3.5.

Table 3.5

*RE and FE Estimation Results*

<table>
<thead>
<tr>
<th></th>
<th>[FE]</th>
<th>[RE]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.01732***</td>
<td>0.01328***</td>
</tr>
<tr>
<td></td>
<td>(0.00305)</td>
<td>(0.00294)</td>
</tr>
<tr>
<td>Credit rating_it</td>
<td>-0.00011</td>
<td>0.00004</td>
</tr>
<tr>
<td></td>
<td>(0.00016)</td>
<td>(0.00016)</td>
</tr>
<tr>
<td>Debt/rev_it</td>
<td>0.38346***</td>
<td>0.39070***</td>
</tr>
<tr>
<td></td>
<td>(0.01001)</td>
<td>(0.00980)</td>
</tr>
<tr>
<td>Debt/cap_it_it</td>
<td>0.37866***</td>
<td>0.34870***</td>
</tr>
<tr>
<td>(thousands of dollars)</td>
<td>(0.01570)</td>
<td>(.01432)</td>
</tr>
<tr>
<td>Inc/cap_it_it</td>
<td>-0.05028***</td>
<td>-0.05272***</td>
</tr>
<tr>
<td>(thousands of dollars)</td>
<td>(0.00305)</td>
<td>(0.00302)</td>
</tr>
<tr>
<td>10yr treas_it</td>
<td>0.03958*</td>
<td>0.05984***</td>
</tr>
<tr>
<td></td>
<td>(0.02209)</td>
<td>(0.02202)</td>
</tr>
</tbody>
</table>

The 10-year Treasury is highly significant with RE, but also noteworthy is that the coefficients for FE and RE are very similar. This is because the λ used for quasi-demeaning the data in RE is 0.882589 in this case, and when λ=0, RE~OLS and when λ=1, RE~FE. In this case, nearly 90% of the mean is subtracted from each observation, so we would expect the RE and FE to be nearly equivalent.
The RE estimator yielded lower standard errors, but the coefficients are more likely to be biased, illustrating the tradeoff between efficiency and consistency in the two estimators. A Hausman test indicates that the RE model is indeed not consistent. However, the results in the RE model help demonstrate that credit ratings have no effect on interest rates because unlike the FE model which demeans any time invariant credit ratings to zero, the RE model will still estimate these variables.

V: SUMMARY AND IMPLICATIONS

Investors do not seem to change their demand on state bond yields with changes in state credit ratings. Instead, readily available data, which give a rough picture of a state’s financial health, seem to be the primary points of concern for investors when evaluating default risk. State income and state debt levels play key roles in determining default risk, just as personal income and personal debt levels are very good proxies for evaluating an individual’s default risk. Lower per capita debt levels mean each resident is better able to pay off debt in the future and wealthier residents are even more equipped to shoulder the tax burden necessary to pay off that same debt. Likewise, the portion of a state’s revenue spent on financing existing debt is also an important factor. These factors would likely prove even more important for revenue bonds specifically, since many of a state’s revenue generating assets tend to produce less revenue during recessions, at which point the bonds may fail. When the data distinguishing general obligation bonds from revenue bonds becomes available, future research could make this analysis.

While investors may not pay much attention to credit ratings, institutions like the Federal Reserve do, at least now. The Fed announced in April 2020 that it would begin buying municipal debt, provided the issuer met a minimal credit rating threshold. Since Illinois was the only state
that did not meet this requirement, an exception had to be made for the Prairie State so that it too will have access to the new program. However, Illinois still will not receive a lower rate. It will have to borrow at above-benchmark rates after first paying an origination fee.

One interesting question to which the data does not yet permit an answer is: what would the effect be if a ratings agency downgraded a state below investment grade? Given the regression results, it seems that this would not weigh heavily on investors. However, this move would have much greater consequences than a downgrade from BBB to BBB- for reasons outlined in the introduction. All movements of one notch within the investment-grade bracket are seen as roughly equal in the eyes of investors so that a downgrade from AA to AA- is a qualitatively equal reduction to a downgrade from A+ to A. Upgrades are viewed in the same light. A movement from BBB- to BB+, however, is considered a much greater downgrade as it crosses a more significant threshold. Other movements in the sub-investment ratings may also be seen as more significant, even though it is still a difference of a single notch, such as a downgrade from B- (lower quality) to CCC+ (poor quality). Should a state suffer the unfortunate consequences of a downgrade into sub-investment territory, it would provide insight as to the ramifications, if any, in the eyes of investors, further testing the hypothesis that state credit ratings do not matter to investors. Moreover, should a state ever suffer a widespread default, this would also provide a myriad of data for researchers amidst the terrible fallout such an event would likely bring. This ghastly prospect could be more likely than previously thought after the U.S. Senate Majority Leader announced in early 2020 that he favored states declaring bankruptcy over federal bailouts.
Finally, an adjustment of the data could be made to observe not only what portion of a state’s revenue is spent on debt financing, but what portion of the state’s total budget is spent on debt financing as well. The difference could help highlight states where coupon payments are being made not with revenue, but with new debt issuances that are in addition to bond sales used to cover the state’s budget deficit. This represents a pattern of quickly escalating debt levels, similar to what has been seen in recent years in at least one state. This seems that it could be a significant factor in determining the interest rate on new bonds, but it is left to future research.

States that wish to pay lower interest rates should focus on paying down outstanding debt, which will also decrease per capita debt levels. Attracting more residents to a state through lower tax burdens would also decrease per capita debt levels, even if the total state debt does not decline. Changes in the structure of a state’s tax code can also enhance revenue generation while increasing long-run economic growth. Higher growth means future higher per capita income. States like Illinois and New Jersey have not followed this formula and, not surprisingly, their bond yields are among the highest in the nation. They are good examples of states with mounting debt obligations, driven in large part by unfunded pension liabilities, and these states, consequently, pay higher interest rates on their bonds. However, other states that are AAA rated, like Illinois-neighboring Indiana, also have higher yields on their bonds, once again demonstrating that investors care more about a few key fundamental figures than the output of algorithms from the ratings agencies.
CHAPTER 4

Just as the federal deficit is fueled by the interest payments on the federal debt, so are state deficits made worse by state debt. Deficits are harmful, both at the federal and state levels, since they increase interest rates, either in the economy as a whole or for municipal debt. States with higher debts and deficits must eventually enact higher taxes to fund those financial deficiencies, and those states can expect to see residents flee from the higher taxes, eroding the tax base and further worsening the fiscal condition of a state. States with poor financial conditions are punished by investors when those investors demand higher yields at debt auctions. This exacerbates existing deficits by increasing financing costs.

State governments would likely benefit by transitioning away from income and property taxes and towards consumption taxes, overall lower tax burdens, and balanced budgets. Fiscal responsibility at the state level leads to long-term financial stability, while fiscal responsibility at the federal level leads to higher long-term growth rates. These are both laudable, and achievable, goals. To achieve these goals, governments should focus on spending reductions, as opposed to tax increases, since people have shown a preference for lower taxes.

Each of these three investigations have, in their own way, echoed the old aphorism: “there is no such thing as a free lunch.” Whether it is loanable funds, tax revenue, municipal debt, or anything else with a price, scarcity is inescapable. Even if this work fails to achieve anything other than to impress upon the reader the indisputable and ubiquitous nature of scarcity, it still will have been worth the effort it took to compose it.
WORKS CONSULTED


Board of Governors of the Federal Reserve System (US), 3-Month Treasury Bill: Secondary Market Rate [TB3MS], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/TB3MS.
Board of Governors of the Federal Reserve System (US), 3-Year Treasury Constant Maturity Rate [DGS3], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/DGS3.

Board of Governors of the Federal Reserve System (US), 10-Year Treasury Constant Maturity Rate [GS10], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/GS10.

Board of Governors of the Federal Reserve System (US), Total Savings Deposits at all Depository Institutions [SAVINGS], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/SAVINGS.


Federal Reserve Bank of St. Louis and U.S. Office of Management and Budget, Federal Surplus or Deficit [-] as Percent of Gross Domestic Product [FYFSGDA188S], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/FYFSGDA188S.


International Monetary Fund. Household debt, all instruments: percent of GDP. https://www.imf.org/external/datamapper/HH_ALL_GDD/USA.


U.S. Bureau of Economic Analysis, Compensation of employees: Wages and salaries: Private industries [A132RC1A027NBEA], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/A132RC1A027NBEA.


U.S. Bureau of Economic Analysis, Federal government current expenditures: Interest payments [A091RC1Q027SBEA], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/A091RC1Q027SBEA.

U.S. Bureau of Economic Analysis, Gross Private Saving [GPSAVE], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/GPSAVE.


U.S. Bureau of Economic Analysis, Real net private domestic investment [A557RX1A020NBEA], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/A557RX1A020NBEA.


