FRASER INSTITUTE

2022

Population and the Fiscal Outcomes of Subnational Jurisdictions

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2022 ▪ Fraser Institute

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by Russell S. Sobel

Contents

Executive Summary

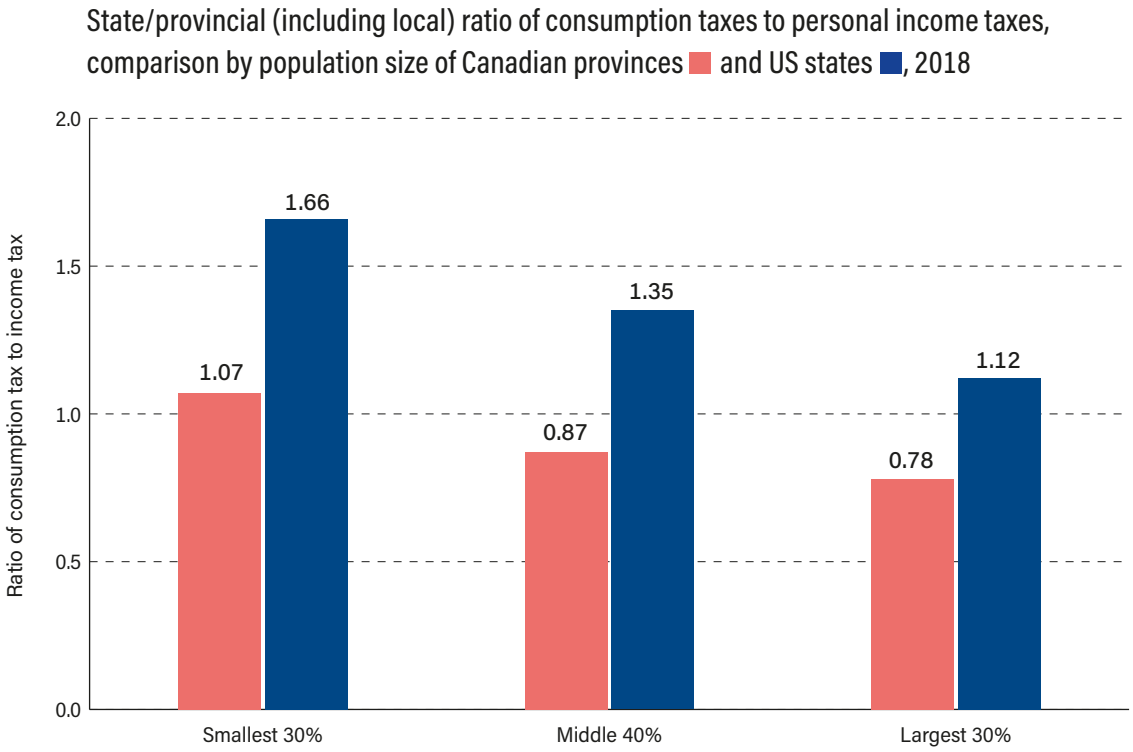
The largest Canadian provinces and US states are roughly 80 times bigger than their least populous counterparts. Using almost three decades of data, this study examines the data from these subnational governments to see whether these differences in population are related to the fiscal outcomes like the size of government, government debt and annual surpluses and deficits, reliance on consumption rather than income taxes, and the progressivity of personal income-tax system.

Size may have a complex relationship with fiscal outcomes and we begin by examining the literature discussing how the size of a government's jurisdiction may affect aspects related to fiscal performance, particularly those that could affect taxes or spending (including regulatory spending). The effects of size may filter through either purely as a result of "public finance" (efficiency) reasons, or through the effects of size on "public choice" factors such as democratic outcomes and representation. Another factor that may affect the results of the empirical analysis is the presence of institutional requirements for a balanced budget in these subnational governments. While the Canadian provinces do not have any such restrictions, 49 of the 50 US states are generally considered to have some form of rule or constraint.

There does seem to be a nonlinear U-shaped relationship between the population size of states and provinces and the size of government as a share of the economy. While government size initially falls with population, beyond some point, it begins to rise again. This point is estimated to be approximately 9.6 million population for Canadian provinces, and 21 million population for US states. Thus, large subnational jurisdictions such as Ontario and California are beyond the size that minimizes government spending as a share of the economy. This relationship holds for both expenditure and revenue and including and excluding local government expenditures.

There is no consistent relationship between the size of states and provinces and their reliance on debt, or their annual budget imbalances (surpluses and deficits) over the full sample. The US states do have significantly less debt, and run smaller deficits, than the Canadian provinces as should be expected considering the balanced budget constraints most US states face. The largest Canadian provinces, however, have slightly higher average surplus levels in the more recent years.

Perhaps the most interesting finding is that larger states and provinces tend to rely relatively less heavily on consumption taxes and more heavily on income taxes, when compared to smaller states and provinces. For each additional one million population, reliance upon consumption taxes falls by about 2 to 3 percentage points relative to reliance on personal income taxes, with the effect being larger when data for local governments is included. Canadian provinces do appear to rely relatively less heavily on consumption taxes (and relatively more heavily on income taxes) than the US states, especially once local data is included.



There is no strong relationship between the progressivity of personal income tax and size of population in the full sample, although the largest Canadian provinces seem to have slightly higher average levels of personal income tax progressivity compared with smaller Canadian provinces in more recent data. The average personal income tax progressivity in the largest US states is roughly similar to the largest Canadian provinces. Smaller and middle-sized US states, however, appear to have more progressive personal income taxes than smaller and middle-sized Canadian provinces.

1 Introduction

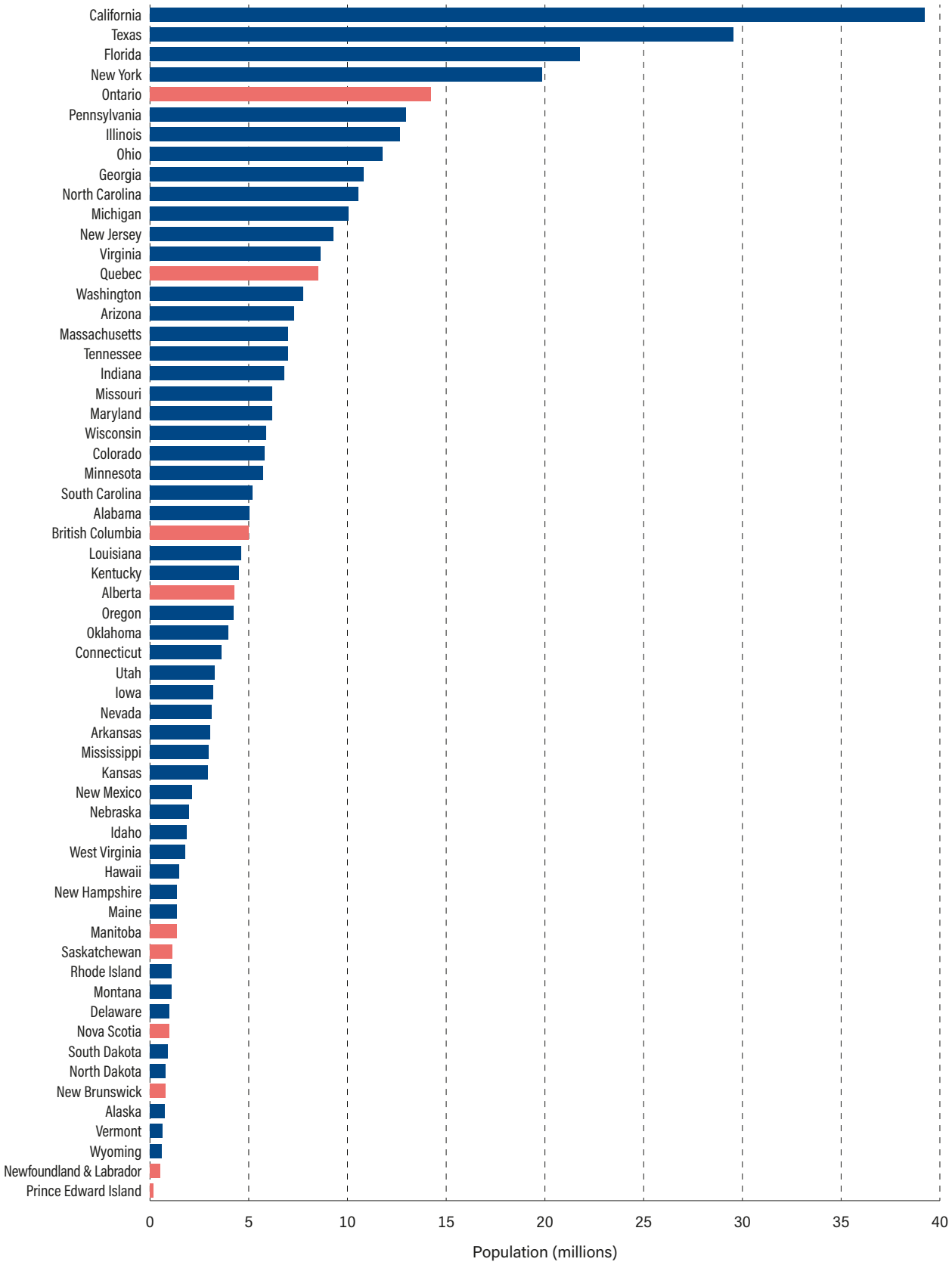
How does the fiscal performance of Canadian provinces and US states correlate with the population size of these subnational jurisdictions? Are some states or provinces simply too large, or too small, to have good fiscal outcomes? This study discusses the reasons that we might expect there to be size effects and provides evidence by examining a variety of measures of fiscal performance.

The rather large extent to which population differs across both Canadian provinces and US states is shown in figure 1. The most populous Canadian province, Ontario, is roughly two-thirds larger than the second largest (Quebec), roughly three times larger than provinces such as British Columbia or Alberta, and over 90 times larger than the least populous province of Prince Edward Island. The most populous US state, California, is roughly one-third larger than the second largest (Texas), approximately three times larger than states such as Pennsylvania and Illinois, and almost 70 times larger than the least populous state of Wyoming. Interestingly, when we view the combined group, the Canadian provinces are fairly evenly scattered among the US states. Ontario is the fifth largest among the combined grouping, while Quebec is fourteenth.

The largest states and provinces are indeed large by global standards. If they were independent countries, for example, Ontario would rank among the top 75, and California among the top 40, most populous countries in the world. Even middle-sized Alberta and Oregon are similar in size to medium-sized countries such as Panama, Kuwait, and Croatia.

Do these population differences predictably influence the fiscal outcomes of the subnational governments in these jurisdictions? To answer this question, this study examines metrics such as government spending as a share of the economy, the mix of consumption compared to income taxes, the progressivity of the tax system, and the level of debt. Prior to an examination of this fiscal data, we begin with a review of the literature that can provide insights into the fiscal effects of jurisdiction size.

Figure 1: Population (millions) of Canadian provinces and US states, 2021



Sources: Statistics Canada, 2022; US Census Bureau, 2021b.

2 Literature Review

We begin by examining the literature about how the size of a government's jurisdiction may affect aspects related to fiscal performance, particularly those that could affect taxes or spending (including regulatory spending). The effects of size may filter through either purely as a result of "public finance" (efficiency) reasons, or through the effects of size on "public choice" factors such as democratic outcomes and representation. This section categorizes and reviews these strands of the literature.

It is worth mentioning that size may have a complex relationship with fiscal outcomes. While it could be that bigger is always better (or worse), it is also possible for a more U-shaped pattern to be present, in which there may be some "optimal" size somewhere in the middle that is best. For example, when examining city population, Frick and Rodriguez-Pose (2018) conclude that cities of up to three million are most conducive to economic growth. Most closely related, Sobel (2021) finds a population of around 9.5 million people for subnational jurisdictions maximizes overall economic freedom.

2a Economies of scale

The literature on public finance often approaches the effects of jurisdiction size in terms of the economies of scale in government provision of goods and services (Tiebout, 1960; Alesina and Spolaore, 1997; Southwick, 2012). Economies of scale exist when per-unit costs of production decline with size. In standard microeconomic production theory, economies of scale usually occur initially, begin to fade, and eventually reverse with costs increasing again at even larger sizes (turning into diseconomies of scale). This implies per-unit production costs can generally be characterized with a U-shaped relationship with size.

To the extent this also applies to government production, there could be some jurisdiction size that minimizes the average "per unit" cost of government, which should be reflected in lower expenditures (and thus taxes) as a share of the economy. The extent of these economies of scale can vary across government policies and programs.[1] The empirical literature examining actual economies of scale has found that they tend to be exhausted quickly however (Southwick, 2012; Frick and Rodriguez-Pose, 2018; Hirsch, 1968; Bish, 1971). These effects could cause taxes as a share of the economy to be predictably larger or smaller depending on population size; however the theory gives us no clear reason to expect size to influence the incentive to debt finance, use consumption rather than income taxes, or have greater tax progressivity.

1. This has implications for which level of government (federal, state/province, or local) should optimally undertake each activity as programs with significant economies of scale should be undertaken by the federal government, while those with significant diseconomies of scale should be done locally. While the public finance literature has often employed the economies-of-scale logic from private firm production to government spending, to the extent that states and provinces produce different mixes of goods and services this can limit the usefulness of the direct comparison.

2b Buchanan's theory of clubs

The traditional economics literature classifies goods as "public goods" when they are both non-excludable and joint-in-consumption (or "non-rival in consumption"). In contrast to private goods for which one person's consumption detracts from the availability of the good for others, for public goods this is not the case. A radio broadcast is an example of a good that is joint-in-consumption because multiple listeners can simultaneously listen to the same signal. Non-excludability means it is difficult (or prohibitively costly) to exclude non-paying customers from enjoying the good, making it difficult for private firms to generate enough revenue to efficiently produce these goods at a profit, providing the traditional economic justification for government provision of these goods and services through taxation. Goods that are joint-in-consumption but from which non-paying customers can be excluded are known as collective-consumption goods, and they can be provided efficiently through private-sector clubs, the theory behind which was outlined in Buchanan's "theory of clubs" article (1965).

In reality, governments provide many goods that are private in nature, and there are also cases of successful private provision of public goods. The relevant factor for our analysis is that the consumption of different goods and services actually provided by state and provincial governments is collective in nature to different degrees. Something like a road or public park, for example, while joint-in-consumption up to some point, will eventually be subject to congestion, as would a court system or the provision of law enforcement. The rate at which a road becomes congested, for example, depends both on the size of the road (amount provided) as well as the number of drivers (users). In Buchanan's theory, there are two conflicting forces at work. As the sharing group increases, the marginal congestion costs increase, lowering the value of the good to each user. On the other hand, because the good is jointly consumed, the cost of its provision per user declines as more users are added. There is thus an optimal size of the road or park, and an optimal number of users to share it, that are jointly determined (at the point at which the marginal costs of congestion rise to equal the marginal reduction in the cost per person). Sizes higher or lower than this are inefficient.

The implication is that to the extent that the goods and services provided by state and provincial governments are collective-consumption in nature, with minimal congestion effects, the large fixed cost of providing them will create a situation in which the cost per user declines as jurisdiction size grows because a given amount of the good provided can simply be shared by a larger group. This implies that government spending (and taxes to fund it) as a share of the economy may decline with the size of the jurisdiction for state and provincial activities that have these public-good characteristics. To the extent that the activities of these governments are instead rival-in-consumption (for example, transfer payments or unemployment benefits), or have significant congestion effects, this will not be the case. For these items, total spending will rise with the size of the jurisdiction and the rate at which it rises relative to the size of the group will determine whether government's share of the economy rises or falls. Thus, if all governments provided were pure public goods, one might expect spending and taxes per person to decrease with jurisdiction size. But in reality, given that few of the true activities of state and provincial governments

meet the criterion for public goods, the prediction is less clear.[2] Like the previous factor, however, the theory offers little prediction for any relationship with the incentive to use debt finance, use consumption rather than income taxes, or have greater tax progressivity.

2c Expressive voting and the charity of the uncharitable

The literature on public choice also suggests jurisdiction size may have significant impacts on democratic political outcomes, which would affect a broader range of fiscal outcomes. Of relevance is the work of Brennan and Lomasky (1993) on expressive voting, and its further refinement by Tullock (1971) on the "charity of the uncharitable". In this theory, as the size of a jurisdiction grows in terms of the number of voters, the probability of casting a decisive vote in elections falls. Tullock explains that for each voter the expected personal cost associated with voting in favour of a new social welfare program that requires more taxes and spending is the probability their vote is decisive times the expected tax cost per person. As jurisdiction size grows, this probability falls, and thus each individual voter faces less personal cost in voting for higher levels of government spending on collective consumption goods and transfer spending.

A perhaps simpler way of looking at this is that, if one's vote is not going to be decisive, then the tax cost is the same whether they vote in favour or against a proposal. It either happens or does not happen without their vote. The only thing the person's vote changes is whether they gain personal satisfaction from the vote as an act of expression of their personal values. Thus, voting in favour of a "feel good" social program may make one more mentally happy than voting against it, and voting in favour carries no additional personal cost as the vote will not change the outcome.[3] Tullock's idea has been supported in the empirical literature for the US states by Wagner and Sobel (2004), who find rising social welfare spending with greater voting populations.

This theory argues that more highly populated jurisdictions should display higher levels of spending and taxes, especially on transfer programs. It also seems to clearly imply that the incentive to support programs such as higher tax progressivity and a greater reliance on income (relative to consumption) taxes that have apparent social goals like income redistribution should grow with the size of the population.[4] The theory, however, seems to offer no clear implications for the incentive to use debt finance.

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2. The results of Holcombe and Sobel (1995), for example, suggest that perhaps 77% or more of what is produced at the US state level would be classified as private goods (not collective-consumption in nature).

3. Caplan's (2007) theory regarding voter irrationality is also related. According to Caplan (2007), some personal beliefs (such as those related to immigration, minimum wages, religion, and so on) are more emotionally appealing than others, which creates a situation in which holding false beliefs generates almost no negative personal cost to individuals whose votes are not likely to be decisive. Being wrong about gravity has specific and highly negative personal consequences; being wrong about the minimum wage generally does not. This effect should grow with reductions in the likelihood of being a decisive voter that accompany larger jurisdiction sizes.

4. Generally, consumption spending as a share of income falls with income, thus income taxes tend to be more progressive both because they tax income rather than consumption, as well as the fact that the tax rates of income taxes can be designed to be progressive while consumption taxes (such as retail sales taxes) are generally flat rates that apply to all individuals.

2d Fractionalization, federalism, and political outcomes

Larger jurisdiction sizes should generally lead to greater degrees of heterogeneity or "fractionalization" among the population as well. The literature on fractionalization concludes that greater heterogeneity among individuals in a political jurisdiction leads to greater social and political conflict and greater disagreements over the provision of government goods and services, and could therefore lead to lower levels of government spending on welfare, education, infrastructure, and other public goods (Alesina and Spolaore, 1997; Alesina and La Ferrara, 2005; Easterly and Levine, 1997). On the other hand, fractionalization and heterogeneity may lead to more rent seeking, corruption, expropriation, and government spending to placate all groups as well as weaker institutions securing property rights (Annett, 2001; Easterly and Levine, 1997; Glaeser and Saks, 2004). Thus, there are effects of the increased heterogeneity of the population with larger jurisdiction sizes, although the direction of the impact is less clear with some theories predicting it lowers spending while others predicting it increases it (Schneider, 1987).

States and localities also exist within a federal system in which the national government provides intergovernmental grants and transfers. To the extent that larger governments have different degrees of political power than smaller ones, this could affect the degree to which their expenditures are larger because they are supported by federal transfers. This relative distribution of political power by state size could also differ between Canada and the United States as a result of the differences in the political institutions. There are also many other reasons or factors we may expect to differ as applied to Canada and the United States. Thus, in all models dummy (indicator) variables will be included that allow for a fixed-effect to net out any such differences. Data and analysis will also examine separate subsamples for Canadian provinces and US states to ensure the results are robust to any possible differences.

2e Population density

The issue of population density is worthy of further discussion. While the theoretical literature postulates that the harmful effects upon fellow citizens of the production or consumption of a good (negative externalities) may grow with density, and thus also the size of government regulation, taxation, and spending to manage them, the empirical literature has found that offsetting productivity gains and agglomeration economies make this relationship very unclear (Turok and McGranahan, 2013). Thus, it is worthwhile to incorporate a variable controlling for the land area of the state or province to adjust for these density effects; however, the expectations based on mixed findings in prior literature are unclear.

2f Other related control variables from prior literature

The prior literature points to several other control variables that are worthy of consideration. The first regards the age distribution of the population. Particularly because of

the differential demands on spending across age groups, it is worth controlling for the proportion of citizens over the age of 65.[5] Areas with greater elderly populations may have higher spending to support social retirement systems and health expenditures and may rely more on debt finance as elderly voters may desire to shift the tax burden to future periods.

Some studies suggest that the age of a jurisdiction's government (that is, how long it has been in continuous operation) may have effects worthy of consideration. Theoretically, Olson argues in *The Rise and Decline of Nations* (1982) that institutional declines predictably happen with the age of a government regime because interest groups become more entrenched. Similarly, the work of Higgs (1987) suggests that over time governments respond to crisis events by increasing their size and that these "ratchets" in spending never dissipate, leading to a larger government sector and more government regulation in older jurisdictions. Both of those theories predict that fiscal performance may change with the age of a jurisdiction, so the year of statehood is a worthwhile control to consider in the analysis.

There is also evidence that legal origins may affect institutional quality (La Porta, Silanes, and Shleifer, 2008), with those jurisdictions founded in the English common-law tradition having superior protections of private property when compared to, for example, those with origins in French civil law (having its origins in Roman law), although this effect is not supported in all studies (Murphy, 2019; March, Lyford, and Powell, 2017). While the United States and Canada generally have British (English common law) legal origins, there are several subnational considerations. In particular, while the rest of Canada is based on the British common law, Quebec is the lone province with a civil code based on the French Napoleonic Code. In the United States, there are ten states that initially had civil-law origins because they were initially settled by France, Mexico, or Spain prior to the American Revolution. These states are Alabama, Arizona, Arkansas, California, Florida, Louisiana, Mississippi, Missouri, New Mexico, and Texas. Eventually all but one of these states transitioned to the common law, with Louisiana retaining its French civil-law system. Berkowitz and Clay (2005, 2006) find lasting, negative, effects on judicial quality and constitutional stability in these 10 US states, and Nattinger and Hall (2012) specifically find that these US states have lower levels of economic freedom.

As Brown (2014) notes, for a variety of reasons related to climate, disease, and colonialization, it is common to include measures of latitude and ocean access in studies of economic development (Hall, 2016; Hall and Jones, 1999; Gallup and Sachs, 1998; Sachs, 2003; Acemoglu, Johnson, and Robinson, 2001). Thus, the latitude of each subnational jurisdiction and a dummy variable for whether a subnational jurisdiction has an

5. While it is impossible to control for subnational partisan political effects in this multi-country analysis, they have not been found to be significant determinants of fiscal performance consistently in the prior literature, so their omission likely has little effect on the results.

ocean border are included in our analysis.[6] Studies at the country-level have found those jurisdictions that border oceans tend to outperform landlocked countries economically (Bauer, 1991; Gallup and Sachs, 1998; Sachs, 2003).[7]

It is worthwhile briefly discussing the issue of partisan political control, which due to the use of multi-nation subnational data it is not possible to include as a control. Based on previous literature, however, is likely that this omission is not a factor as there is no robust finding that partisan political control affects the level of debt, taxes, or spending either for the US states or Canadian provinces (Bjørnskov and Potrafke, 2012; Hankins and Hoover, 2019; Gu, Compton, Giedeman, and Hoover, 2017; Campbell and Mitchell, 2011). The lone policy area often found to correlate with party control is that of labour regulations, which are not directly reflected in the types of data we analyze. Thus, while it is an omitted factor, the prior literature suggests it is not one that should strongly influence the findings related to the size of population.

6. Studies generally use the capital city's latitude, which is employed here, but the literature has considered latitude of the jurisdiction's geographic centroid and found no significant difference (Fagerberg, Srholec, and Knell, 2007). In his country-level analysis, Brown (2014) created several alternative measures to replace the simple ocean border indicator (exitability, coastalness, and shapefactor). All three were employed to test for robustness in the specifications in this study but none were statistically significant, and their inclusion did not alter the main results so only the results using the simpler ocean border variable are presented.

7. Based on the logic of intergovernmental competition through exit (that is, "voting with your feet"), following Tiebout (1956) and Diamond (1997), one might expect better institutions when the ease of exit is higher as a result of ocean access.

3 Balanced Budget Constraints

One factor worth discussing explicitly is the presence of institutional requirements for a balanced budget in these subnational governments. While the Canadian provinces do not have any such restrictions, 49 of the 50 US states are generally considered to have some form of rule or constraint (Vermont is the exception). US state balanced-budget requirements come in three general possible forms. The first is some sort of requirement that the (US state) governor propose a balanced budget to the legislature. Note that, even if the governor does propose a balanced budget, the legislature may alter the proposed budget and pass into law one that is not balanced. Thus, the second category of restriction is whether the (US state) legislature is required to pass a balanced budget. Even for this restriction, however, the balance is required only based upon forecast revenue and spending and, if actual revenue or expenditure differs from the forecast, say as a result of a change in economic conditions, there still can be an actual out-of-balance budget. The final category of restriction limits whether an actual deficit can be carried over into the next fiscal year. States with a no-carry-over deficit restriction often have to make mid-year budgetary cuts if revenue falls below that forecast. Another dimension is whether the rule is mandated within the state's constitution or is only statutory.

These requirements largely refer only to each state's operating budget, which in most states is called the "general fund" budget. For many states, this is only a fraction (50%–60%) of total spending as a variety of other special purpose "funds" exist (such as for roads, education, and so on). States are generally able to run debt for (bond finance) capital projects and public investments in roads, buildings, and these sometimes require approval of the legislature or even the voting public. In the end, these various rules do not really apply to whether a state's entire budget is in balance, so there is less clarity than one would assume about actual binding constraints, and indeed the data show significant use of debt across the US states.

For our empirical analysis it may be useful to control for these rules, and since they take so many forms it is also worth discussing briefly the previous published literature as a guide to what should be included as controls. It is best to start out with the simple summary that, largely, there is very little consistent evidence that these rules matter. This is largely consistent with the expectations one would have based on how these rules work in practice. Clingermayer and Wood (1995), for example, find no effects of any of these rules and suggest that debt levels are primarily determined by normal economic and financial considerations.

There are, however, some studies suggesting that there may be some possible effect of two rules, at least when examining narrower fiscal measures. Hou and Smith (2010) find that rules prohibiting carry-over deficits (the only budgetary outcome-based rule) have stronger and more significant effects than do rules on the process of assembling and approving the budget, but even then these effects are limited to narrowly defined

measures of balance (for example, general fund only). They also find no consistent or significant difference between constitutional and statutory rules. In a follow-up analysis on state spending levels alone , Smith and Hou (2013) find again that rules that constrain carry-over deficits tend to have significant effects, but also when considering spending levels that rules requiring the governor to submit a balanced budget may matter. Other studies such as Mahdavi and Westerlund (2011), Bohn and Inman (1996) and Calcagno and Escaleras (2007) have found similar results, and in general the literature suggests that, if any controls are worthy of consideration, they are (1) the presence of either a rule (either constitutional or statutory) that requires the governor to submit a balanced budget, and (2) whether carry-over deficits are not allowed. This report sources data on these two rules from the National Association of State Budget Officers (2008) and the National Conference of State Legislatures.

In addition, to ensure robustness this report will also consider a frequently used index measure of the "stringency" of state debt limits constructed by the United States Advisory Commission on Intergovernmental Relations (1987). This "ACIR stringency index" uses a large variety of factors about each state's budgetary processes to code each state's rules on the scale of zero (no limits, only Vermont) to ten.

4 Data and Empirical Model

The main dependent variables in the analysis are the subnational fiscal measures reflecting the size of government spending (and revenue) as a share of the economy, the use of annual budget surpluses or deficits, the overall reliance on (size of) debt, the mix of consumption versus income taxes, and the progressivity of the personal income-tax system. For each measure, we explore both the state/provincial government (central government only) values, as well as the values inclusive of the local governments within the state/province. Greater detail on the sources, years, and availability of all variables employed throughout the analysis can be found in Appendix A, while the descriptive statistics can be found in Appendix B. In the analysis that follows, results are generally presented using both a full panel sample that employs data for the years 1991 through 2018, as well as a cross-sectional sample on only 2018 data. These sample periods were chosen both based on data availability and to avoid years unusually affected by the COVID-pandemic.

Our main independent variable of interest is the population of each state or province (in millions of individuals). To test for any possible U-shaped patterns or nonlinearities, the squared value of the population variable is also included in some specifications. If this squared term is statistically significant, it suggests a nonlinear relationship. When so, the dependent variable of interest, here we use Y for generality, is then a quadratic function of population (Pop) of the form: $Y = \beta_1 \times Pop + \beta_2 \times Pop^2$. This leads to four possible relationships depending upon whether the coefficients β_1 and β_2 take positive or negative values. If both are positive this implies that the variable always increases with population, but nonlinearly, while if both are negative it implies that the variable always decreases with population, but nonlinearly. If the coefficient on the main linear variable (β_1) is positive and the coefficient on the squared variable (β_2) is negative, this implies an inverted U-shaped pattern in which the variable of interest rises initially with population, reaches a maximum, then begins to decline at larger levels of population. If the coefficient on the main linear variable (β_1) is negative and the coefficient on the squared variable (β_2) is positive, this implies a U-shaped pattern in which the variable of interest falls initially with population, reaches a minimum, then begins to increase again at larger levels of population. The actual value of the population variable that maximizes (or minimizes) the relationship can be found through partial differentiation, $\partial Y/\partial Pop = \beta_1 + 2 \times \beta_2 \times Pop$, and then setting this equal to zero and solving for the value of population, which yields $-\beta_1 / 2 \times \beta_2$. In cases where a statistically significant U-shaped relationship exists, the results of this calculation will be provided in the associated table of results.

The prior literature helped identify the other control variables employed in the empirical models including the latitude of each subnational jurisdiction's capital city, the year of statehood, the percentage of the population aged 65 and over, a dummy indicator variable equal to one if the state or province has an ocean border, and a dummy indicator variable equal to one if the state or province has French legal origins. For

any specifications regarding annual surplus or deficits, or overall debt, measures of a requirement for a balanced budget are included for the US states as were discussed in the literature review. These are dummy indicator variables equal to one if the state has a rule that the state governor must submit a balanced budget and if the state has a rule that forbids the state from having carry-over deficits, as well as each state's rating on the ACIR stringency index of state debt limits.[8] Lastly, to control for any other omitted factors that could cause differences between the Canadian provinces and US states, a country-level fixed effect is included in the form of an indicator dummy variable equal to one for all Canadian provinces.[9]

As for the estimation strategy, because most of our variables are time-invariant (area, latitude, statehood, ocean border, legal origins, and so on) we follow Feldmann (2019) and use a panel "between" specification using the entire panel sample of data for all years available. These specifications help us to identify the effects caused by more permanent cross-sectional differences in geography and size (Hankins and Hoover, 2019; Fredriksson, Wang, and Warren, 2013). It also helps to alleviate concerns about endogeneity that would be present using high frequency panel-data analysis, which could suffer from endogeneity if population migration was strongly correlated with the fiscal measures. For robustness, we also consider specifications using just fiscal year 2018, the final single cross-sectional year for which all variables are available but is not influenced by the COVID-19 pandemic situation. This allows us to see if our main estimates based on the entire, longer series of historical data produce conclusions that are relevant in the most recent data. For each regression, the number of cross-sectional units as well as the total sample on which the regression is based are shown in the results table.

8. The Canadian provinces are given the zero (no constraint) values for these variables.

9. As we discuss later, in the specifications examining income-tax progressivity an additional variable is included in some specifications to control for the beginning and ending points of the top and bottom tax brackets.

5 Results

We now turn to the results of our empirical estimations, discussed by topic of analysis: 5a. Size of government; 5b. Government debt and annual surplus or deficit; 5c. Reliance on consumption rather than income taxes and the progressivity of personal income tax.

5a Size of government

Table 1A shows the initial regression results for the size of the state and provincial governments relative to their economies using both the level of expenditure and of revenue as a share of state or provincial gross domestic product (GDP). The analysis is performed for both the data only including the central state or provincial government, as well as for the data that also includes the local governments within each state or province as well. This helps to ensure that differences across states and provinces in terms of which activities are centralized or decentralized is not affecting the interpretation of our results. Finally, we perform the estimations using only the linear population term, and also with the nonlinear population squared term that allows for a possible U-shaped relationship.

Column (1) of table 1A, for example, shows the specification including only a linear population effect for central state and provincial government total expenditures as a share of state/provincial GDP. The results show a clear negative relationship with an estimated coefficient of −0.206. Given the scaling of our dependent and independent variables, this implies that for every additional 1 million population, state/provincial expenditures are −0.206 percentage points lower. More conveniently scaled, this implies that for roughly every additional 5 million in population, expenditures are approximately one percentage point lower as a share of state/provincial GDP. The estimation for central state/provincial revenues as a share of state GDP, in column (3), show a similarly sized coefficient of −0.215. Columns (2) and (4) show that these same negative relationships are mostly present once we include local government spending as well, but not as strongly with coefficients of −0.104 and −0.127.

Columns (5) through (8) of table 1A replicate these models with the addition of the population squared variable to test for the presence of a non-linear effect. As can be seen in the table, these terms are all statistically significant suggesting significant non-linearities in the relationship. The negative coefficient on the linear population variable with an accompanying positive coefficient on the population squared variable suggests that the size of government initially falls with population but that at some point reaches a minimum and begins to rise again. The estimated population at which this minimum point of this U-shaped relationship occurs can be calculated as indicated earlier, and this minimum point is shown in table 1A on one of the lower rows in the table, which is around 20.9 million for state/provincial expenditures (or 20.6 including local), or

Table 1A: Determinants of subnational government size—between-group panel estimates

	Expenditure as percentage of State/Provincial GDP		Revenue as percentage of State/Provincial GDP		Expenditure as percentage of State/Provincial GDP		Revenue as percentage of State/Provincial GDP	
	State/Province Only	State/Province and Local Total	State/Province Only	State/Province and Local Total	State/Province Only	State/Province and Local Total	State/Province Only	State/Province and Local Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	−32.1	−27.6	−43.6*	−38.2*	−4.67	−8.32	−13.7	−15.5
	(−1.50)	(−1.35)	(−2.01)	(−1.78)	(−0.203)	(−0.367)	(−0.592)	(−0.657)
Population (Mil.)	−0.206***	−0.104	−0.215***	−0.127*	−0.623***	−0.398**	−0.670***	−0.472**
	(−2.86)	(−1.51)	(−2.94)	(−1.75)	(−3.51)	(−2.27)	(−3.75)	(−2.59)
Population^2 (Mil.)					0.0149**	0.0105*	0.0163***	0.0123**
					(2.55)	(1.82)	(2.76)	(2.06)
Area (Mil. Sq. Mi.)	1.16	1.51	1.44	2.00	2.28*	2.30*	2.67**	2.93**
	(0.913)	(1.24)	(1.12)	(1.57)	(1.78)	(1.82)	(2.06)	(2.22)
Canadian Province	6.25***	5.11***	4.10***	3.06**	6.80***	5.50***	4.70***	3.52**
	(4.40)	(3.77)	(2.84)	(2.15)	(4.98)	(4.09)	(3.41)	(2.51)
French Legal Origin	1.62	1.47	1.73	1.66	0.887	0.952	0.929	1.05
	(1.28)	(1.21)	(1.34)	(1.30)	(0.715)	(0.777)	(0.743)	(0.822)
Latitude	0.119	0.113	0.159	0.158	0.0242	0.0458	0.0552	0.0794
	(1.16)	(1.15)	(1.52)	(1.53)	(0.232)	(0.445)	(0.525)	(0.741)
Ocean Border	2.09**	1.89**	1.94**	1.71*	1.48	1.46	1.27	1.21
	(2.30)	(2.18)	(2.10)	(1.88)	(1.65)	(1.66)	(1.41)	(1.31)
Year of Statehood	0.0183*	0.0190*	0.0241**	0.0242**	0.00582	0.0102	0.0105	0.0139
	(1.74)	(1.88)	(2.25)	(2.29)	(0.523)	(0.927)	(0.935)	(1.22)
Percent Aged 65+	0.472*	0.497*	0.481*	0.506*	0.533**	0.541**	0.548**	0.558**
	(1.74)	(1.91)	(1.75)	(1.86)	(2.07)	(2.12)	(2.11)	(2.10)
Est. Pop. Min. (Mil.)					20.9	19.0	20.6	19.2
Cross sectional obs.	60	60	60	60	60	60	60	60
Total observations	1680	1680	1680	1680	1680	1680	1680	1680
Adjusted R^2	0.657	0.607	0.609	0.555	0.691	0.624	0.654	0.581

Sources: see Appendix A and "Sources", pp. 37–38..

Notes: Population in millions (including squared term); area in millions of square miles; t-statistics in parentheses (based on robust standard errors); statistical significance levels denoted as follows: * = 10%; ** = 5%; *** = 1%. The 95% confidence intervals for the population values (in millions) for the minimums shown in the table for columns (5) through (8) are: 19.25–22.51, 16.76–21.17, 19.00–22.18, and 17.09–21.20, respectively.

19.0 million for state/provincial revenue (19.2 including local). The precise estimated confidence intervals for these values (roughly plus or minus 1.5 million) are given in the notes of the table.

Table 1B shows the same estimations performed on only the final year of pre-COVID complete data in our sample (2018). Despite the much smaller sample size, the results are almost identical using only the recent data. There are significant nonlinear effects, with minimum points just slightly larger than found using the full sample. For a better understanding of these results, let us briefly examine the actual relationships behind these results using the underlying raw data.

Table 1B: Determinants of subnational government size—final sample-year (2018) OLS estimates

	Expenditure as percentage of State/Provincial GDP		Revenue as percentage of State/Provincial GDP		Expenditure as percentage of State/Provincial GDP		Revenue as percentage of State/Provincial GDP	
	State/Province Only	State/Province and Local Total	State/Province Only	State/Province and Local Total	State/Province Only	State/Province and Local Total	State/Province Only	State/Province and Local Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	−11.4	−4.40	−21.5	−12.6	18.0	20.8	6.76	9.87
	(−0.525)	(−0.211)	(−0.898)	(−0.537)	(0.811)	(0.942)	(0.280)	(0.392)
Population (Mil.)	−0.193**	−0.108	−0.171*	−0.0926	−0.588***	−0.446**	−0.550***	−0.394**
	(−2.28)	(−1.34)	(−1.94)	(−1.09)	(−3.56)	(−2.56)	(−3.25)	(−2.13)
Population^2 (Mil.)					0.0125***	0.0107**	0.0120***	0.00955**
					(3.20)	(2.66)	(3.00)	(2.21)
Area (Mil. Sq. Mi.)	2.18	2.33	0.748	1.06	3.21**	3.22**	1.74	1.84*
	(1.41)	(1.61)	(0.593)	(0.928)	(2.37)	(2.44)	(1.55)	(1.71)
Canadian Province	5.02***	3.20**	3.40**	2.63	5.70***	3.79**	4.06***	3.15**
	(3.16)	(2.02)	(2.21)	(1.67)	(3.85)	(2.51)	(2.71)	(2.02)
French Legal Origin	2.83**	2.57**	3.03**	2.96**	2.06	1.90	2.29*	2.37*
	(2.02)	(2.01)	(2.22)	(2.32)	(1.55)	(1.56)	(1.77)	(1.91)
Latitude	0.0917	0.0937	0.101	0.103	−0.00353	0.0122	0.0100	0.0300
	(1.02)	(1.10)	(1.07)	(1.25)	(−0.0463)	(0.146)	(0.122)	(0.367)
Ocean Border	0.642	0.607	0.155	0.283	−0.00132	0.0556	−0.463	−0.208
	(0.694)	(0.686)	(0.177)	(0.332)	(−0.00150)	(0.0653)	(−0.551)	(−0.247)
Year of Statehood	0.00544	0.00519	0.0100	0.00877	−0.00760	−0.00599	−0.00253	−0.00118
	(0.511)	(0.513)	(0.862)	(0.794)	(−0.711)	(−0.567)	(−0.220)	(−0.100)
Percent Aged 65+	0.676***	0.614***	0.847***	0.789***	0.676***	0.615***	0.847***	0.789***
	(2.89)	(2.95)	(3.04)	(2.97)	(3.41)	(3.36)	(3.39)	(3.19)
Est. Pop. Min. (Mil.)					23.5	20.8	22.9	20.6
Cross sectional obs.	60	60	60	60	60	60	60	60
Total observations	60	60	60	60	60	60	60	60
Adjusted R^2	0.603	0.466	0.516	0.419	0.644	0.503	0.560	0.447

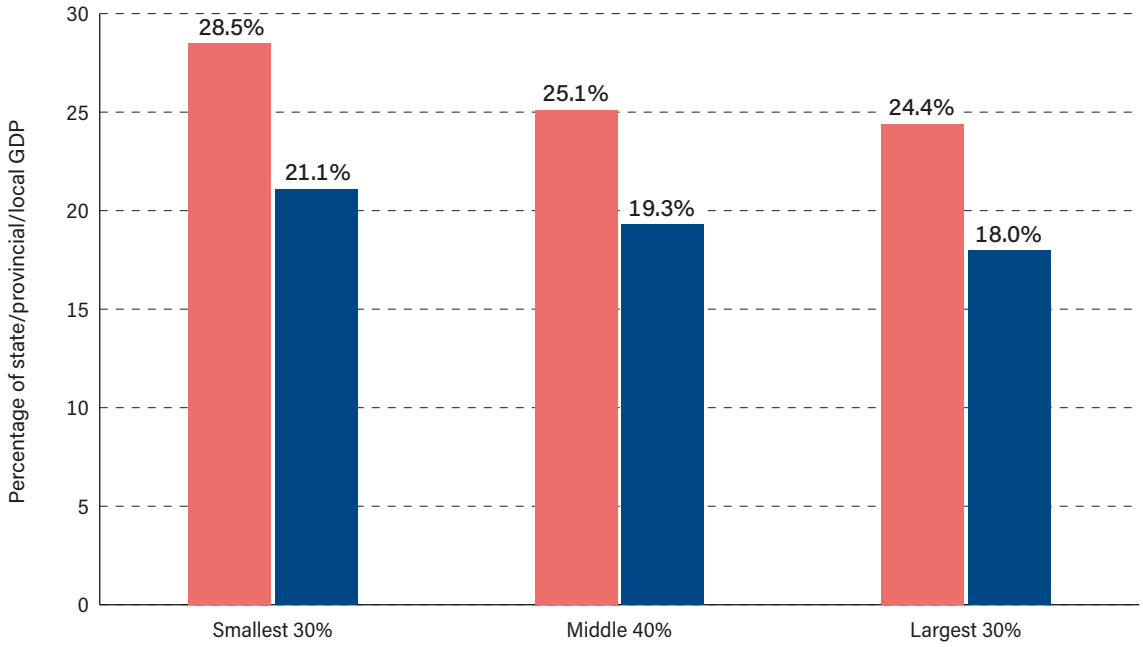
Sources: see Appendix A and "Sources", pp. 37–38.

Notes: Population in millions (including squared term); area in millions of square miles; t-statistics in parentheses (based on robust standard errors); statistical significance levels denoted as follows: * = 10%; ** = 5%; *** = 1%. The 95% confidence intervals for the population values (in millions) for the minimums shown in the table for columns (5) through (8) are: 21.83–25.09, 18.58–23.00, 21.27–24.44, and 18.56–22.66, respectively.

Figure 2A shows the average state/provincial (including local) government spending as a share of GDP for roughly the top, middle, and lower third of both Canadian provinces and US states.[10] As can be seen, in both countries, government size as a share of the economy falls with population when the data is split into several larger groupings. Government size is on average larger (by roughly 6 percentage points) in Canadian provinces than in the US states for all groups.

10. With 10 provinces, the top 30%, middle 40%, and bottom 30% cut-offs were the closest to equal thirds that were possible with a clear whole number of provinces for each group (top 3, middle 4, and bottom 3); so, these same cutoffs were used for the 50 US states data grouping (top 15, middle 20, and bottom 15).

Figure 2A: Total expenditure by state/provincial (including local) governments as a percentage of GDP, comparison by population size of Canadian provinces and US states, 2018



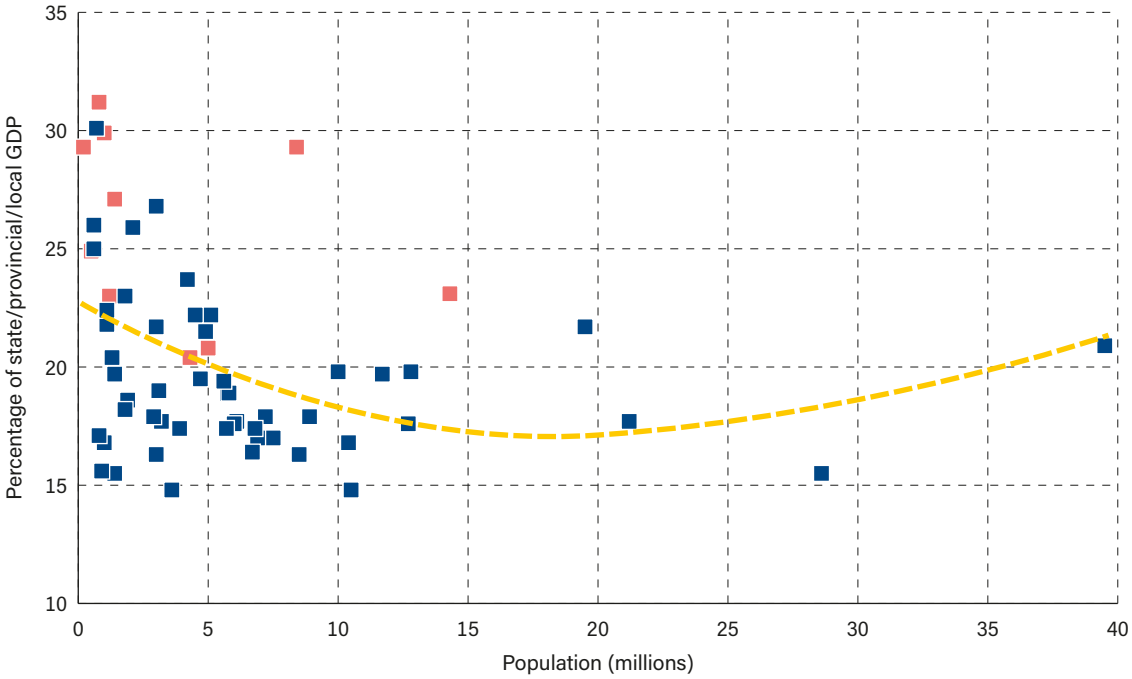
Sources: Finances of the Nation, n.d. a [total expenditure, consolidated P-T/Local]; Statistics Canada, 2021a, 2021b; US Bureau of Economic Analysis, 2022; US Census Bureau 2021a, 2021c, 2021d.

Figure 2B and figure 2C show this data for all states and provinces in the same way the regression sees the data and tries to fit it. Figure 2C shows all of the observations, while figure 2B restricts the plot to only the final full pre-COVID year (2018). Clearly, the US state of California at the right side of figure 2B is a factor in the nonlinearity. With a population of almost 40 million, and government spending (state and local) over 20% of the economy, this causes the estimation to curve back upward at very high population levels. To see how much California is influencing the results, Table 1C presents estimates from models for expenditures as a share of GDP that omit California. The first four columns use all remaining US states and Canadian provinces, while the final four columns use data only for the other 49 US states. As can be seen when California is omitted, the nonlinear term loses its statistical significance.

It is worthwhile to also examine the estimates and data focusing on separate samples for the Canadian provinces and US states. Figure 2D (p. 20) shows the subsample of data for the Canadian provinces only. From the figure, it is clear the similar negative, but perhaps nonlinear, relationship is present in the Canadian data alone. Table 1D shows the results of the estimated regressions on the subsamples of Canadian and US data for expenditures as a share of GDP.

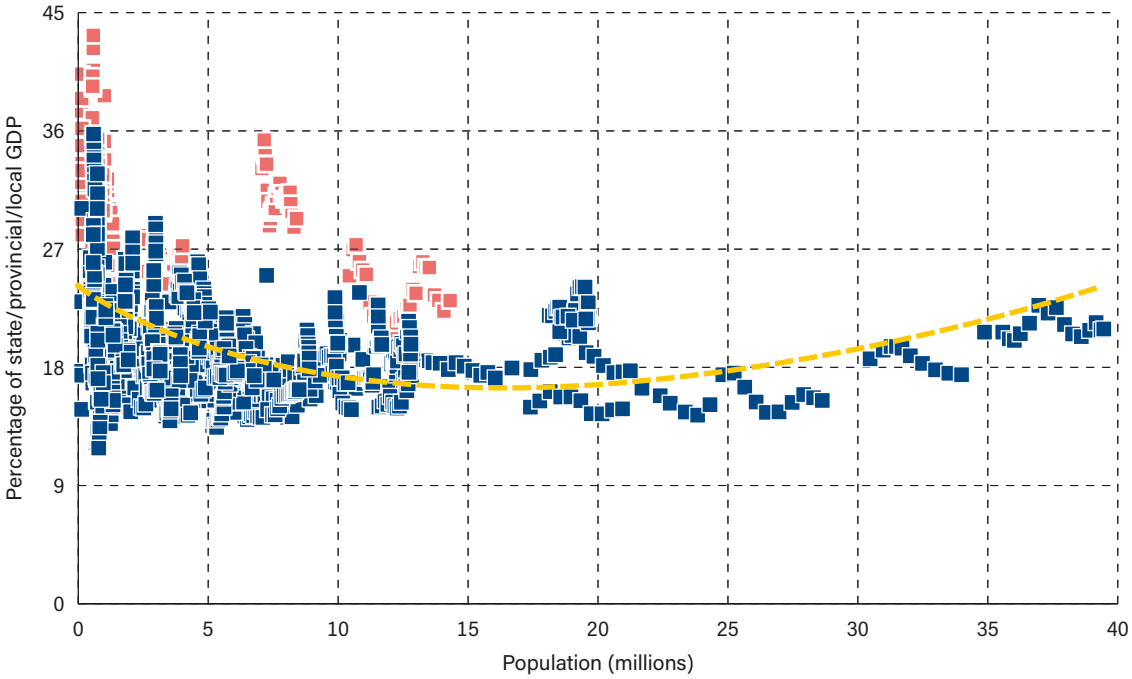
While the samples using only the US data [columns (5)–(8)] basically mirror the results from the full sample in table 1A, the estimates using only Canadian provinces seem to show a stronger negative relationship between population and government

Figure 2B: Total expenditure by state/provincial (including local) governments as a percentage of GDP compared to population, Canadian provinces and US states, 2018



Sources: Finances of the Nation, n.d. a [total expenditure, consolidated P-T/Local]; Statistics Canada, 2021a, 2021b; US Bureau of Economic Analysis, 2022; US Census Bureau 2021a, 2021c, 2021d.

Figure 2C: Total expenditure by state/provincial (including local) governments as a percentage of GDP compared to population, Canadian provinces and US states, all data points



Sources: Finances of the Nation, n.d. a [total expenditure, consolidated P-T/Local]; Statistics Canada, 2021a, 2021b; US Bureau of Economic Analysis, 2022; US Census Bureau 2021a, 2021c, 2021d.

Table 1C: Determinants of subnational government size—subsamples without California, both full sample and US data only

	Expenditure as a percentage of State/Provincial GDP							
	Full Sample, Excluding California				US Data Subsample Only, Excluding California			
	State/Province Only (1)	State/Province and Local Total (2)	State/Province Only (3)	State/Province and Local Total (4)	State/Province Only (5)	State/Province and Local Total (6)	State/Province Only (7)	State/Province and Local Total (8)
Constant	−18.4	−18.5	−2.22	−6.00	7.00	2.70	14.0	6.21
	(−0.838)	(−0.860)	(−0.0937)	(−0.257)	(0.357)	(0.139)	(0.667)	(0.297)
Population (Mil.)	−0.319***	−0.180**	−0.708***	−0.479*	−0.262***	−0.121	−0.468**	−0.225
	(−3.49)	(−2.02)	(−2.84)	(−1.95)	(−3.33)	(−1.56)	(−2.03)	(−0.982)
Population^2 (Mil.)			0.0200	0.0153			0.0104	0.00518
			(1.68)	(1.31)			(0.953)	(0.482)
Area (Mil. Sq. Mi.)	1.89	2.00	2.30*	2.32*	4.37***	4.08***	4.37***	4.08***
	(1.46)	(1.58)	(1.77)	(1.81)	(3.29)	(3.11)	(3.29)	(3.08)
Canadian Province	6.56***	5.32***	6.83***	5.53***				
	(4.71)	(3.92)	(4.96)	(4.08)				
French Legal Origin	1.13	1.14	0.885	0.949	0.668	0.771	0.533	0.702
	(0.895)	(0.925)	(0.707)	(0.769)	(0.603)	(0.703)	(0.477)	(0.628)
Latitude	0.0551	0.0697	0.0242	0.0459	−0.0213	0.0115	−0.0307	0.00681
	(0.523)	(0.677)	(0.230)	(0.442)	(−0.231)	(0.126)	(−0.330)	(0.0734)
Ocean Border	1.81**	1.71*	1.41	1.39	0.353	0.340	0.189	0.258
	(2.03)	(1.96)	(1.54)	(1.55)	(0.434)	(0.423)	(0.227)	(0.310)
Year of Statehood	0.0121	0.0148	0.00468	0.00910	0.00002	0.00502	−0.00310	0.00345
	(1.13)	(1.41)	(0.409)	(0.806)	(0.00174)	(0.523)	(−0.302)	(0.338)
Percent Aged 65+	0.535**	0.539**	0.522*	0.531**	0.525**	0.479*	0.508**	0.470*
	(2.01)	(2.08)	(2.00)	(2.06)	(2.17)	(2.00)	(2.09)	(1.94)
Est. Pop. Min. (Mil.)			n/a	n/a			n/a	n/a
Cross sectional obs.	59	59	59	59	49	49	49	49
Total observations	1652	1652	1652	1652	1372	1372	1372	1372
Adjusted R^2	0.679	0.620	0.690	0.625	0.384	0.314	0.383	0.301

Sources: see Appendix A and "Sources", pp. 37–38.

Notes: Population in millions (including squared term); area in millions of square miles; t-statistics in parentheses (based on robust standard errors); statistical significance levels denoted as follows: * = 10%; ** = 5%; *** = 1%; between-group panel estimates shown, all excluding California.

size, and a non-linear relationship with a minimum occurring at a smaller population level of 9.58 million for provincial data excluding local governments, or 9.73 including local government.[11] Thus, importantly, the Canadian data seem to suggest that the U-shaped pattern that was seemingly caused by California in the full sample also holds among Canadian provinces. This increases our certainty that, while California was to a

11. Non-parametric estimation on the full sample using local polynomials also produced two local minimum values at approximately 9 and 21 million, corresponding to the estimates from the separate Canadian and US models, although the fitted line beyond 9 million was virtually flat.

Table 1D: Determinants of subnational government size—subsamples of Canadian data only

Expenditure as a percentage of State/Provincial GDP

	Canadian Data Only				US Data Subsample Only, Including California			
	State/Province Only (1)	State/Province and Local Total (2)	State/Province Only (3)	State/Province and Local Total (4)	State/Province Only (5)	State/Province and Local Total (6)	State/Province Only (7)	State/Province and Local Total (8)
Constant	−0.188	77.2	32.9	116***	−5.36	−4.76	14.6	6.86
	(−0.004)	(1.70)	(1.01)	(4.51)	(−0.276)	(−0.255)	(0.713)	(0.337)
Population (Mil.)	−0.870**	−1.09**	−3.19***	−3.82***	−0.156**	−0.0573	−0.495***	−0.255
	(−2.61)	(−2.97)	(−6.13)	(−10.8)	(−2.50)	(−0.958)	(−3.13)	(−1.62)
Population^2 (Mil.)			0.166***	0.197***			0.0119**	0.00692
			(4.16)	(9.08)			(2.31)	(1.35)
Area (Mil. Sq. Mi.)	−2.28	0.817	0.790	4.44***	3.71***	3.68***	4.34***	4.05***
	(−0.811)	(0.262)	(0.518)	(4.43)	(2.77)	(2.87)	(3.33)	(3.11)
French Legal Origin	8.76***	6.74**	10.2***	8.48***	1.10	1.03	0.529	0.697
	(4.66)	(2.77)	(6.90)	(14.7)	(0.977)	(0.953)	(0.479)	(0.632)
Latitude	−0.643	−1.18*	−0.408	−0.906***	0.0356	0.0460	−0.0300	0.00767
	(−1.16)	(−2.09)	(−1.14)	(−3.93)	(0.389)	(0.523)	(−0.327)	(0.0837)
Ocean Border	3.86	1.88	4.16***	2.23***	0.580	0.477	0.173	0.239
	(1.68)	(0.760)	(3.33)	(3.45)	(0.693)	(0.595)	(0.212)	(0.294)
Year of Statehood	0.0306**	0.00809	0.00853	−0.0180**	0.00572	0.00846	−0.00335	0.00317
	(2.39)	(0.602)	(0.746)	(−2.65)	(0.592)	(0.912)	(−0.335)	(0.317)
Percent Aged 65+	−0.258	−0.521	−0.384	−0.669**	0.455*	0.436*	0.502**	0.464*
	(−0.898)	(−1.70)	(−1.45)	(−2.35)	(1.83)	(1.83)	(2.12)	(1.96)
Est. Pop. Min. (Mil.)			9.58	9.73			20.81	n/a
Cross sectional obs.	10	10	10	10	50	50	50	50
Total observations	280	280	280	280	1400	1400	1400	1400
Adjusted R^2	0.655	0.603	0.710	0.684	0.322	0.292	0.385	0.305

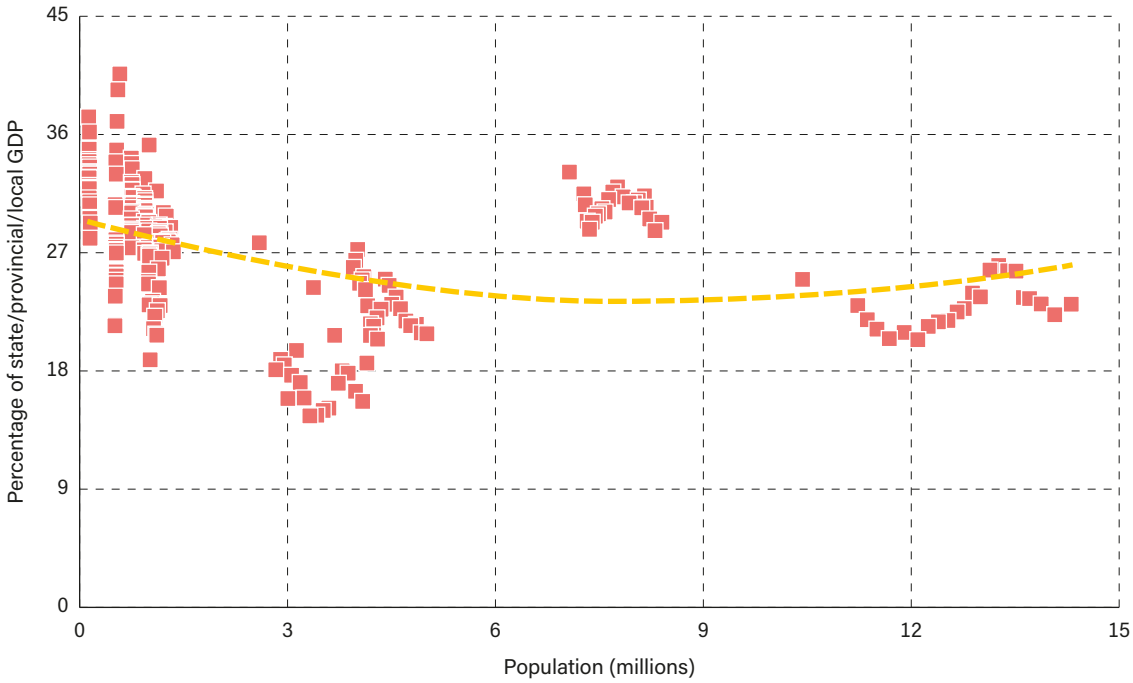
Sources: see Appendix A and "Sources", pp. 37–38.

Notes: Population in millions (including squared term); area in millions of square miles; t-statistics in parentheses (based on robust standard errors); statistical significance levels denoted as follows: * = 10%; ** = 5%; *** = 1%; between-group panel estimates shown for the United States and pooled OLS for Canada because of the lower number of cross-sectional observations. The 95% confidence intervals for the population values (in millions) for the minimums shown in the table for columns (3), (4), and (7) are: 8.61–10.55, 8.86–10.60, and 19.19–22.43, respectively. While the squared term in the specification in column (8) is insignificant, it would have resulted in a population value minimum of 18.41 with a confidence interval of 16.80–20.03 if it were statistically significant.

large extent responsible for the curvature in the full sample, it is a true U-shaped relationship across both countries and is not something spurious. Simply put, the largest states and provinces are so large that government spending as a share of the economy begins to increase again.

What then can we conclude about the relationship between the population size of states/provinces and the size of government? Clearly the relationship is negative over the majority of the relevant range of data for smaller and medium-sized states and provinces. Among the combined sample of states and provinces, for roughly every 5

Figure 2D: Total expenditure by provincial (including local) governments as a percentage of GDP compared to population, Canadian data only



Sources: Finances of the Nation, n.d. a [total expenditure, consolidated P-T/Local]; Statistics Canada, 2021a, 2021b.

million additional population central state and provincial total expenditure (or revenue) as a share of state/provincial GDP falls by approximately one percentage point. When the estimation is restricted to the Canadian provinces, this effect is somewhat stronger (falling by one percentage point for roughly every one or two million in additional population). The estimated negative effect once local governments are included is smaller for the full sample, or subsample of US states, but is roughly the same for Canadian provinces. There does seem to be clear evidence of a significant nonlinearity in which beyond some population size government as a share of the economy begins to rise again. This point is estimated to be approximately 9.6 million for Canadian provinces, and 21 million for US states. Provinces and states beyond these sizes, such as Ontario and California, thus have larger governments as a share of their economy than some that are less populous.

Before moving on to our next fiscal measure, it is worth briefly discussing the effects of the other control variables in the specifications shown. The significant positive coefficient on the Canadian-province variable suggests that, on average, once controlling for other factors, Canadian provinces have approximately 6 to 7 percentage-point higher levels of central provincial government spending as a share of the economy (or 4 to 5 percentage point higher levels of revenue) than US states, and these effects are about one-percentage point smaller when the comparison is made including local governments. States with a higher percentage of the population aged 65 or older have significantly higher levels of spending as a share of their economies (this also holds in

the full sample, but not in the subsample for Canadian provinces only). The estimated coefficient of roughly −0.5 implies that for every additional two percentage points of the population accounted for by those 65 and older, spending rises by approximately one percentage point of GDP. The other variables that show occasional statistical significance are year of statehood, ocean border, and French legal origin, all of which may have positive effects on the level of spending as a share of the economy.

5b Government debt and annual surplus or deficit

In any given year, the revenue of a state or province may exceed expenditure, in which case there is a surplus in that year. In contrast, in any given year expenditure may exceed revenue, in which case there is a deficit in that year. Total debt is the accumulated effect of this over time, such that a surplus could be used to pay down existing debt from prior years while a deficit would add to and increase the level of debt accumulated in prior years. In addition, because of governmental accounting practices, capital projects (for example, roads and buildings) are usually debt financed outside the accounts reflecting annual current revenue and expenditure, so a government may accumulate debt without ever running a deficit.

As discussed in the literature review, most US states have balanced budget constraints, some more binding and inclusive than others. Table 2 shows the estimated effects of population size on the average levels of debt to state/provincial GDP and the average annual surplus (+) or deficit (−). Because no significant non-linear population effects were found, for space considerations, table 2 includes only the linear population models. Both the results for the full sample [columns (1)–(4)] as well as the recent final year subsample [columns (5)–(8)] are shown in table 2.

In 7 out of the 8 specifications, population is statistically insignificant, suggesting there is not a strong correlation between the population size of states/provinces and their budget imbalances or use of debt. As might be expected given our discussion of the US state balanced-budget rules, the Canadian provinces tend to have significantly higher levels of debt (8.78 percentage points of GDP over the full sample, 14.7 percentage points of GDP in the final year), and for the full sample tend to run larger deficits (about 2.4 percentage points higher as a share of GDP). None of the other control variables are robustly significant although the models do show some limited evidence that, among the many different types of budget constraints, the rules prohibiting carry-over deficits may reduce debt and increase average surpluses in US states.

To help understand the relationships, figure 3A and figure 3B show some of the raw data for the US states and Canadian provinces grouped by population size. Other than the conclusion we reached above, that Canadian provinces tend to have higher debt levels and larger average annual deficits, there seems to be little consistent effect of population size across the full sample of states and provinces, although the largest Canadian provinces do seem to have slightly higher average surplus levels in the recent raw data. This is likely driving the one significant positive and significant population coefficient in column (7) of table 2 that uses only central government data for the recent year.

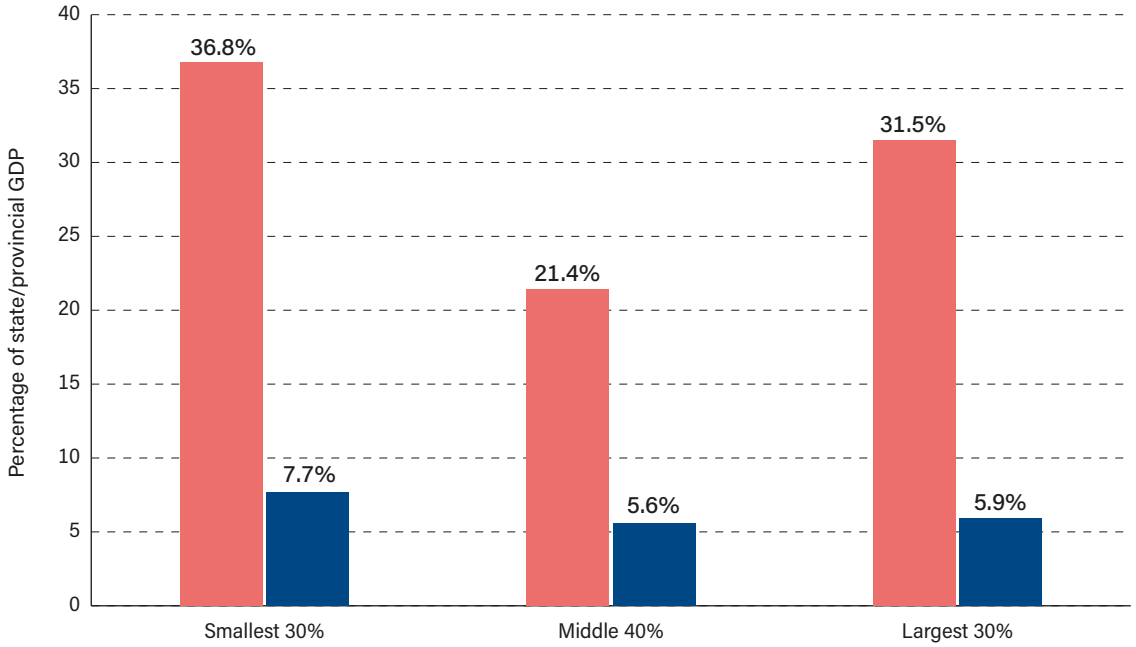
Table 2: Determinants of subnational government total debt and annual surplus/deficits

	Between-group Panel Estimates				Final Sample Year OLS Estimates			
	Debt as percentage of State/Provincial GDP		Surplus/Deficit as percentage of State/Provincial GDP		Debt as percentage of State/Provincial GDP		Surplus/Deficit as percentage of State/Provincial GDP	
	State/Province Only	State/Province and Local Total	State/Province Only	State/Province and Local Total	State/Province Only	State/Province and Local Total	State/Province Only	State/Province and Local Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	−61.6	−1.38	−11.1***	−10.4**	−26.2	21.3	−8.87	−7.50
	(−1.52)	(−0.0611)	(−2.93)	(−2.60)	(−0.733)	(0.640)	(−0.656)	(−0.652)
Population (Mil.)	−0.221	0.0335	−0.00138	−0.0170	−0.118	0.0565	0.0349*	0.0243
	(−1.55)	(0.444)	(−0.104)	(−1.22)	(−1.11)	(1.11)	(1.73)	(1.18)
Area (Mil. Sq. Mi.)	1.07	3.44**	0.301	0.508**	1.82	1.45	−1.42	−1.26
	(0.443)	(2.21)	(1.33)	(2.14)	(0.653)	(1.20)	(−1.57)	(−1.46)
Canadian Province	8.78**		−2.38***	−2.42***	14.7***		−0.931	0.121
	(2.06)		(−5.97)	(−5.80)	(3.45)		(−0.900)	(0.118)
French Legal Origin	−0.397	−1.33	0.0876	0.184	0.0939	−0.432	0.126	0.328
	(−0.163)	(−1.00)	(0.384)	(0.769)	(0.0472)	(−0.283)	(0.204)	(0.660)
Latitude	0.0633	−0.0482	0.0445**	0.0502**	−0.00985	−0.0825	0.0173	0.0126
	(0.307)	(−0.431)	(2.31)	(2.48)	(−0.0662)	(−0.561)	(0.340)	(0.302)
Ocean Border	6.39***	1.52	−0.123	−0.136	4.53***	−0.0285	−0.550	−0.392
	(3.61)	(1.53)	(−0.745)	(−0.782)	(3.14)	(−0.0226)	(−1.33)	(−1.00)
Year of Statehood	0.0290	0.00867	0.00536***	0.00503**	0.00855	−0.00203	0.00316	0.00263
	(1.42)	(0.753)	(2.80)	(2.50)	(0.473)	(−0.114)	(0.470)	(0.461)
Percent Aged 65+	1.24**	0.237	0.0372	0.0352	1.15*	0.0263	0.193	0.190
	(2.33)	(0.789)	(0.748)	(0.673)	(1.95)	(0.122)	(1.39)	(1.44)
Budget Stringency	−0.485	−0.295	−0.00310	−0.00208	−0.160	−0.254	0.0229	0.0173
	(−1.24)	(−1.46)	(−0.0847)	(−0.0542)	(−0.917)	(−1.36)	(0.326)	(0.257)
Gov. Bal. Budget	−0.698	2.49**	−0.549**	−0.618**	−0.166	2.91**	0.0856	0.319
	(−0.297)	(2.05)	(−2.50)	(−2.67)	(−0.168)	(2.11)	(0.187)	(0.841)
No Carry-over Deficit	−1.37	−1.63	0.409*	0.310	−2.74**	−1.88*	0.566	0.348
	(−0.608)	(−1.40)	(1.94)	(1.40)	(−2.31)	(−1.78)	(1.42)	(0.996)
Cross sectional obs.	60	50	60	60	60	50	60	60
Total observations	1680	1400	1680	1680	60	50	60	60
Adjusted R^2	0.676	0.293	0.652	0.634	0.743	0.062	0.292	0.162

Sources: see Appendix A and "Sources", pp. 37–38.

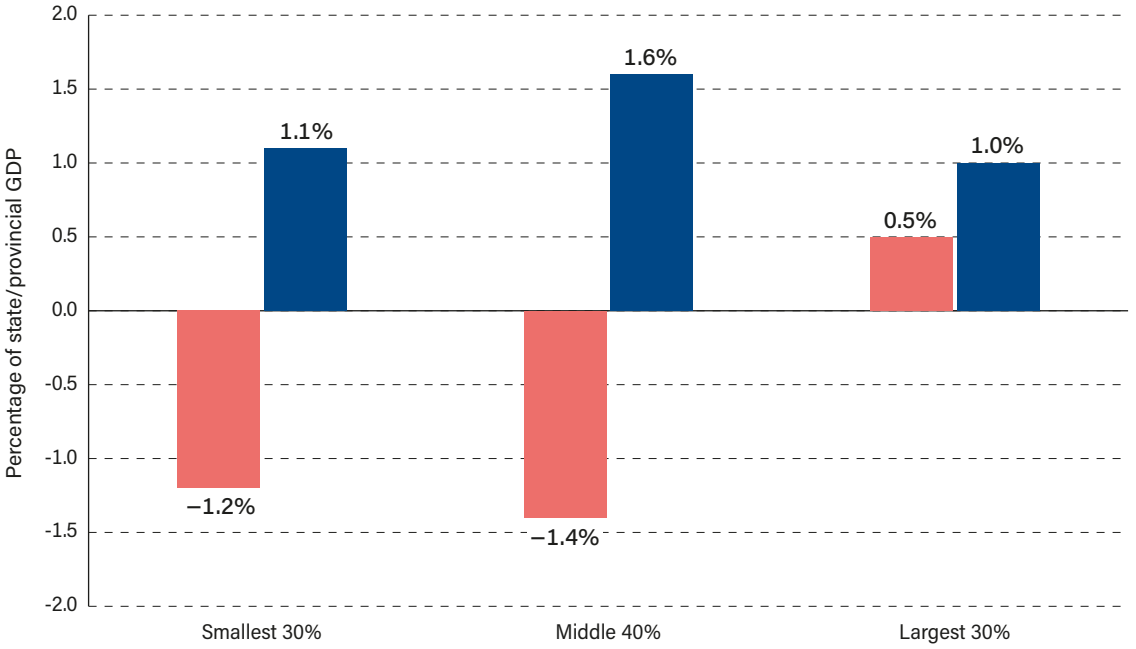
Notes: Population in millions (including squared term); area in millions of square miles; t-statistics in parentheses (based on robust standard errors); statistical significance levels denoted as follows: * = 10%; ** = 5%; *** = 1%. Only linear population versions are shown for space considerations because no significant nonlinear effects were found..

Figure 3A: State/provincial net debt as a percentage of GDP, comparison by population size of Canadian provinces and US states, 2018



Sources: Finances of the Nation, n.d. b; Statistics Canada, 2021a, 2021b; US Bureau of Economic Analysis, 2022; US Census Bureau 2021a, 2021c, 2021d.

Figure 3B: State/provincial surplus or deficit as a percentage of GDP, comparison by population size of Canadian provinces and US states, 2018



Sources: Finances of the Nation, n.d. a [consumption taxes & income taxes, Provincial-Territorial (P-T); i.e., not consolidated]; Statistics Canada, 2021a; US Census Bureau 2021a, 2021c, 2021d.

5c Reliance on consumption rather than income taxes and the progressivity of personal income tax

Reliance on consumption taxes and income taxes

The final topics to examine need a closer examination of state and provincial revenue sources. Economists often discuss the relative merits of consumption and income taxes, and it is worth examining whether the relative reliance on these two types of taxes differs consistently by population size. We also consider whether the progressivity of state/provincial personal income taxes, as measured by the ratio of the top to the bottom marginal income-tax rates, is correlated with population size. The results of these estimations are shown in table 3. Because no statistically significant non-linear population effects were found, for space considerations only the linear models are shown, and the table shows the estimates both for the full sample as well as the final year of data.[12]

Beginning with columns (1), (2), (5), and (6), we can see that there is a significant negative relationship between population size and state/provincial reliance on consumption taxes relative to income taxes. Thus, larger states and provinces tend to rely less heavily on consumption taxes and more heavily on income taxes than smaller states and provinces. The estimated coefficients of −2.09 for the central government and −2.95 including local governments from columns (1) and (2) suggest that for every additional one million in population size, reliance upon consumption taxes falls by about 2 to 3 percentage points relative to reliance on income taxes, with the effect being larger once local governments are included. States and provinces with French legal origin tend to have a significantly heavier reliance on consumption taxes than other states and provinces. The negative coefficient on latitude suggests that more northerly states and provinces tend to rely less heavily on consumption (and more heavily on income) taxes and there is some limited evidence that newer states and provinces may rely more heavily on consumption taxes than older ones, especially when examining the data including local governments.

Figure 4A and figure 4B show some of the raw data for the US states and Canadian provinces grouped by population size, giving the ratio of reliance on consumption com to reliance on income tax. Because this is a relative measure, the ratio takes a value of one if the state or province relies equally on both (that is, total consumption tax revenue equals total income-tax revenue). A value greater than one implies revenue from consumption taxes exceeds income-tax revenue, while a value less than one implies revenue from consumption taxes is less than income-tax revenue. The negative relationship found in the empirical model is clearly visible in the data for both countries. While Canadian provinces appear to rely less heavily on consumption taxes (and more

12. As a result of the use of the ratio, and the inability to divide by zero, only states with standard wage-based personal income taxes are included in the sample in table 3 and the data shown in figures 4A and 4B. The pattern and conclusions are similar if one reverses the ratio and excludes states or provinces without general sales taxes.

Table 3: Determinants of subnational government reliance on consumption taxes compared to personal income taxes and income tax progressivity

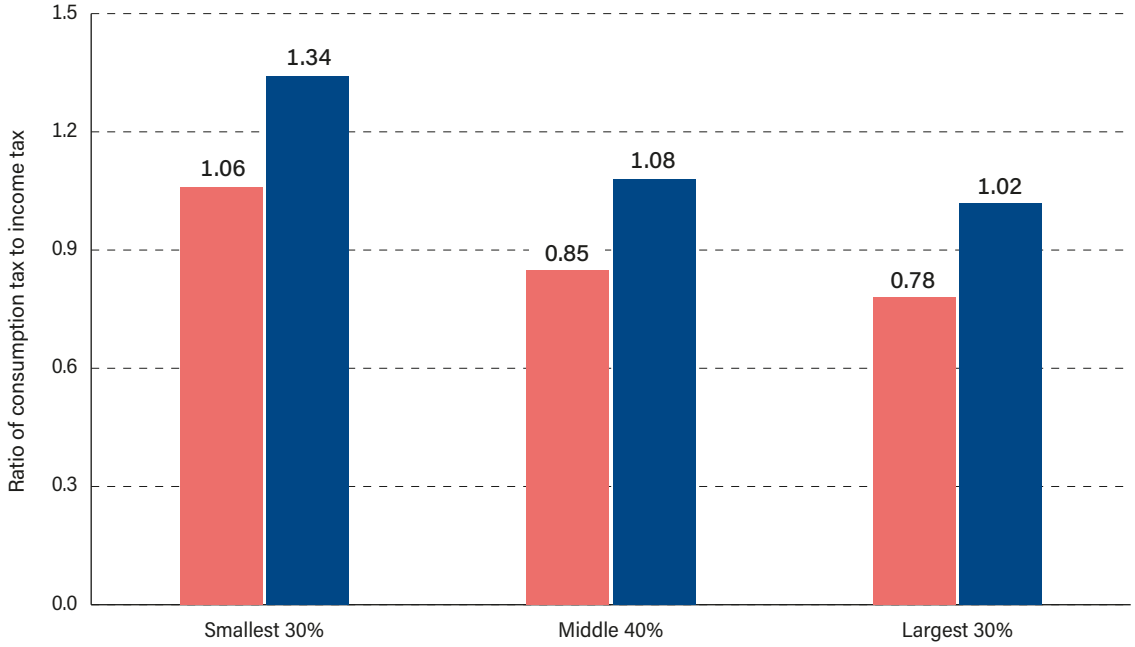
	Between-group Panel Estimates				Final Sample Year OLS Estimates			
	Ratio of Consumption to Income Tax Revenue		Ratio of Top to Bottom State/Province Personal Income Tax Rate		Ratio of Consumption to Income Tax Revenue		Ratio of Top to Bottom State/Province Personal Income Tax Rate	
	State/Province Only	State/Province and Local Total			State/Province Only	State/Province and Local Total		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	−116	−216	−36.2	−28.9	−144	−583	−38.1*	−31.6
	(−0.375)	(−0.635)	(−1.09)	(−0.895)	(−0.333)	(−1.10)	(−1.81)	(−1.40)
Population (Mil.)	−2.09**	−2.95***	0.167	0.109	−2.16**	−3.68***	0.166*	0.122
	(−2.11)	(−2.72)	(1.52)	(0.992)	(−2.53)	(−3.87)	(1.71)	(1.11)
Area (Mil. Sq. Mi.)	−8.35	−11.1	0.280	0.576	12.1	36.7	−0.0326	0.261
	(−0.480)	(−0.580)	(0.103)	(0.219)	(0.487)	(1.08)	(−0.0304)	(0.219)
Canadian Province	−3.61	−14.6	−1.81	−0.866	−16.1	−61.8*	−1.72	−1.15
	(−0.185)	(−0.688)	(−0.663)	(−0.323)	(−0.625)	(−1.83)	(−1.30)	(−0.954)
French Legal Origin	36.9**	69.5***	−0.721	−0.577	36.9*	74.7***	−0.334	−0.153
	(2.25)	(3.86)	(−0.410)	(−0.339)	(1.73)	(2.87)	(−0.272)	(−0.130)
Latitude	−2.83*	−3.72**	−0.105	−0.131	−2.59	−2.92	−0.0780	−0.0922
	(−1.97)	(−2.37)	(−0.670)	(−0.861)	(−1.16)	(−1.07)	(−0.944)	(−1.12)
Ocean Border	−11.7	−8.76	−0.746	−1.38	−23.3	−6.01	−0.142	−0.748
	(−0.924)	(−0.629)	(−0.512)	(−0.956)	(−1.41)	(−0.349)	(−0.110)	(−0.477)
Year of Statehood	0.161	0.290*	0.0193	0.0155	0.177	0.477*	0.0225**	0.0190*
	(1.08)	(1.78)	(1.20)	(0.992)	(0.868)	(1.88)	(2.19)	(1.69)
Percent Aged 65+	4.46	−1.97	0.617	0.656	2.99	−2.11	0.166	0.197
	(1.12)	(−0.450)	(1.43)	(1.57)	(0.775)	(−0.415)	(0.803)	(0.917)
Top/bottom bracket				0.0448*				0.0195
				(2.01)				(1.02)
Cross sectional obs.	53	53	51	51	53	53	51	51
Total observations	1680	1400	1680	1680	53	53	51	51
Adjusted R^2	0.369	0.531	0.001	0.053	0.225	0.460	0.039	0.024

Sources: see Appendix A and "Sources", pp. 37–38.

Notes: Population in millions (including squared term); area in millions of square miles; t-statistics in parentheses (based on robust standard errors); statistical significance levels denoted as follows: *=10%; **=5%; ***=1%. Only linear population versions are shown for space considerations because no significant nonlinear effects were found.

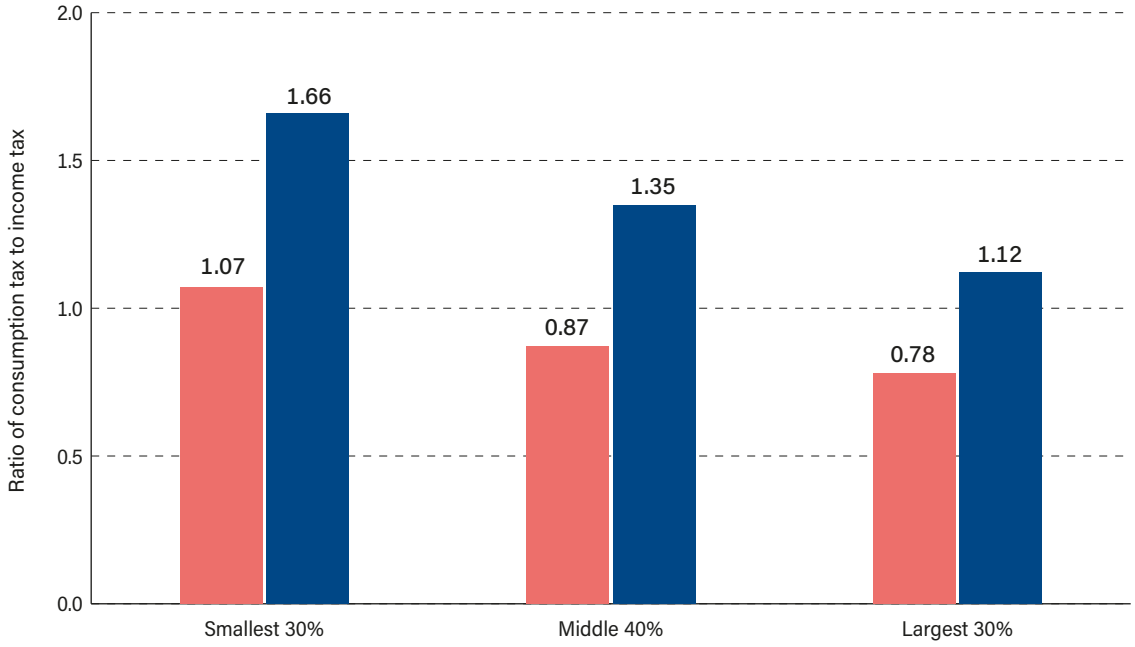
heavily on income taxes) in general compared to US states, these differences were not large enough to be statistically significant after controlling for other factors in the empirical model in three of the four specifications; the exception is state/provincial including local final year where the difference was statistically significant, which is the data plotted in figure 4B.

Figure 4A: State/provincial ratio of consumption taxes to personal income taxes, comparison by population size of Canadian provinces and US states, 2018



Sources: Finances of the Nation, n.d. a [consumption taxes & income taxes, Provincial-Territorial (P-T); i.e., not consolidated]; Statistics Canada, 2021a; US Census Bureau 2021a, 2021c, 2021d.

Figure 4B: State/provincial (including local) ratio of consumption taxes to personal income taxes, comparison by population size of Canadian provinces and US states, 2018



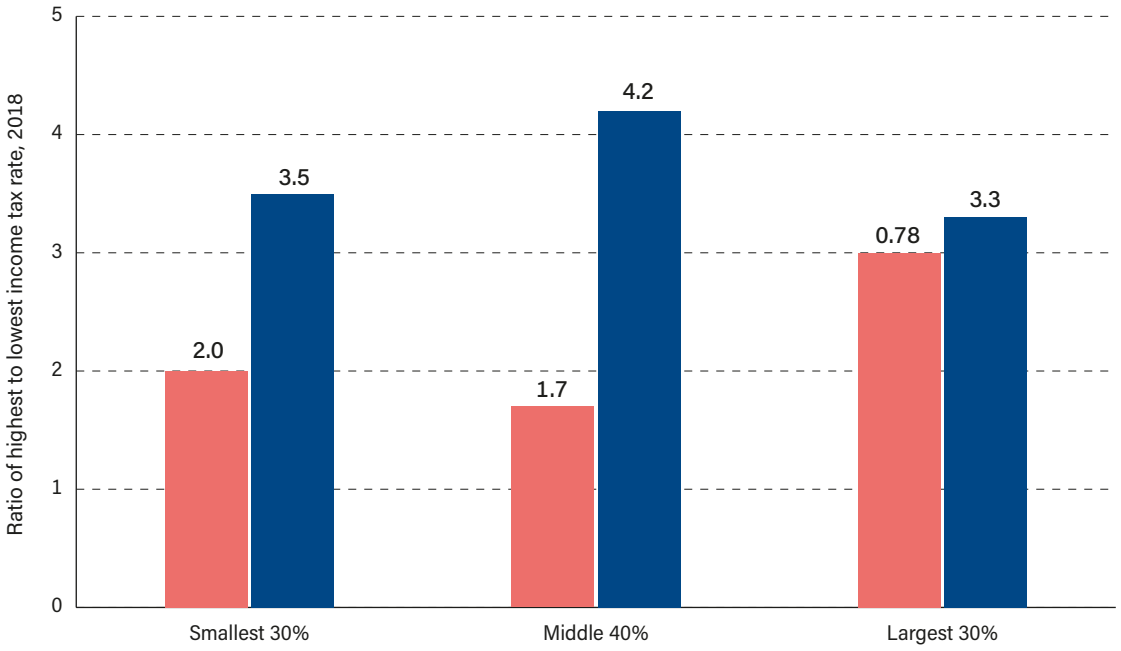
Sources: Finances of the Nation, n.d. a [consumption taxes & income taxes, Provincial-Territorial (P-T); i.e., not consolidated]; Statistics Canada, 2021a; US Census Bureau 2021a, 2021c, 2021d.

Progressivity of person income tax

Returning to table 3, we now examine the progressivity of state/provincial personal income tax. The specifications shown in columns (3), (4), (7), and (8) show how the ratio of the top-to-bottom marginal personal income-tax rate is correlated with population and the other variables. We run specifications with and without the variable measuring the ratio of the income-level threshold that begins the top income-tax bracket to the income level that ends the lowest income-tax bracket to control for the size of the income range over which these rates apply.[13] While generally the coefficients are positive on population, in only one case, the final year data without controlling for bracket size in column (7), is the coefficient statistically significant. Thus, there simply is no robust evidence that there is a strong correlation between income tax progressivity and population.

Figure 5 shows the raw data for 2018 on income-tax progressivity for the US states and Canadian provinces grouped by population size to better understand our estimates.

Figure 5: Progressivity of state/provincial personal income taxes (ratio of highest to lowest tax rate), comparison by population size of Canadian provinces and US states, 2018



Sources: Government of Canada, 2022; Tax Foundation, 2022.

13. Progressivity reflects how rapidly tax rates rise over a range of income. The ratio of the top to the bottom rate is the most frequently employed measure as the data on statutory tax rates are consistently available. A comparison of the average tax rate at some arbitrary higher versus lower income level is another measure employed in the literature, but it requires micro-level data on tax payments and a subjective decision on which two levels of income to compare. Because the top and bottom rates begin and end at different income levels in different states and provinces, we also control for these bracket thresholds. One might expect that the higher the starting income level of the top bracket, for example, the higher the rate that may apply, so the coefficient on the bracket ratio will be positive. Indeed, this is the case in the estimations, and the effect is statistically significant in the full sample only.

As can be seen in the data, there is little in the way of a consistent pattern across the full sample of states and provinces, although the largest Canadian provinces do seem to have slightly higher average levels of income-tax progressivity in the recent raw data than the smaller Canadian provinces. Interestingly, the smaller and middle-sized US states do appear to have significantly more progressive income taxes than smaller and middle-sized Canadian provinces, while the largest provinces and states seem to both have similar degrees of personal income-tax progressivity.

6 Conclusion

Across both Canadian provinces and US states there are substantial differences in population sizes. The largest Canadian province is over 90 times more populous than the smallest and the largest US state is almost 70 times more populous than the smallest. While the largest US state (California) is significantly larger than the largest Canadian province (Ontario), as a whole the Canadian provinces are fairly evenly distributed among the US states when viewed as a group. Ontario, for example, has the fifth largest population among the combined grouping. This study has attempted to examine whether these differences in population size consistently influence subnational government fiscal outcomes. Using a sample of almost three decades of data, there are some clear conclusions.

First, among smaller and medium-sized states and provinces size of government as a share of the economy generally falls with population size. This is true of both expenditure and revenue, and is also true whether local governments are included or excluded. In the combined sample of states and provinces, for roughly every 5 million additional population central state and provincial total expenditure (or revenue) as a share of state/provincial GDP falls by approximately one percentage point. This effect is somewhat stronger when estimated on a subsample of Canadian data alone, falling by one percentage point for roughly every one or two million in additional population. The estimated negative effect once local governments are included is slightly smaller for US states but is roughly the same for Canadian provinces. There is an end to this negative relationship, however, as beyond some population size government as a share of the economy begins to rise again. This point is estimated to be approximately 9.6 million for Canadian provinces, and 21 million for US states. Thus, the largest subnational jurisdictions of Ontario and California are beyond the population sizes that minimize government size as a share of the economy. Subnational government size as a share of the economy is generally about 5 to 6 percentage points larger in Canadian provinces than US states and is also larger for US states with a larger share of the population aged 65 and older.

Second, there seems to be no consistent relationship between the size of states and provinces and their reliance on debt, or their annual budget imbalances (surpluses and deficits), although the US states have significantly less debt, and run smaller deficits, than the Canadian provinces, as might be expected because of the balanced-budget constraints most US states face. The one possible exception is that, in the recent data, the largest Canadian provinces did seem to have slightly higher average surplus levels.

Third, larger states and provinces tend to rely relatively less heavily on consumption taxes, and relatively more heavily on income taxes, compared to smaller states and provinces. This is perhaps the most interesting finding given how much academic attention is paid to the relative merits of these two types of taxes. The estimates suggest that for every additional one million in population size, reliance on consumption taxes falls by about 2 to 3 percentage points relative to reliance upon income tax, with the effect

being larger once local governments are included. Canadian provinces do appear to rely relatively less heavily on consumption taxes (and relatively more heavily on income taxes) compared to US states, especially once local data is included.

Fourth, there is no robust evidence of a strong correlation between the progressivity of personal income tax and population size, although the largest Canadian provinces do seem to have slightly higher average levels of personal income-tax progressivity in the recent raw data when compared with smaller Canadian provinces. The average personal income-tax progressivity in the largest US states is roughly similar to what it is in the largest Canadian provinces. Smaller and middle-sized US states, however, do appear to have more progressive personal income taxes than smaller and middle-sized Canadian provinces.

In the end, size does matter for the fiscal outcomes of subnational jurisdictions in Canada and the United States, although it matters more for some fiscal outcomes than others.

Appendix A: Data Sources

[See "Sources", pp. 37–38 for specific data locations]

Canada

- Years of data included: 1991–2018; 10 Canadian provinces.
- Demographic and economic data including provincial population, 65+ population share, and provincial gross domestic product (expenditure-based GDP) are sourced from Statistics Canada <https://www150.statcan.gc.ca/>.
- Fiscal data including provincial net debt (only available at the provincial level; total provincial and local were unavailable), provincial and local expenditure, and revenue data are sourced from Finances of the Nation <https://financesofthenation.ca/>.
- Personal income tax rate and threshold information sourced from Government of Canada <https://www.canada.ca/en/revenue-agency/services/tax/individuals/>.
- The author thanks Joel Emes and Milagros Palacios (Fraser Institute) for assistance in the collection of this data.

United States

Years of data included: 1991–2018; 50 US states.

- Demographic and fiscal data including state population, 65+ population share, state and local debt, expenditure, and revenue are sourced from the United States Census Bureau <https://www.census.gov/>. Note that local data was not available for 2001 and 2003 so for those two years only state-level data is available.
- Economic data including state gross domestic product (GDP) are from the United States Bureau of Economic Analysis <https://www.bea.gov/>.
- Personal income tax rate and threshold information sourced from The Council of State Governments, *Book of the States Archive*, various issues <https://issuu.com/csg.publications/stacks/46495f12f95847e6935d331969ed650a>; and the Tax Foundation <https://taxfoundation.org/>.
- Balanced budget rule data is from National Conference of State Legislatures <https://www.nasbo.org/>, National Association of State Budget Officers <https://www.ncsl.org/>, and United States Advisory Commission on Intergovernmental Relations (ACIR), *Fiscal Discipline in the Federal System* <http://digital.library.unt.edu>.
- The author thanks Joel Emes and Milagros Palacios (Fraser Institute) for assistance in the collection of this data.

Common data sources for both countries

- Source for all geographic area data: Homeland Infrastructure Foundation-Level Data (HIFLD) <https://hifld-geoplatform.opendata.arcgis.com/datasets/political-boundaries-area>.
- The author thanks Chris Mothorpe (College of Charleston) for assistance in the collection and access to this GIS data.
- Legal origin and statehood data is compiled from various internet-searched sources.

Appendix B: Descriptive Statistics

	Full Sample			Last Year (2018)		
	Mean	Min.	Max.	Mean	Min.	Max.
Population (Mil.)	5.41	0.13	39.46	6.05	0.15	39.46
Area (Mil. Sq. Mi.)	0.25	0.00	3.15	0.25	0.00	3.15
Canadian Province	0.17	0.00	1.00	0.17	0.00	1.00
French Legal Origin	0.18	0.00	1.00	0.18	0.00	1.00
Latitude	40.80	21.32	58.32	40.80	21.32	58.32
Ocean Border	0.52	0.00	1.00	0.52	0.00	1.00
Year of Statehood	1847.1	1787.0	1959.0	1847.1	1787.0	1959.0
Percent Aged 65+	13.46	4.18	20.73	16.72	11.07	20.73
Budget Stringency	6.73	0.00	10.00	6.73	0.00	10.00
Gov. Bal. Budget	0.72	0.00	1.00	0.72	0.00	1.00
No Carryover Deficit	0.62	0.00	1.00	0.62	0.00	1.00
Exp % GDP (S/P)	14.50	7.50	40.05	14.73	8.60	27.64
Exp % GDP (S/P&L)	20.72	11.86	43.27	20.52	14.78	31.21
Rev % (S/P)	15.06	3.45	39.25	15.64	9.43	28.38
Rev % GDP (S/P&L)	21.44	9.41	47.39	21.85	15.77	32.75
Debt % GDP (S/P)	10.41	-13.07	67.56	10.11	1.62	42.79
Debt % GDP (S/P&L)	15.59	4.93	56.17	14.29	4.93	23.29
Surplus/Deficit % GDP (S/P)	0.56	-10.97	18.58	0.91	-5.73	6.09
Surplus/Deficit % GDP (S/P&L)	0.72	-11.94	19.16	1.33	-4.89	5.43
Ratio Cons/Inc Tax Rev (S/P)	110.75	11.37	293.85	109.46	17.14	293.85
Ratio Cons/Inc Tax Rev (S/P&L)	124.76	17.90	376.15	128.83	22.96	351.66
Ratio Top/Bot Inc Tax Rate	3.53	0.99	24.95	3.43	1.00	24.94
Top/Bottom Bracket	14.07	0.00	1000.00	19.48	0.00	250.00

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Acknowledgments

The author thanks Joel Emes and Milagros Palacios (Fraser Institute) for assistance in the collection of Canadian and US data; and Chris Mothorpe (College of Charleston) for assistance in the collection and access to the GIS data. Any remaining errors or oversights are the sole responsibility of the author. As the researcher has worked independently, the views and conclusions expressed in this paper do not necessarily reflect those of the Board of Directors of the Fraser Institute, the staff, or supporters.

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Date of issue

2022

ISBN

978-0-88975-713-4.

Citation

Russell S. Sobel (2022). *Population and the Fiscal Outcomes of Subnational Jurisdictions*. Fraser Institute. <http://www.fraserinstitute.org>.

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