REVENUE NOTE

New York City Council
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March 2018

Budget Reserves: How Much Does New York City Need?

In January 2007, the country slid into a recession. By the fall of 2008, a full-blown financial crisis broke out, the likes of which the country had not seen since the 1930s. It took time for the crisis to affect state and local governments, but when it did, it hit them hard. Between 2009 and 2013, real spending by state and local governments fell by 8.4 percent.[2] Between 2009 and 2011, the number of teachers in the United States fell by 220,000, or 5.6 percent.[3] In the same period, the number of police officers fell by 56,000, or 8.4 percent.[4] With reductions in spending and personnel came a loss of services. Far too often, these reductions affected children, the elderly, and other vulnerable populations. At the municipal level, the National League of Cities found that 25 percent of municipalities in the United States had made reductions to public safety programs, usually one of the last areas to see cuts, during the Great Recession.[5]

With the impact of budget cuts and tax increases resulting from the crisis, the people and government of New York City experienced hard times. However, the City did not see the level of reductions of services or public sector layoffs experienced by the rest of the country. New York had an ace in the hole – during the good times the City had saved, creating budgetary reserves that were used to cushion the blow of the Great Recession. In Fiscal 2008, the City's reserves peaked at $11 billion. Between Fiscal 2009 and Fiscal 2013, the City used approximately $7 billion in reserves to help balance its budget. Since Fiscal 2014, reserves have been growing again.[6]

This paper looks at budgetary reserves and asks the question: how much does New York City need? Maintenance of reserves entails costs and benefits, and the appropriate level of reserves depends upon the attitude towards risk held by the public and its representatives. A forecast-simulation model is used to simulate possible paths for the overall balance (revenues minus expenditures) of the City's budget between Fiscal 2018 and Fiscal 2021. Roughly speaking, in these simulations, three out of ten

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[1] The Revenue and Economics Unit wishes to thank: Kenneth Kriz (Regents Distinguished Professor of Public Finance, Wichita State University), Philip Martin (Chief Data Scientist, Policy and Innovation Division, New York City Council), Lawrence Mielnicki (Chief Economist, New York City Office of the Comptroller), Luis Daniel Torres Gonzalez (Doctoral Candidate in Economics, New School for Social Research), Rebecca Chasan and Eric Bernstein (Counsels, Finance Division New York City Council)

[2] Finance Division calculations based on US Bureau of Economic Analysis data, State and Local purchases on a National Income and Product Accounts (NIPA) basis.

[3] Michael Greenstone and Adam Looney "A Record Decline in Government Jobs: Implications for the Economy and America's Workforce." Brookings on Job Numbers, August 3, 2012, https://www.brookings.edu/blog/jobs/2012/08/03/a-record-decline-in-government-jobs-implications-for-the-economy-and-americas-workforce/.

[4] Id.

[5] Javier C. Hernandez "Bloomberg Offers 'Good News' on New York's Budget." *The New York Times*, February 17, 2011, https://www.nytimes.com/2011/02/18/nyregion/18nycbudget.html.

[6] Reserves are "End of Year Reserves" defined below.

times the budget will end each year either balanced or with a surplus (without the need for tax increases, budget cuts, or the need to use reserves). Additionally, slightly under four out of ten times, the $8.3 billion in reserves that the City held at the end of Fiscal 2017 would be sufficient to cover budget shortfalls over the same period. Finally, approximately three out of ten times, current reserves will be insufficient to balance the budget over this period. Following a discussion of the results of this simulation, the paper ends with a discussion of the costs of keeping reserves, as well as the risks that the model does not account for (e.g. political risks and the risks of infrastructure failure). The model is described in detail in the appendix of this paper.

Budgeting and Risk

Budgeting involves making decisions about future needs, the costs of meeting those needs, and the resources available in the future. Since the future is unknown, budgeting takes place in a world of risk and uncertainty. Risk involves possible events where it is possible to calculate, based on experience, the odds that such events will occur. Uncertainty refers to possible occurrences for which probabilities cannot be calculated and therefore cannot be modeled; it may also refer to events that may not even be known as possibilities.[7] Both risk and uncertainty matter for budgeting.

There are a variety of risks in the City Budget. A few of the more important are:

Risks due to the business cycle	Risks due to price fluctuations	Political Risks	Other Risks
• Tax Revenue	• Pensions • Debt Service • Health Insurance Costs • Other input prices • Labor contracts	• Federal/State Categorical Grants	• Self-insurance • Infrastructure • Extreme events

Some of these risks are managed by specialized reserves, such as the collective bargaining reserve and the reserve for disallowances of state and federal grants, while other risks have specialized mechanisms to manage them. For example, the pension funds' portfolios have diversification rules to reduce their risk, as well as rules to smooth out the impact of gains and losses in the portfolio on the City's budget.

As the introduction to this paper suggests, the most significant risk to the City's budget comes from the impact of the City's economy on City tax revenue. In Fiscal 2017, local taxes accounted for 64 percent of the City's total budget of approximately $84 billion.[8] The City has a number of taxes that depend heavily on Wall Street, and others that depend heavily on the buying and selling of real estate. These major sources of revenue are highly volatile and are subject to steep decreases during economic downturns. For example, revenue from the City's personal income tax fell from $8.2 billion in Fiscal 2008 to roughly $5.5 billion in Fiscal 2009, a decrease of nearly 33 percent. The City's

[7] Pablo A. Guerron-Quintana "Risk and Uncertainty." Federal Reserve Bank of Philadelphia, Business Review Q1 2012.
[8] The remainder of the City's budget comes from State aid (17 percent) and federal aid (11 percent), the latter of which has become smaller as a proportion of total revenue over the past few decades.

mortgage recording tax, which is even more volatile, decreased by over 53 percent during the same period.

Although there is substantial volatility in many of the City's other taxes, New York City's tax revenue is overall more stable than that of other governments, such as New York State. This is largely due to the stabilizing effect of the City's property tax. Thus, even with the extreme dips in the taxes mentioned above (among others) between Fiscal 2008 and Fiscal 2009, total tax revenue dropped by only nine percent.[9] In stark contrast to the other taxes, property tax collections during this time actually grew by almost 5.5 percent, lessening the blow of the recession.

New York City Reserves

New York City's fiscal cushion consists of several reserve accounts and other funds. The function and purpose of these accounts vary, as does the amount of money that is appropriated each year for each fund.

New York City applies Generally Accepted Accounting Principles (GAAP) to both its accounting and budgeting. The City has a strict balanced budget requirement, which can be traced to the Financial Emergency Act of 1975, and which was incorporated into the New York City Charter in 2005.[10] This requirement limits the City's ability to use savings from prior years to pay current year expenses.[11] It also prohibits the City from having a rainy day fund of the kind that most states have created.[12] Accordingly, the City has developed a set of practices that provide budgetary cushions within these rules.[13] Some of the City's principal reserve funds include:

The **General Reserve** account acts as a temporary contingency reserve, covering reductions in projected revenues or increases in projected expenditures in a given year.[14] It must contain at least $100 million at the start of any fiscal year.[15] Because the account is funded at the beginning of each fiscal year, it does not act as a long-term reserve tool. Instead, if unused funds remain in the reserve at the end of the fiscal year they are transferred out, typically to the Budget Stabilization Account (BSA/Surplus Roll). In Fiscal 2015, the amount allocated to the General Reserve was raised from $300-450 million to $750 million, and in Fiscal 2016 that amount was raised once again to $1 billion. As of the Fiscal 2019 Preliminary Financial Plan, the City allocated $1 billion annually through Fiscal 2022.

The **Capital Stabilization Reserve**, created in 2016, has been designated for use in funding capital projects. Funds that are not used in the current fiscal year can be used to pay off

[9] Both the change in total tax revenue and the change in property tax revenue discussed below are adjusted for tax policy changes. The Fiscal 2009 program included approximately $580 million in tax increases primarily from an increase in the property tax rate.

[10] New York City Charter § 258(a).

[11] Office of the New York City Comptroller Scott M. Stringer, "Measuring New York City's Budget Cushion" NYC Budget Brief, August 2015, p.2

[12] Pew Charitable Trusts "State Rainy Day Funds in 2017" http://www.pewtrusts.org/en/research-and-analysis/fact-sheets/2017/07/state-rainy-day-funds-in-2017

[13] For the development of these practices see: Dall Forsythe "Cyclical Budget Management in New York City" Public Budgeting and Finance Section of the Western Social Science Association, Phoenix, AZ, April 20, 2006.

[14] New York City Charter § 258(b)(5).

[15] Id.

outyear debt service and to fund bond defeasance.[16] The reserve first appeared in the Fiscal 2016 budget with an allocation of $500 million. In the Fiscal 2019 Preliminary Financial Plan, $250 million has been pledged for each year between Fiscal 2019 through 2022.

The **Budget Stabilization Account/Surplus Roll Reserve** is used to roll over current year surplus resources. These funds are then used to prepay debt service and certain subsidies, such as those to the city's library systems or to NYC Health and Hospitals. In Fiscal 2017, the surplus roll was $4.2 billion, and in Fiscal 2018 the roll is currently $2.6 billion, but will likely end the year higher.[17]

The **Retirement Health Benefit Trust (RHBT)** was created at the end of Fiscal 2006 with the intention of helping offset "Other Post-Employment Benefits" (OPEB) liabilities. The Governmental Accounting Standards Board defines OPEB liabilities as any benefit to public retirees other than pensions.[18] This includes life insurance, disability payments, and health care. Currently, the City pays this expense on a pay-as-you-go basis, as opposed to actuarial funding. The net OPEB liability was valued at approximately $88.4 billion in Fiscal 2017. The RHBT's primary purpose is to cover health insurance costs for future retirees with the secondary function of acting as a reserve. The fund was started with a $1 billion deposit in Fiscal 2006 and a $1.5 billion contribution in Fiscal 2007. With accumulating interest, along with an additional contribution of $460 million in Fiscal 2008, the trust reached a balance of nearly $3.2 billion in Fiscal 2008. During the recession, the fund was used as a de facto reserve because the City did not contribute additional funds, and the balance reached a low of roughly $1.4 billion by the end of Fiscal 2013. Since Fiscal 2013, the City has contributed an additional $2.4 billion and the total now stands at over $4.6 billion.[19]

How much does the City have in Reserves?

Given the various reserves and budgetary cushions with the City's budget, it is instructive to calculate the total amount that the City has in reserves. There are at least three different methods of approaching this question, including:

- End-of-Year Reserves = Surplus Roll + Bond defeasances + end-of-year RHBT balance.
- Reserves in Plan = Current Year General Reserve + Current Year Capital Stabilization Reserve + RHBT balance.

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[16] Bond defeasance is a way of paying off or retiring outstanding bonds.

[17] As of the Fiscal 2019 Preliminary Financial Plan

[18] Governmental Accounting Standards Board, "SUMMARY OF STATEMENT NO. 45: *ACCOUNTING AND FINANCIAL REPORTING BY EMPLOYERS FOR POSTEMPLOYMENT BENEFITS OTHER THAN PENSIONS*" (issued June 2004), http://www.gasb.org/st/summary/gstsm45.html

[19] In addition to the primary reserves discussed here, the City also has maintained two special reserves:

1) The Reserve for Disallowances is set-aside to safe-guard against the potential rejection of City claims for federal and State categorical grants. The account averaged a balance of $230 million between Fiscal 1980 and 2005. The City began increasing the reserve's holdings in Fiscal 2006 and at the end of Fiscal 2016 the reserve held $1.1 billion. At this time, a review conducted by the Office of Management and Budget concluded a lower balance would be sufficient and $628 million was released from the reserve.

2) The Reserve for Collective Bargaining is used to set aside funds that will be used for anticipated wage increases. The reserve operates under the assumption that there will be a wage increase of one percent per year following the expiration of contracts from the 2010-2017 round of collective bargaining.

- Prior-year Accumulated Resources and Reserves (PARR) = Reserves in Plan + Current Year Budget Stabilization Account + Bond defeasances.

Historically the Finance Division used the End-of-Year Reserve measure, which is similar to that reported by the National Association of State Budget Officers, to calculate the City's reserves.[20] By this measure, the City had $8.4 billion in reserves at the end of Fiscal 2017.

The Mayor's Office of Management and Budget (OMB) uses the Reserves in Plan measure, which focuses on the current year in the financial plan. By this measure, the City has $5.5 billion in reserves, as of the Fiscal 2019 Preliminary Financial Plan.

In 2015, the City Comptroller introduced the PARR measure, which was subsequently adopted for use by the Finance Division. Like the Reserves in Plan measure used by OMB, it focuses on the current year plan, but is designed for the latter part of the fiscal year, when the plan is already preparing to roll money into the next year. In the Fiscal 2019 Preliminary Financial Plan, the PARR number is identical to Reserves in Plan number of $5.5 billion.

The forecast-simulation in this note calculates the end of the year budget balance. The forecast-simulation does not use the financial plan, so there are no assumptions about the size of the General Reserve or the Capital Stabilization Reserve. Because of this factor, both the Reserves in Plan and PARR measures are inappropriate for this study. Therefore, in this paper, reserves are calculated using the End-of the-Year measure.[21] Based on this measure, the City's reserves totaled $8.4 billion at the end of Fiscal 2017.

Risk and Reserves

The Finance Division next assessed the level of reserves necessary to protect the City from the need to increase taxes or make budget cuts to achieve a balanced budget. In order to answer this question, the Division followed an approach developed by Dr. Kenneth Kriz, Director of the Kansas Public Finance Center at Wichita State University.[22] The methodology is described in detail in the appendix to this note.

The forecast-simulation method chosen for building a model of potential budget balances has two key parts. The first part is a forecast of the tax revenues and expenses of New York City's budget for Fiscal 2018 through Fiscal 2021. This is done using a tool common in macro-economics, a Vector Error Correction Model. In short, this is a time-series statistical model of the tax revenues and total expenditures of the City. The Finance Division model uses economic variables often used as predictors of those revenues and expenditures – namely, total wage and salary disbursements in New York City and before-tax economic profits.

[20] https://www.nasbo.org/reports-data/fiscal-survey-of-states

[21] The chosen measure of reserves does carry one caveat, namely that the RHBT constitutes a large part of the end-of-year Reserves, but nominally its primary purpose is to offset OPEB liabilities. However, as noted above it has been used like a rainy day fund and its portfolio is more like a rainy day fund than a fund offsetting a long-term liability. RHBT holds short-term liquid assets useful for quickly drawing down large portions of the reserve.

[22] Kenneth Kriz "Is there an Optimal Size of Fiscal Reserves for Local Government? Chapter 9 in Local Government Budget Stabilization Explorations and Evidence, edited by Yilin Hou, Springer New York 2015.

The second part uses a Monte Carlo simulation of the end-of-the-year balance of the City's budget. These simulations are commonly used in financial economics to model the probability of different outcomes. Information from the initial forecasts is used to simulate 10,000 five-year trajectories of the City's budget balance. Based on these simulations, one can determine the probability that a certain amount of reserves will be adequate to protect the City from having to make budget cuts or raise taxes.

Based on these forecasts, the table below shows the level of reserves the City should have at various levels of confidence. Through the entire period, there is a 30 percent certainty that no reserves would be necessary to avoid tax increases or budget cuts, because the budget would end the period with a surplus. To be 90 percent certain that tax increases or budget cuts would not be needed, the City should hold $12.7 billion in reserves by Fiscal 2021, and to be 50 percent certain, the City could hold as little as $2.6 billion in reserves.

Table 1: Cumulative Reserves Needed by Level of Certainty* ($ millions)

Percent Certainty	FY 2018	FY 2019	FY 2020	FY 2021
20%	surplus	surplus	surplus	surplus
30%	surplus	surplus	surplus	surplus
40%	surplus	surplus	100	600
50%	300	700	1,500	2,600
60%	900	1,800	3,000	4,600
70%	1,600	2,900	4,600	6,700
80%	2,400	4,200	6,400	9,200
90%	3,500	6,000	9,000	12,700
95%	4,400	7,500	11,300	15,600
99%	6,200	10,400	15,100	20,700

* Figures rounded to the nearest hundred million.

The table above indicates how risk and uncertainty accumulate over time. For example, in order to be 80 percent certain of getting through Fiscal 2018 without tax increases or budget cuts, $2.4 billion in reserves would be necessary. To be 80 percent certain of getting through Fiscal 2020, $6.4 billion would be necessary. Finally, to be 80 percent certain of getting through Fiscal 2021, $9.2 billion would necessary. The City's Fiscal 2017 end of year reserves, totaling $8.3 billion, gives the City approximately an 80-90 percent chance of getting through Fiscal 2020, and a 70-80 percent chance of getting through Fiscal 2021.

Deciding on Reserves: Considerations for Policymakers

Reserves are resources that could be used today to provide additional public services or to lower taxes. Forgoing these options is the cost of keeping reserves. How one views this cost depends on how one thinks about services today compared with services in the future. Most people tend to discount benefits received in the future. [23] Thus, avoiding $1 billion in budget cuts in four years might

[23] Hiroyuki Kohyama, "Selecting Discount Rates for Budgetary Purposes," Harvard Law School Federal Policy Seminar, May 22, 2006 http://www.law.harvard.edu/faculty/hjackson/DiscountRates_29.pdf.

not be worth $1 billion today. As such, New Yorkers might prefer to keep only $850 million in reserves, while spending $150 million today and accepting $150 million in cuts in the future.

This tradeoff is a policy question rather than a technical decision. Does the City want to save enough to manage shortfalls without budget cuts or tax increases? Alternatively, should it have more services and lower taxes now, and then make cuts and raise taxes when times get tough? This is a choice for the Council and the Mayor acting on behalf of the people of the City.

However, there is a considerable economics literature on social discount rates, which are the rates used to calculate the present value of future costs in government budgeting.[24] Following the approach taken by Kriz, the Finance Division calculated the present value of the necessary reserves using a four percent discount rate, which is the annual rate for variable rate Transitional Finance Authority (TFA) Bonds in the Fiscal 2018 November Financial Plan.[25] This is demonstrated in Table 2 below.

Table 2: Comparison of Cumulative Needed Reserves and Socially Discounted "Optimal" Reserves

Percent Certainty	Reserves Needed to Cover Cumulative Deficits 2018-2021	Optimal Reserves 2018-2021
20%	surplus	surplus
30%	surplus	surplus
40%	633	563
50%	2,600	2,300
60%	4,600	4,100
70%	6,700	5,900
80%	9,200	8,100
90%	12,700	11,300
95%	15,600	13,900
99%	20,700	18,400

* Figures rounded to the nearest hundred million.

Reserves calculated using the social discount rate are known as "optimal reserves." They are optimal in the sense that the calculation considers both the need for reserves and the cost of reserves.

[24] Id.

[25] In selecting a discount rate, Kriz (2015) takes the approach that the percentage to be used should be "our estimate of the cost of obtaining capital for a jurisdiction with a moderately strong credit rating." The optimal level in this paper was calculated by using:

$$Reserve\ Total_{\ 2018-2021} = \frac{Balance_{2018}}{(1+i)} + \frac{Balance_{2019}}{(1+i)^2} + \frac{Balance_{2020}}{(1+i)^3} + \frac{Balance_{2021}}{(1+i)^4}$$

Where i is the discount rate (in this case four percent).

Comparing optimal reserves to the reserves needed to cover cumulative deficits, it is clear that the optimal level of reserves would be insufficient to safeguard the City from having to make budget cuts or raise taxes. As discussed above, in order to be 80 percent certain the City could cover cumulative deficits between Fiscal 2018 and Fiscal 2021, the City would need $9.2 billion in reserves. However, considering the cost of reserves using the social discount rate, it would make sense to keep a smaller level of reserves, in this case $8.1 billion, and to plan to cover the rest of the deficit by budget cuts and tax increases in the future.

Finally, the Finance Division comments that it would be wise to augment the amount of reserves chosen based on the model discussed above, because the model does not capture certain risks.[26] These risks include:

- Political risks to the City's budget. In December 2017, the President signed the Tax Cuts and Jobs Act, the effects of which will have an impact on City tax revenues. Due to the projected deficits that will result from the Act, it will also undermine the public finance of the United States in a way that could lead to reductions in federal grants to the City and federal programs for the people of the City. Reserves cannot protect from the long-term impact of such legislation, but they can make it easier to adjust to the new levels of federal aid.
- Infrastructure risks. The City's subways and public housing stock have experienced crises related to long-term shortfalls in capital spending and maintenance. Reserves are not designed to cover these long-term problems, but can provide emergency funding to address some of the associated issues.
- Uncertainty. There are things that matter for which "there is no scientific basis on which to form any calculable probability whatever. We simply do not know."[27] For this immeasurable reason alone, it is worth it to add a little more to the reserves.

Summary

As of the present time, and assuming that the preference for services today can be summed up with a 4 percent social discount rate, the Fiscal 2017 End of the Year Reserves of $8.4 billion provide an 80 percent certainty of having sufficient reserves, and a $200 million buffer for risks not in the model.

Given the Finance Division's model of the budget, and simulation of the budget balance, policymakers in New York City must make three decisions in determining the necessary level of reserves that the City will need to hold:

- What degree of certainty should the City be comfortable with in determining that it has sufficient reserves?
- How much do the people of the City prefer services received today to services received in the future?
- How much should the City add to reserves to deal with risks not addressed in the above model?

[26] The Government Financial Officers Association in its "Risk-Based Analysis of General Fund Requirements" (May 2013) recommends a "Triple A Approach:" accept there is uncertainty, assess its impact and augment because you will not catch everything.

[27] John Maynard Keynes, The General Theory and After: Defense and Development. Vol. 14 of The Collected Writings of John Maynard Keynes. London: Macmillan, 1973, pp. 113-114

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Appendix

The methodology used closely follows the work of Kenneth Kriz, "Is There an Optimal Size of Fiscal Reserves for Local Governments?"[28]

The Data

There are four **endogenous variables** used (three revenue variables and total expenditures):

1. Real Property Tax
2. Income Sensitive Taxes
3. All Other Revenue
4. Total Expenditures

The primary endogenous variable, and the leading revenue source for New York City, is the Real Property Tax. Income Sensitive Taxes is a catch-all endogenous variable; it is the sum of the following City taxes: personal income, business corporation, commercial rent, hotel occupancy, mortgage recording, real property transfer, sales, and unincorporated business. All Other Revenue represents the remaining sources of revenue: intergovernmental aid (State and federal), utility, cigarette, and other miscellaneous revenues.

Each of the revenue variables is adjusted for tax policy to match current law. The endogenous variables are available for Fiscal Years 1988-2017.

Numerous models, with various combinations of **exogenous variables,** were explored in conducting the analysis. Two variables were ultimately chosen:

1. Total Wage and Salary Disbursements in New York City
2. Before-tax economic profits

Total wages is an excellent indicator of an economy's health and, like before-tax economic profits, is frequently used in the Finance Division's forecasts. These two variables are available for Fiscal 1988-2021 from IHS Global Insight, a data, software and forecasting company often utilized by the Finance Division in its analyses and forecasts.[29]

Vector Error Correction Model and Forecast of Endogenous Variables:

The Division ran a Vector Autoregression (VAR) with the endogenous and exogenous variables listed above. However, a co-integration test according to the Johansen method indicated that the endogenous variables shared a long-term trend. Given this information, the Finance Division proceeded by estimating a Vector Error Correction model (VECM) to predict the revenue and expenditure variables. After some initial testing, a lag length of two was determined to be optimal and two co-integrating equations were identified. The VECM estimation and generated forecasts for Fiscal 2018 through Fiscal 2021 for each endogenous variable are shown below.

[28] See supra, footnote 18.
[29] http://ihsglobalinsight.com/

Vector Error Correction Estimates
Date: 11/14/17 Time: 12:54
Sample (adjusted): 1991 2017
Included observations: 27 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	CointEq2
LOG(REAL_PROP(-1))	1.000000	0.000000
LOG(INCOME_SENS_TAXES(-1))	0.000000	1.000000
LOG(ALL_OTHER_REV(-1))	0.447453	0.893904**
	(0.32962)	(0.29489)
	[1.35747]	[3.03131]
LOG(EXPEND(-1))	-3.764029**	-0.127232
	(0.27445)	(0.24553)
	[-13.7148]	[-0.51819]
C	26.55713	-17.08648

Error Correction:	D(LOG(REAL_PROP))	D(LOG(INCOME_SENS_TAXES))	D(LOG(ALL_OTHER_REV))	D(LOG(EXPEND))
CointEq1	0.145660	-0.331546*	-0.446651*	0.061019
	(0.10872)	(0.17757)	(0.24529)	(0.09887)
	[1.33981]	[-1.86709]	[-1.82092]	[0.61717]
CointEq2	0.197068	-1.13538**	-0.516322	-0.146587
	(0.15198)	(0.24824)	(0.34291)	(0.13822)
	[1.29664]	[-4.57365]	[-1.50572]	[-1.06055]
D(LOG(REAL_PROP(-1)))	-0.038331	-0.227564	-0.443112	0.067599
	(0.25798)	(0.42137)	(0.58205)	(0.23461)
	[-0.14858]	[-0.54006]	[-0.76130]	[0.28813]

D(LOG(REAL_PROP(-2)))	0.390456	-0.899335**	-0.362479	-0.069104
	(0.24027)	(0.39245)	(0.54211)	(0.21851)
	[1.62505]	[-2.29157]	[-0.66865]	[-0.31625]
D(LOG(INCOME_SENS_ TAXES(-1)))	-0.211072	0.123615	0.229887	-0.04552
	(0.14616)	(0.23873)	(0.32976)	(0.13292)
	[-1.44413]	[0.51780]	[0.69712]	[-0.34246]
D(LOG(INCOME_SENS_ TAXES(-2)))	-0.159903	0.084986	0.074346	-0.145554
	(0.13555)	(0.22140)	(0.30583)	(0.12327)
	[-1.17967]	[0.38386]	[0.24310]	[-1.18076]
D(LOG(ALL_OTHER_REV (-1)))	-0.043894	0.203883	-0.072473	-0.060338
	(0.20709)	(0.33825)	(0.46723)	(0.18833)
	[-0.21196]	[0.60276]	[-0.15511]	[-0.32038]
D(LOG(ALL_OTHER_REV (-2)))	-0.312291	0.535538	0.060474	-0.120516
	(0.21697)	(0.35439)	(0.48953)	(0.19732)
	[-1.43932]	[1.51115]	[0.12354]	[-0.61077]
D(LOG(EXPEND(-1)))	0.579480	0.308195	-1.187943	0.088888
	(0.44229)	(0.72242)	(0.99790)	(0.40223)
	[1.31019]	[0.42662]	[-1.19045]	[0.22099]
D(LOG(EXPEND(-2)))	0.811835*	-1.338335*	0.214021	0.557474
	(0.45425)	(0.74196)	(1.02489)	(0.41311)
	[1.78720]	[-1.80380]	[0.20882]	[1.34947]
C	-0.275131	-9.394471**	-1.100625	-3.840886**
	(1.52445)	(2.48999)	(3.43950)	(1.38638)
	[-0.18048]	[-3.77290]	[-0.32000]	[-2.77044]
LOG(WAGES)	0.001389	0.510882**	0.272336	0.253568**
	(0.12742)	(0.20812)	(0.28748)	(0.11587)
	[0.01090]	[2.45480]	[0.94733]	[2.18829]
LOG(ZBIVA)	0.036310	0.455341**	-0.309951**	0.105501**
	(0.05363)	(0.08760)	(0.12100)	(0.04877)
	[0.67705]	[5.19820]	[-2.56160]	[2.16316]

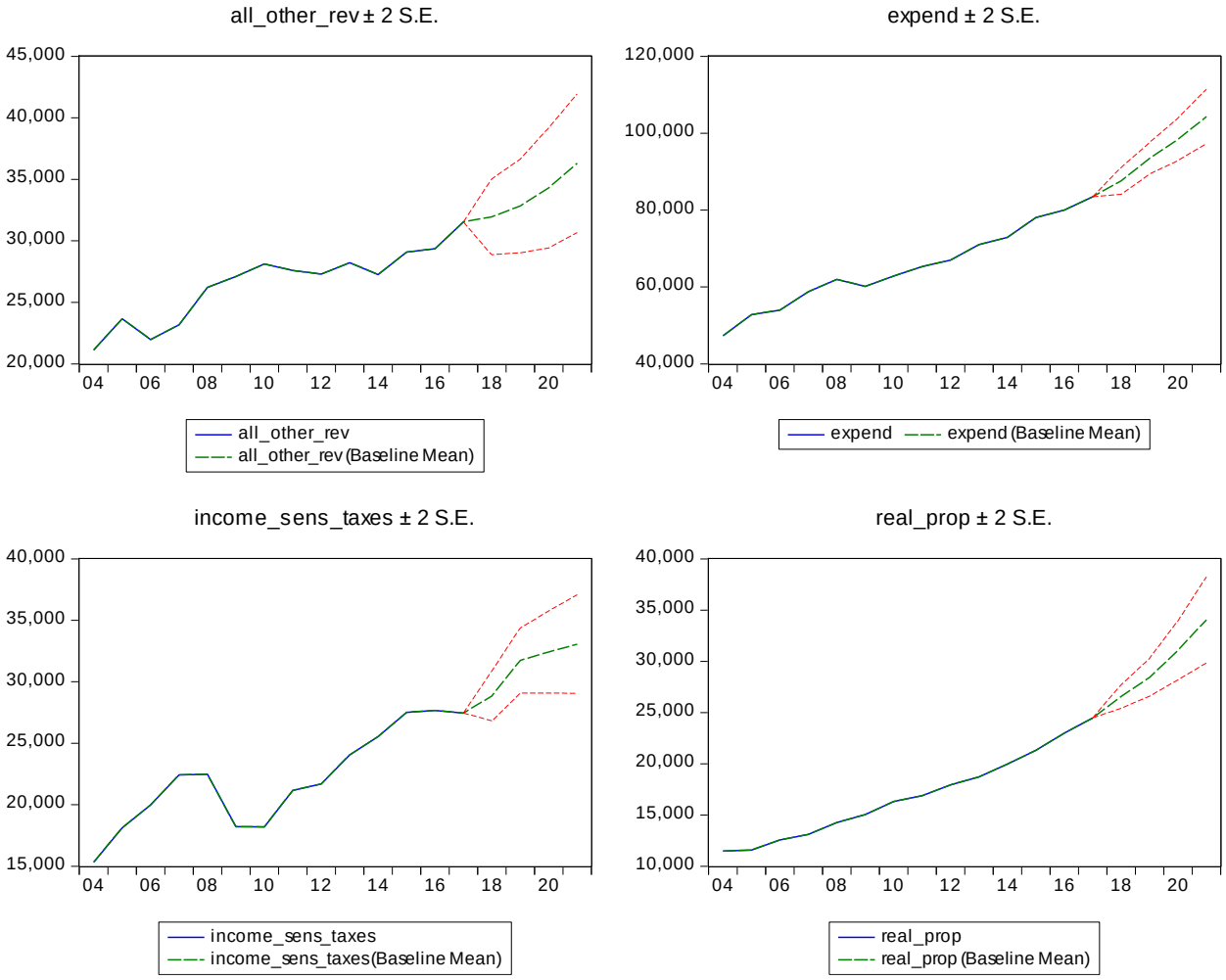
R-squared	0.762806	0.923060	0.553860	0.741418
Adj. R-squared	0.559497	0.857112	0.171454	0.519777
Sum sq. resids	0.006200	0.016540	0.031559	0.005127
S.E. equation	0.021044	0.034372	0.047479	0.019138
F-statistic	3.751956	13.99668	1.448357	3.345126
Log likelihood	74.80655	61.55922	52.83693	77.36994
Akaike AIC	-4.578263	-3.596979	-2.950884	-4.768144
Schwarz SC	-3.954342	-2.973058	-2.326963	-4.144222
Mean dependent	0.040487	0.047932	0.037588	0.043289
S.D. dependent	0.031706	0.090929	0.052160	0.027616

Determinant resid covariance (dof adj.)	3.56E-14
Determinant resid covariance	2.58E-15
Log likelihood	300.2502
Akaike information criterion	-17.79631
Schwarz criterion	-14.91667

* $p < .10$
** $p < .05$

Forecasts:

For the endogenous variables shown below, each X-axis shows Fiscal 2004 through 2021, while each Y-axis measures dollars in millions.



The root mean squares errors (RMSE) of in-sample estimates (back to 2012), were quite low. It is therefore the Finance Division's opinion that these forecasts are reasonable, with the exception of All Other Revenue, which may resemble a random walk. Both revenue and expense forecasts are higher than the Fiscal 2018 November Financial Plan.

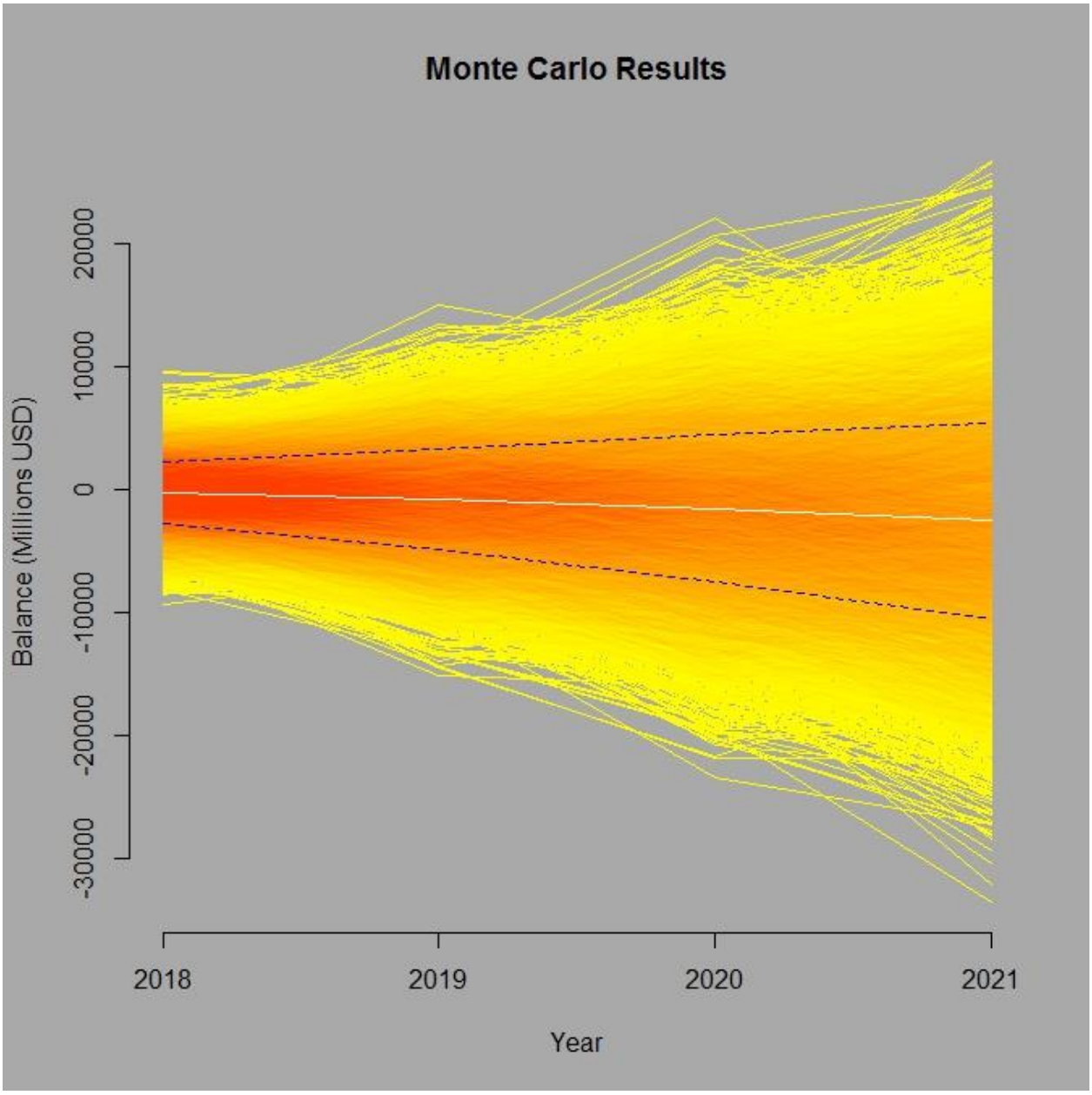
Monte Carlo Simulation

The mean forecast and associated standard errors were then used in a Monte Carlo simulation framework. Ultimately, the interest is in the budget balance (total revenues minus total expenditures) for each year of the forecast. The Balance Equation is as follows:

$$Balance_t = \widetilde{Balance_{t-1}} + \widetilde{Real\ Prop_t} + \widetilde{Income\ Sens\ Taxes_t} + \widetilde{All\ Other\ Revenue_t} - \widetilde{Total\ Expenditures_t}$$

The tildes represent further uncertainty in the realization of each variable. Given each variable's mean and standard deviation for that year, one can draw from the normal distribution and "simulate" thousands of potential estimates for each variable. The frequencies of these simulations will form a normal distribution where one can then determine probabilities.

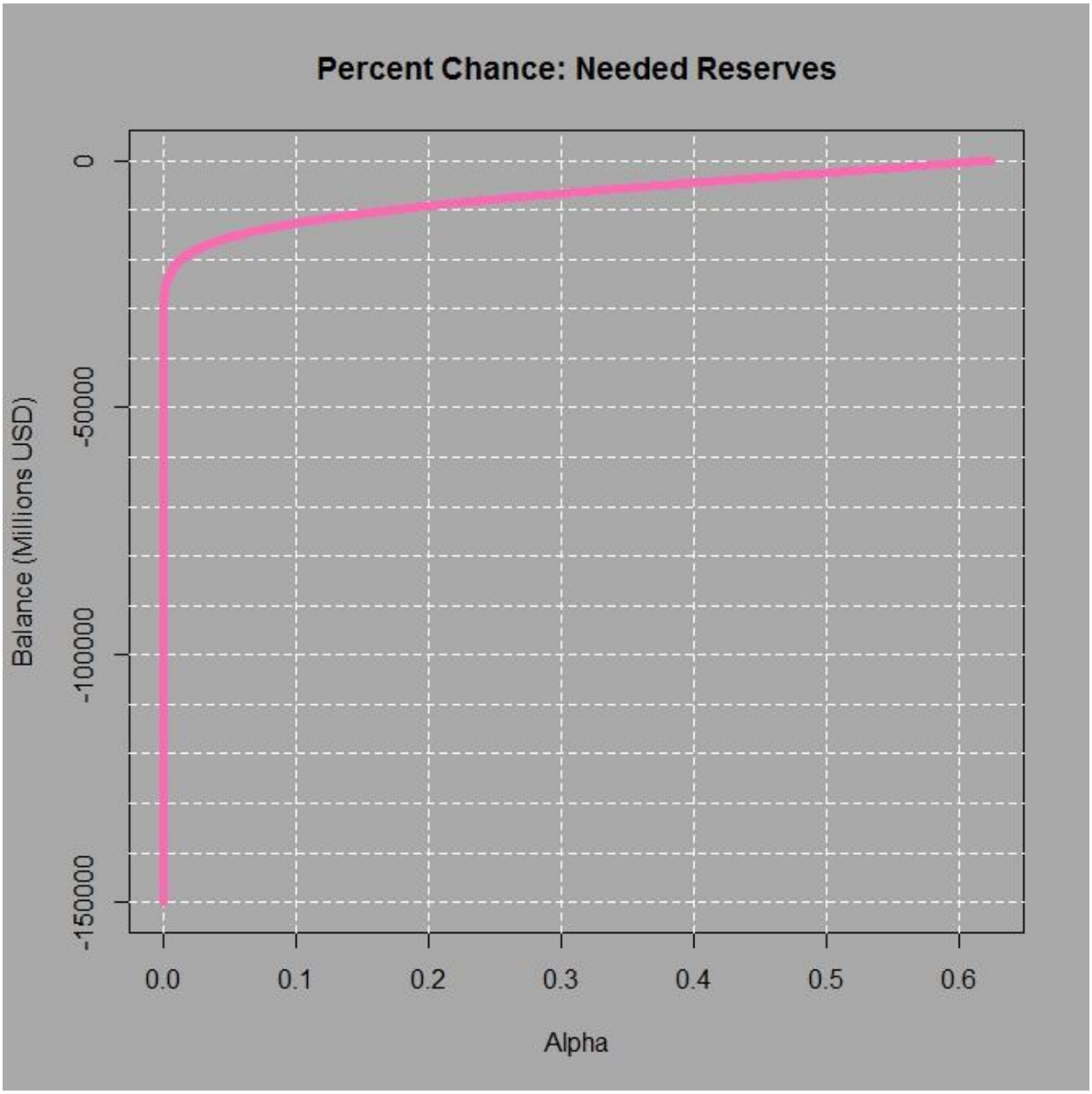
After simulating 10,000 "runs," one can plot the following paths in terms of the balance equation over the forecasted years:



This shows that the average balance (the white line) grows increasingly negative through the outyears, reaching roughly $2.5 billion in 2021. Because the estimates at each year are normally distributed, balances closer to this white line are most likely, with a 68 percent chance the budget balance will be between the two blue dotted lines at any given point. The very worst-case scenario of

the simulations would result in a deficit of roughly $33.5 billion, whereas the best-case scenario would result in a surplus of nearly $26.8 billion – both of which have only a one in 10,000 chance of happening (or 0.01% likelihood).

It is useful to look at other probabilities as well. What if we wanted to be 50 percent sure we had enough reserves so as not to make cuts or raise taxes? 90 percent sure? The following graph shows the cumulative balance deficit (or level of reserves needed) through Fiscal 2021 at various levels of confidence:



For example, if the City wanted to be 90 percent certain (alpha = 0.1) it had adequate reserves to last through the next four years, it should have approximately $12.7 billion in reserves.