Using R to simulate the finances of public sector pension funds

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The Rockefeller Institute of Government is excited to be developing models to simulate the finances of public pension funds, using R.

Public pension funds invest contributions from governments and public sector workers in an effort to ensure that they can pay all promised benefits when due. State and local government pension funds in the United States currently have more than $3 trillion invested, more than $2 trillion of which is in equity-like investments. For example, NYC, has over $158 billion invested. Governments usually act as a backstop: if pension fund investment returns do better than expected, governments will be able to contribute less, but if investment returns fall short they will have to contribute more. When that happens, politicians must raise taxes or cut spending programs. These risks often are not well understood or widely discussed. (For a discussion of many of the most significant issues, see Strengthening the Security of Public Sector Defined Benefit Plans.)

We are building stochastic simulation models in R to help quantify the investment risks and their potential consequences. We are modeling the finances of specific pension plans, taking into account all of the main flows such as current and expected benefit payouts to workers, contributions from governments and from workers, and investment returns, and how they affect liabilities and investible assets. The models will take into account the changing demographics of the workforce and retiree populations. We are modeling investment returns stochastically, examining different return scenarios and different economic environments, as well as different governmental contribution policies. We will use these models to evaluate the risks currently being taken and to help provide policy advice to governments, pension funds, and others. (For a full description of our approach, see Modeling and Disclosing Public Pension Fund Risk, and Consequences for Pension Funding Security)

We have chosen R because:

- It is extremely flexible, allowing us to do data collection, data management, exploratory data analysis, and other essential non-modeling tasks.

- Manipulating matrices is easy.

- It has sophisticated tools for modeling investment returns and for analyzing and presenting results of simulations. And it has great tools for visualizing results.

- The work can be completely open and reproducible, which is essential to the success of this project.

All programming languages have weaknesses. R's great flexibility means that it is easy to write ill-organized programs that are hard to understand and debug. And poorly written programs that do not take advantage of R's strengths can be extremely slow. We believe we

can compensate for these weaknesses by making our programs modular, using a consistent programming style with appropriate documentation, and by using R features smartly and speed-testing where appropriate.

R analysts and programmers interested in learning about the opportunity to work on this project should examine the programmer/analyst position description and related materials at the [Rockefeller Institute's web site](#).