Innovation and productivity policies: A budgetary perspective

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- Policy debates often focus not only on how policy changes may impact outcomes - does the policy achieve its goal? - but also on how policy changes may impact government budgetary outlays and revenues

- Unfortunately, in some cases the policy process – perhaps inadvertently – relies on budgetary estimates that starkly differ from the actual budgetary effects, in ways that might mislead policymakers

- My talk today:
  - Motivating example: High-skilled immigration
  - Articulation of the underlying policy issue: Dynamic scoring
  - Two additional examples: R&D investments and permitting regulations

A few prefatory remarks:

1. The examples are meant to illustrate the magnitudes involved and estimates under feasible alternative approaches; they are not meant to convey a policy position or normative view
2. The details are – or may seem – arcane, complicated, and technical, but I will spend time on them because the details here are important
3. My remarks are US-focused, on the Congressional Budget Office (CBO) and the staff of the Joint Committee on Taxation (JCT)
   - The conceptual issues are quite relevant to the UK, including in particular the work of the Office for Budget Responsibility (OBR)
   - Non-traditional phrasing: "budgetary estimates" rather than "cost estimates" and "revenue estimates" of legislative proposals

Let me also thank without implicating my collaborators and teachers:

- Many extremely patient current and former staff of the CBO and the JCT – including Teri Gullo, Doug Holtz-Eakin, Donald Marron, Ben Page, David Weiner, and especially Doug Elmendorf
- My other collaborators on this work: Matt Clancy, Matt Esche, Glenn Hubbard, Zach Liscow, Jeremy Neufeld
- Alex Arnon and Kent Smetters from the Penn Wharton Budget Model

Outline

1. Motivating example: High-skilled immigration
2. Dynamic scoring: Why, when, and how
3. Three examples
   - High-skilled immigration
   - Federally funded R&D investments
   - Changes to NEPA / permitting

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A Toolkit of Policies to Promote Innovation

Nicholas Bloom, John Van Reenen,
and Heidi Williams

Table 2

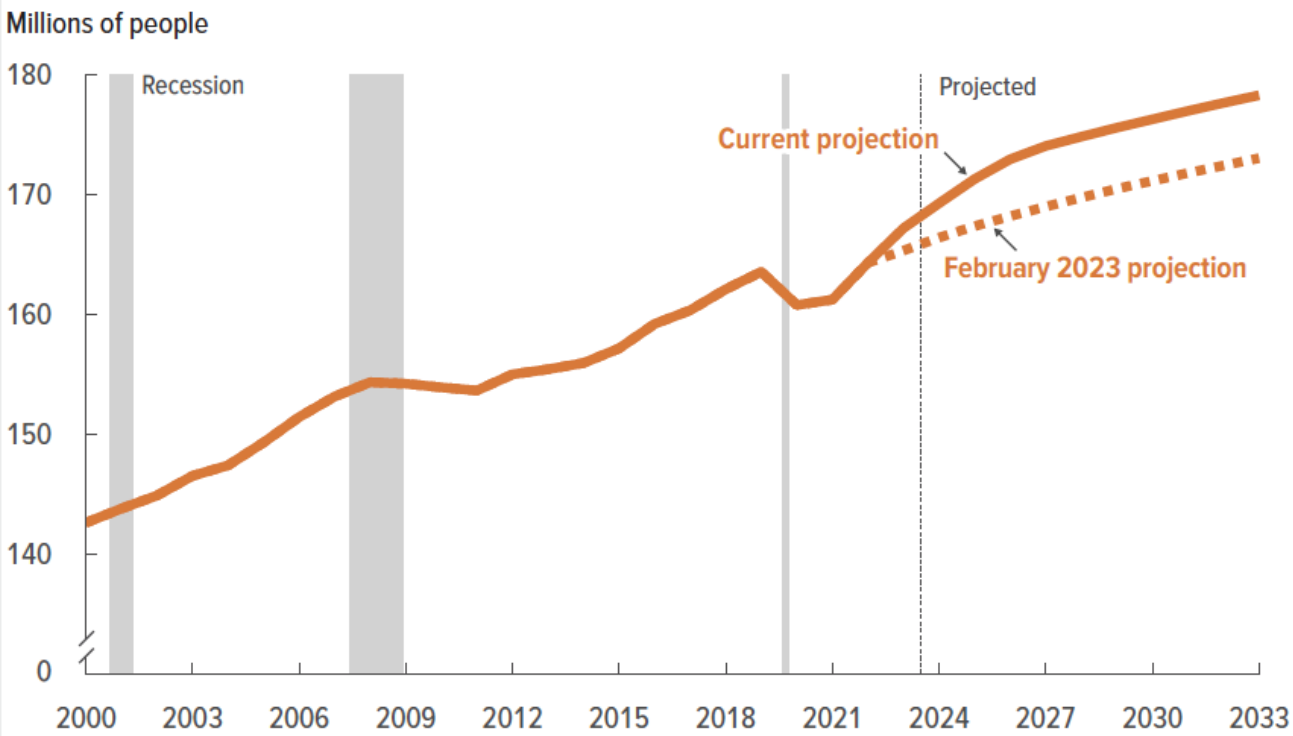
Innovation Policy Toolkit

Policy	*Quality of evidence* (1)	*Conclusiveness of evidence* (2)	*Net benefit* (3)	*Time frame* (4)	*Effect on inequality* (5)
Direct R&D grants	Medium	Medium	💡💡	Medium run	↑
R&D tax credits	High	High	💡💡💡	Short run	↑
Patent box	Medium	Medium	Negative	NA	↑
Skilled immigration	High	High	💡💡💡	Short to medium run	↓
Universities: incentives	Medium	Low	💡	Medium run	↑
Universities: STEM supply	Medium	Medium	💡💡	Long run	↓
Trade and competition	High	Medium	💡💡💡	Medium run	↑
Intellectual property reform	Medium	Low	Unknown	Medium run	Unknown
Mission-oriented policies	Low	Low	💡	Medium run	Unknown

Source: The authors.

Notes: This is our highly subjective reading of the evidence. Column 1 reflects a mixture of the number of studies and the quality of the research design. Column 2 indicates whether the existing evidence delivers any firm policy conclusions. Column 3 is our assessment of the magnitude of the benefits minus the costs (assuming these are positive). Column 4 delineates whether the main benefits (if there are any) are likely to be seen in the short run (roughly, the next three to four years) or in the longer run (roughly ten years or more); NA means not applicable. Column 5 lists the likely effect on inequality.

CBO's Projections of the Labor Force



Since last year, CBO has increased its projection of the size of the labor force in 2033 by 5.2 million people. Most of that increase results from higher projected net immigration.

Data source: Congressional Budget Office. See www.cbo.gov/publication/59710#data.

The labor force consists of people age 16 or older in the civilian noninstitutionalized population who have jobs or who are unemployed (available for work and either seeking work or expecting to be recalled from a temporary layoff).

Box 2-1. Continued

Economic Effects of CBO's Revised Population Projections

who will enter their prime working age over the coming decade—is projected to increase the labor force by roughly 0.9 million people by 2033 compared with what its size would be if the additional foreign nationals had the same age characteristics as the overall population.

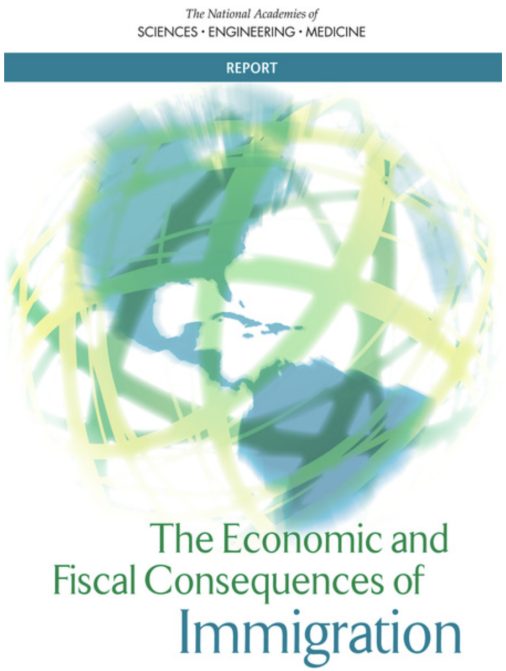
Increased immigration also affects the supply of goods and services by altering total factor productivity. CBO expects the projected increase in immigration to reduce TFP in the near term and boost it in later years.

The near-term effect reflects the expectation that a significant share of additional foreign nationals will initially work in sectors of the economy that have relatively low productivity, such as services, thus pushing down TFP by a small amount. That effect is projected to partly reverse over time as immigrants assimilate into the labor market and gain additional skills. In addition, CBO expects that roughly 2 percent of the additional foreign nationals will be highly skilled workers employed in the fields of science, technology, engineering, or mathematics. Those immigrants are expected to boost total factor productivity through innovation. That positive effect on TFP is projected to outweigh the negative effect by 2027, causing TFP to be roughly 0.2 percent greater in 2034 than it otherwise would have been.

Increased net immigration is projected to affect average real wages through several channels. First, additional foreign nationals are expected to work in sectors of the economy that pay relatively low wages, thus putting downward pressure on average wages. Second, the projected increase in workers reduces the amount of capital (factories and machinery) per worker, which also puts downward pressure on average real wages. Both effects are expected to lessen over time as workers gain more skills and as additional capital is built. Third, the projected increase in total factor productivity is expected to put upward pressure on wages. That effect is expected to build slowly over time. By 2034, CBO estimates, the three effects combined will cause average real wages to be slightly lower than they would have been otherwise.

High-skilled immigration: Budgetary effects

A 2017 National Academies report concluded that on average, highly skilled immigrants and their descendants contribute hundreds of thousands of dollars more in tax revenues than they receive in benefits



Director's Statement on the Budget and Economic Outlook for 2024 to 2034

Posted by Phill Swagel on February 7, 2024

In our projections, the deficit is also smaller than it was last year because economic output is greater, partly as a result of more people working. The labor force in 2033 is larger by 5.2 million people, mostly because of higher net immigration. As a result of those changes in the labor force, we estimate that, from 2023 to 2034, GDP will be greater by about $7 trillion and revenues will be greater by about $1 trillion than they would have been otherwise. We are continuing to assess the implications of immigration for revenues and spending.

- Yet budgetary estimates for proposals that increase the number of highly skilled immigrants to the U.S. have generally been estimated by CBO to result in a net cost to the U.S. federal budget
- Example: Section 80303 of America COMPETES Act – which proposed increasing the availability of green cards for STEM masters and PhDs – was estimated to cost the federal government $3.1 billion over 10 years

Congressional Budget Office
Cost Estimate

March 21, 2022

Estimated Budgetary Effects of H.R. 4521, the America COMPETES Act of 2022, as Passed by the House of Representatives on February 4, 2022

		By Fiscal Year, Millions of Dollars											
		2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2022-2026	2022-2031
		Increases or Decreases (-) in Direct Spending											
Sec. 80303	Advanced Degree Stem Graduates[f]												
	Estimated Budget Authority	0	70	183	241	249	316	390	486	575	652	743	3,162
	Estimated Outlays	0	70	183	241	249	316	390	486	575	652	743	3,162

Notes: CBO (2022), https://www.cbo.gov/publication/57898.

How can CBO be reporting a budgetary estimate that is so at odds not just with the evidence, but with CBO's own (baseline) estimates of the budgetary and economic effects of highly skilled immigrants?

- As I'll explain, CBO didn't make a mistake in this estimate; they simply followed procedures specified by Congress, but those procedures did not serve Congress well in this case

Does this really matter? *Yes*

- Debates over legislative proposals are relying on incomplete information
- CBO's estimates matter more sharply than ever, due e.g. to increased reliance on the heavily rules-based reconciliation process
- But budgetary estimates matter in a larger sense: Policy development
  - Example: NDAA provision

Outline

Motivation: Innovation, productivity, and growth

- Dating back at least to Solow (1957), productivity has been understood to be the key driver of long-run economic growth and human welfare
- A central goal of public policy is improving productivity
- But: productivity estimated as a residual given measures of output/inputs

- For economic researchers – or, at least, for me – this prioritizes the intellectual project of unpacking the "black box" of productivity growth
  - Economists have made notable recent progress in understanding what types of policy changes - e.g. changes in R&D investments, tax policy, patent policy, high-skilled immigration, labor market policy, competition policy - appear to increase innovation, productivity, and growth
  - Economists have, unfortunately, focused less attention on understanding the budgetary impacts of innovation and productivity policies

Budgetary analysis approaches: Conventional and dynamic

- Congress receives budgetary estimates for proposed legislation from Congressional Budget Office & staff of the Joint Committee on Taxation

- Conventional budgetary estimates include:
  - Mechanical effects, e.g., subsidizing flu vaccine prices increases government spending
  - Behavioral responses, e.g., lower flu vaccine prices would probably encourage more people to get vaccinated

- What conventional budgetary estimates do not take into account is how a legislative proposal could potentially affect total population, employment, income, and productivity in the U.S. economy
  - Such effects are included in so-called dynamic budgetary estimates
  - Conventional estimates hold these fixed at the baseline projections
  - Example: holding population fixed for immigration proposals

Budgetary analysis approaches: The status quo

- Under current practice, dynamic budgetary estimates are rarely reported
  - Dynamic analyses are conducted, e.g. for baseline projections
  - But dynamic analyses are rarely included in the budgetary estimates CBO reports for specific legislative proposals
- This means that when Congress looks for information on how policies which directly aim to spur productivity growth – such as R&D investments – would affect the federal budget, the budgetary estimates they receive do not take account of any of the potential productivity effects that these policies are, by construction, designed to spur

- Historically, debates over dynamic analysis have centered on tax policy
- But of course, many non-tax policies also have potential effects on total population, employment, income, and productivity

Dynamic scoring: When and how

- In most cases, conventional and dynamic estimates will be similar
- However, in cases where they differ, credible dynamic estimates are more comprehensive and therefore more informative for lawmakers

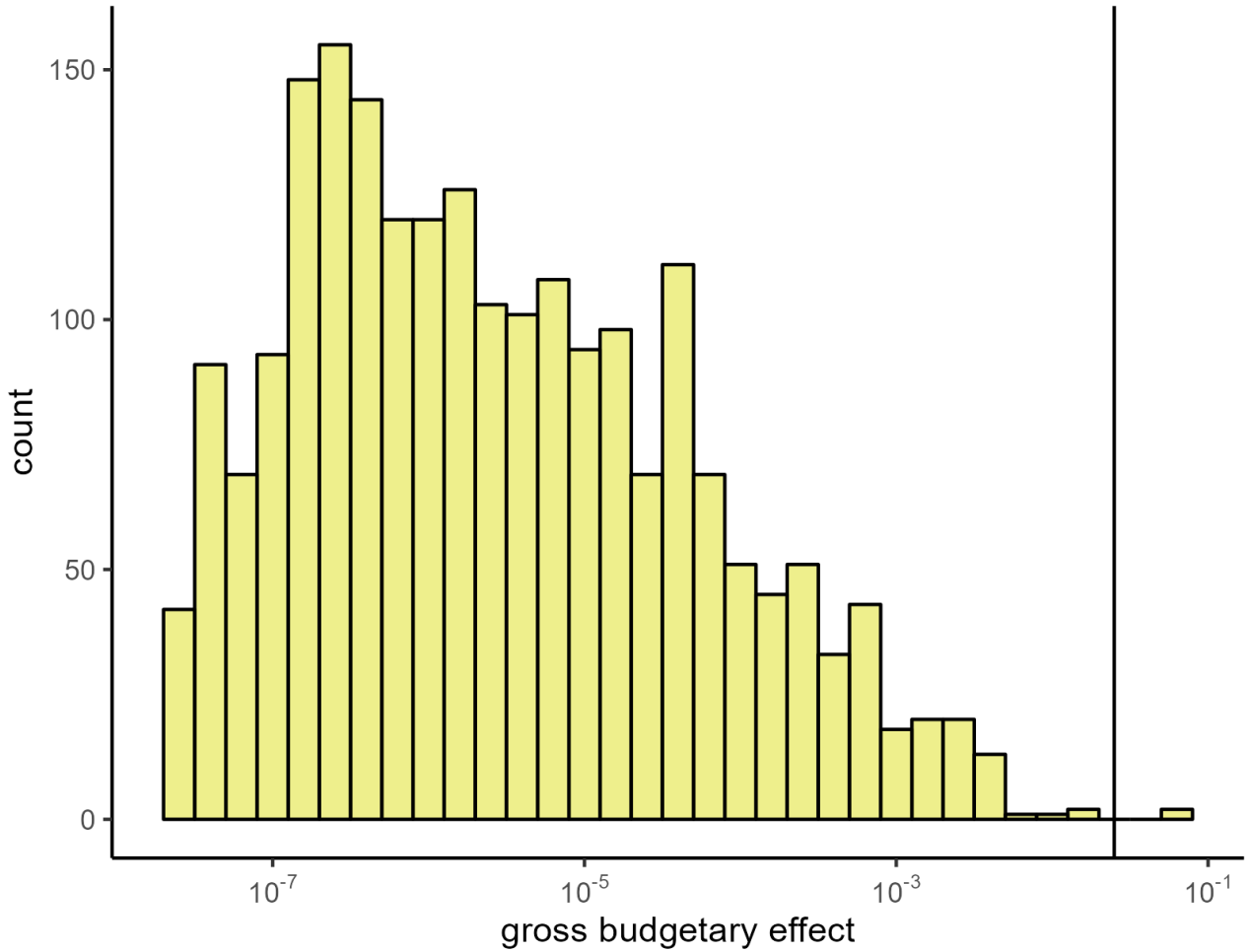
- Why not always do dynamic analysis?
  1. **Time and resource costs.** Modeling the impacts of legislative proposals on these additional outcomes requires (substantially) more staff time and resources from CBO and JCT, which are responsible for delivering thousands of formal and informal budgetary estimates each year
  2. **Lack of clear evidence.** As with conventional estimates – although more so here – the economics literature does not always provide clear guidance on the sign and magnitude of relevant budgetary and economic impacts

Dynamic scoring: The status quo

- Recognizing these trade-offs, former CBO director Doug Elmendorf (2015) argued dynamic scoring should be applied to "major" legislation – roughly defined as policies that have large gross budgetary effects
- This rule has a certain logic: "large" pieces of legislation are plausibly more likely to have substantial effects on employment and productivity

- However, in practice the major legislation rule as currently designed has resulted in CBO only undertaking dynamic analysis for a budgetary estimate of a legislative proposal once since 2019

Dynamic scoring: The major legislation rule



Notes: This figure plots the distribution of gross budgetary effect estimates for the universe of CBO's cost estimates from the 118th, 117th, and 116th Congresses, and illustrates that there are – empirically – very few legislative proposals that are even close to qualifying for dynamic analysis under the current major legislation rule. The one case that did qualify for dynamic analysis under the major legislation rule – H.R. 3938, Build It in America Act – was deemed by JCT and CBO to have negligible macroeconomic effects in practice.

Dynamic scoring: Elmendorf (2015)

- "*Even if the macroeconomic effects of a proposal with limited budgetary impact are small relative to the overall economy, their feedback effect on the federal budget could still be large relative to the nonmacroeconomic budgetary impact of the proposal. In those circumstances, careful dynamic scoring would significantly improve the accuracy of the budget estimate.*"

- Yet despite this acknowledgement, Elmendorf's 2015 paper argued: "*CBO and JCT cannot do careful analyses of the macroeconomic effects of all proposals, and ... using rules of thumb in place of careful analyses could reduce the accuracy of those estimates and diminish the credibility of CBO's and JCT's estimates more generally. In my judgment, those costs outweigh the benefits.*"

Dynamic scoring: A progress report on why, when, and how

- "*We reach a different conclusion today*."
  1. CBO's modeling and experience have improved considerably so that the macroeconomic complexities can be distilled down in a credible manner
  2. Evidence base for economic impacts has improved substantially
  3. The major legislation rule, which was intended to introduce dynamic scoring for some proposals, has effectively failed to accomplish that goal

- Three examples: High-skilled immigration, R&D, permitting
- Reassess the "when" of dynamic scoring, in terms of potential alternatives to the major legislation rule

(with Doug Elmendorf and Glenn Hubbard, accepted for *Brookings Papers on Economic Activity*)

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   - Changes to NEPA / permitting

CBO, sometimes in collaboration with JCT, has produced budgetary estimates of changes to immigration laws under three different approaches:

1. Conventional approach
2. Dynamic approach: applied twice, although not as the basis for official budgetary estimates – for S. 744 and for S. 2611
3. Population change approach: applied to four legislative proposals – H.R. 2131, S. 744, Senate Amendment 1150 to S. 1348, and S. 2611

One way of thinking about the population change approach is correcting an asymmetry: holding population fixed at baseline levels could mean including either outlays and revenues or neither outlays nor revenues, but the current practice of counting outlays but not revenues is – in my view – hard to justify.

CBO (2015): *"But following the standard convention of assuming that employment would remain unchanged relative to current law would have implied that any employment of the additional immigrants would be offset one-for-one by lower employment elsewhere in the population. Because that outcome would be highly implausible, CBO and JCT relaxed the assumption of fixed GDP and employment and incorporated into the cost estimate their projections of the legislation's direct effects on the U.S. population, employment, and taxable compensation, which primarily affected the amount of additional tax revenues that would have resulted from enacting the bill."*

High-skilled immigration: Section 80303

H.R. 4521 America COMPETES Act Section 80303 aimed to increase the availability of green cards for foreign nationals with STEM advanced degrees

- Roughly, exempted employment-based green cards from statutory limits for applicants who had earned a doctoral or master's degree in a STEM field at a U.S. research institution or foreign equivalent
- The cap exemption applied to the principal immigrant as well as their accompanying spouse and minor children

Section 80303 population modeling: Esche, Neufeld, Williams (2023)

- Attempt to (roughly) estimate how Section 80303 would affect the number and characteristics of people in the U.S. population by immigration status, education, country-of-origin, gender, and age
- Starting point is recognition of the fact that an increase in the number of green cards made available by law does not translate into a one-for-one increase in the number of people in the U.S.
  - Moreover, there is not a straightforward way to simply divide newly available green cards between new arrivals and people already in the U.S.
  - Instead, behavioral responses by the foreign-born population must be accounted for which significantly complicates this picture

Section 80303 population modeling: Esche, Neufeld, Williams (2023)

- Availability of new green cards changes expected wait times and therefore has an effect on individual's choices between green cards and temporary visas; choices between staying in the U.S. versus leaving; and the choice to come to the U.S. at all
- These choices can have cascading effects
  - Example: someone who applies for a green card instead of a temporary visa such as an H-1B may free up a temporary visa slot for another individual who is not eligible for the newly uncapped green card pathway
- Examples:
  - Backlog modeling: CRS (2020)
  - Wait times/stay rates of students: Kahn-MacGarvie (2020), Khosla (2018)
  - Characteristics of H-4 spouses authorized to work: Zavodny (2022)
  - Expected sponsorship via family-based pathways: Carr-Tienda (2013)

High-skilled immigration: Section 80303

Congressional Budget Office
Cost Estimate

March 21, 2022

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Notes: CBO (2022), https://www.cbo.gov/publication/57898.

Elmendorf and Williams (2024) provide a direct comparison of conventional approach and population-change approach budgetary estimates for an illustrative policy – similar to H.R. 4521, Section 80303.

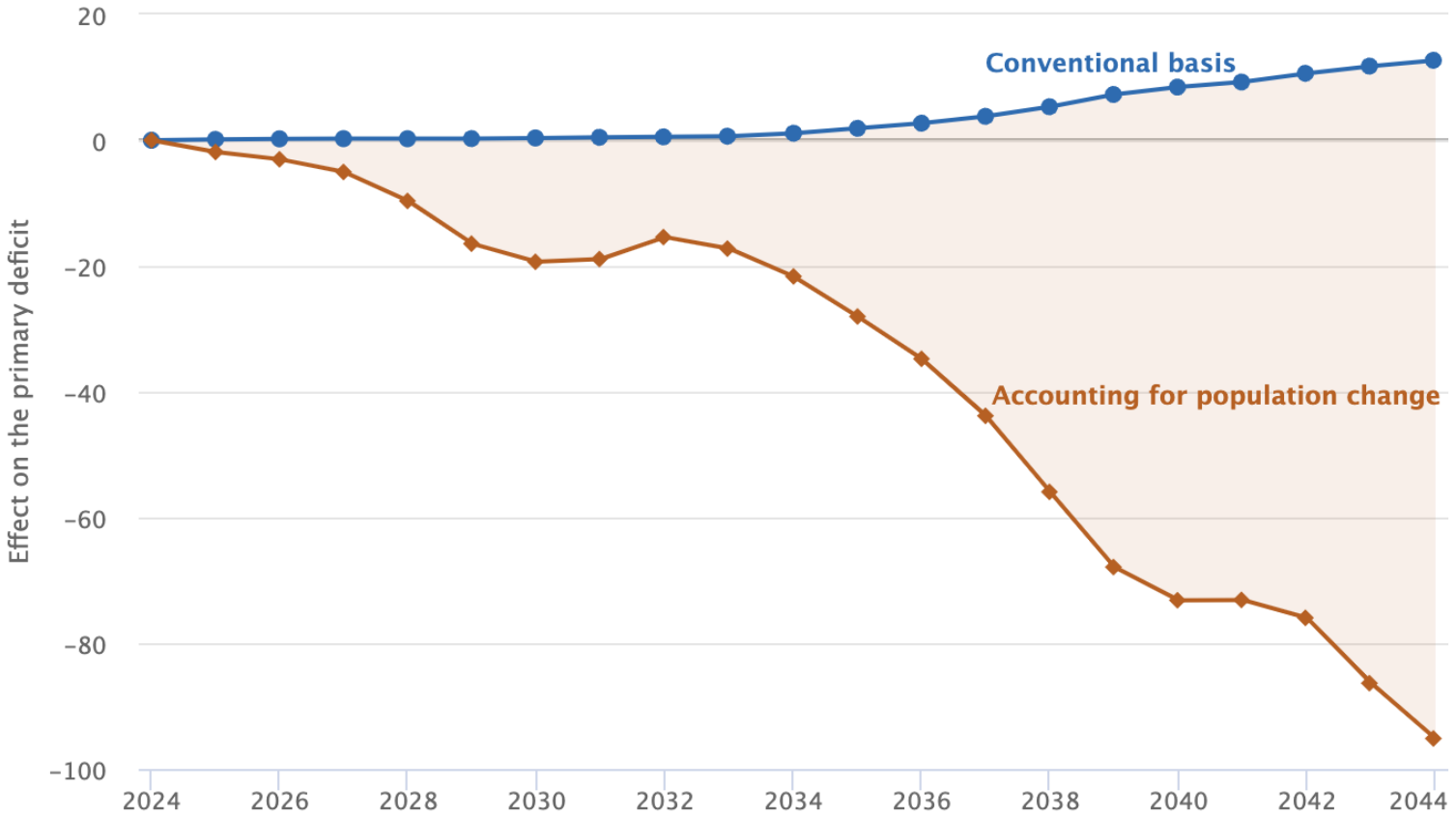
How Does Accounting for Population Change Affect Estimates of the Effect of Immigration Policies on the Federal Budget?

By Douglas Elmendorf and Heidi Williams[1]

Budgetary estimates: Elmendorf and Williams (2024)

Figure 1. Estimated Effect on the Deficit, Conventional Basis and Population-Change Approach

Billions of dollars



Source: Penn Wharton Budget Model

Budgetary estimates: Elmendorf and Williams (2024)

Table 1. Estimated budgetary effects, 2025-2034

DOWNLOAD DATA

Billions of dollars

Fiscal Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2025-2034
Increases or Decreases (-) in Direct Spending											
Outlays	0.1	0.2	0.3	0.2	0.3	0.4	0.5	0.5	0.6	1.1	4.2
Increases or Decreases (-) in Revenues											
Revenues	2.0	3.2	5.3	9.9	16.7	19.7	19.4	15.9	17.9	22.8	132.8
Net Increases or Decreases (-) in the Primary Deficit											
Effect on the deficit	-1.9	-3.0	-5.0	-9.7	-16.5	-19.3	-18.9	-15.4	-17.2	-21.7	-128.6

Source: Penn Wharton Budget Model

Over the following decade, the difference between the conventional approach and population-change approach estimates is even larger: swinging from a $74 billion increase in the budget deficit to a $634 billion decrease

Journal of Economic Perspectives—Volume 38, Number 2—Spring 2024—Pages 3–24

How Economists Could Help Inform Economic and Budget Analysis Used by the US Congress

Staff of the Congressional Budget Office

How Does Immigration Affect Productivity?

In 2013, the Congressional Budget Office analyzed a large immigration reform bill (CBO 2013). For that analysis, the agency projected the legislation's direct effects on the size of the US population, employment, and taxable compensation—and then incorporated those projections into its cost estimate. Since then, CBO has continued developing additional capacity to analyze a wider range of effects of changes in immigration policy. For example, the agency uses its macroeconomic models (discussed in the next section) to estimate changes in the income earned by capital, the rate of return on capital (and therefore the interest rates on government debt), and the differences in wages for workers with different skills. Recently,

Immigration: Dynamic analysis

Blog

A Call for New Research in the Area of Labor

Posted by Julie Topoleski on July 20, 2023

How Does Immigration Affect Productivity?

Changes to immigration law can affect productivity in the economy, which can, in turn, affect the federal budget. Effects on productivity depend in part on how the changes affect the education, work experience, and other skills of immigrants and on how those immigrants affect other workers, the allocation of capital, and technological progress. CBO's analysis of immigration policy could be enhanced by additional research that estimates the effects of immigration on productivity, the timing of those effects, and how they vary depending on the skill composition of immigrants.

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Congressional Budget Office
Nonpartisan Analysis for the U.S. Congress

Effects of Physical Infrastructure Spending on the Economy and the Budget Under Two Illustrative Scenarios

AUGUST | 2021

Outline

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Congressional Budget Office
Cost Estimate

October 6, 2023

S. 2226 would prescribe various authorities and policies that govern national defense and foreign affairs. Many of those changes would affect authorizations of appropriations. The bill also would affect direct spending and revenues, as shown in the table and discussed below. Those effects stem from expanding eligibility for benefits under the Radiation Exposure Compensation Act and the World Trade Center Health Program, permitting multiyear procurement, ratifying the water rights compact between the Fort Belknap Indian Community and the State of Montana, allowing generic and biosimilar pharmaceuticals to reach the market more quickly, and other changes.

Estimated Changes in Direct Spending and Revenues of S. 2226, the National Defense Authorization Act for Fiscal Year 2024

As Passed by the Senate on July 27, 2023

https://www.congress.gov/118/bills/s2226/BILLS-118s2226es.pdf

	By Fiscal Year, Millions of Dollars											
	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2024-2028	2024-2033
Increases or Decreases (-) in Direct Spending												
Section 1090G. Semiconductor Program[f]												
Estimated Budget Authority	0	0	0	0	0	0	0	0	0	0	0	0
Estimated Outlays	58	43	24	14	10	5	5	-58	-43	-24	149	34

f. Section 1090G would exclude certain semiconductor projects funded by a direct appropriation in the CHIPS and Science Act from the requirements of the National Environmental Policy Act (NEPA) and the National Historic Preservation Act (NHPA). Based on information from the Department of Commerce and research about the extent to which NEPA and NHPA affect the timeline for implementing federally funded projects, CBO estimates that enacting section 1090G would speed up certain semiconductor projects.

Notes: CBO (2023), https://www.cbo.gov/publication/59643.

Journal of Economic Perspectives—Volume 38, Number 2—Spring 2024—Pages 3–24

How Economists Could Help Inform Economic and Budget Analysis Used by the US Congress

Staff of the Congressional Budget Office

How Would Changes to the Federal Permitting Process Affect Energy Markets, CO_2 Emissions, and the Macroeconomy?

and from a greater propensity for developers to invest in new projects. Second, increases in aggregate productivity from greater capital investment and from lower costs of energy would generate broader macroeconomic effects that, in turn, would increase tax revenues.

Wrap-up

- Budget analysis can seem arcane, complicated, and technical
  - Historically neglected as a topic by economists

- But in my view, systematic disconnects between reported budgetary estimates and actual budgetary impacts are:
  1. Quantitatively important enough to matter, shaping which policies are developed and how existing legislative proposals fare in political debates
  2. Are tractable to improve in the sense that – in at least some cases – better data and and better modeling can result in higher quality budgetary estimates which are better aligned with actual budgetary impacts