The silent wager: Artificial intelligence, productivity and US debt sustainability

No. 551, 2 July 2026

Author: Dr Stephan Bales, Tel. +49 69 7431-99048, stephan.bales@kfw.de

For more than three years, Artificial Intelligence (AI) has been driving financial markets, yet its macroeconomic productivity effect remains a subject of debate. The simulation results presented in this report illustrate how AI-induced growth could fundamentally enhance US debt sustainability. Due to the progressive tax system, revenues increase disproportionately to economic growth, while expenditures remain demographically inelastic. This fiscal wedge reduces the debt-to-GDP ratio without requiring austerity measures. However, this dynamic is constrained by technological misinvestments and fiscal countermeasures in the form of tax cuts. Furthermore, monetary policy errors pose a threat if interest rate cuts are predicated on productivity expectations that ultimately fail to materialise. Consequently, AI implicitly represents a wager on the sustainability of US sovereign debt.

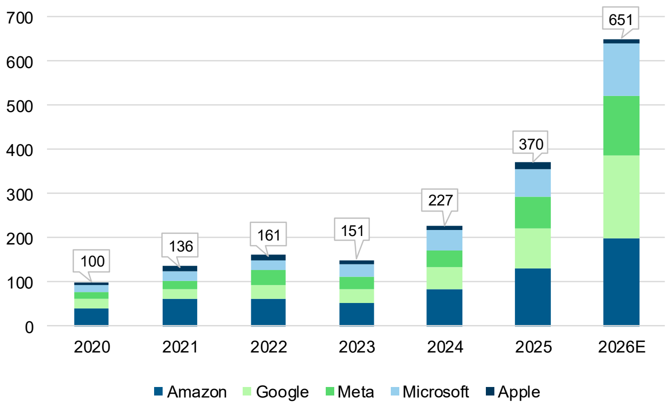
The AI productivity paradox

Transformative technologies often promise more than they can deliver in the *short term*. This was true for the steam engine, electricity and the personal computer and it may also hold true for Artificial Intelligence. Since the release of ChatGPT in late 2022, companies worldwide have invested hundreds of billions of dollars in AI infrastructure. Five of the leading US technology corporations alone project cumulative capital expenditures of approximately USD 650 billion for the current year, as illustrated in Figure 1. Since 2023, this drastic acceleration in spending has been driven almost exclusively by the massive expansion of data centres and hardware dedicated to Artificial Intelligence. Current stock market valuations reflect these transformative expectations. However, the pivotal question remains when and to what extent these investments will translate into measurable productivity gains across the broader economy.

History counsels patience. When the personal computer conquered offices in the 1980s, economist Robert Solow famously observed: "*You can see the computer age everywhere except in the productivity statistics.*"[1] Yet, it took another decade before the productivity boom of the late 1990s proved the sceptics wrong. Economists explain this pattern using the so-called J-curve: new technologies initially require massive investments in new processes, training and organisational structures before the benefits are reflected in the data. In the short term, measured productivity may even decline because resources are channelled into capacity building rather than production.[2] According to survey data from the US Census Bureau, approximately 18 percent of US firms had adopted Artificial Intelligence by the end of 2025. However, according to assessments by the Federal Reserve, profound macroeconomic leaps in productivity will only occur upon widespread adoption and following a complete realignment of corporate workflows.[3]

Figure 1: The AI investment race

Capital expenditure of the five largest US technology companies in USD billions



Source: Bloomberg, Consensus Estimates, Earnings Reports.

Thus far, no pronounced increase in US productivity has materialised. Over the past two years, annual productivity growth averaged approximately 2.3% (2024) and 2.2% (2025), thereby exceeding the historical average of the pre-generative AI era of about 1.4%.[4] Whether this improvement relative to the historical average is already attributable to an early productivity dividend from AI adoption, or simply to broader cyclical forces, remains an open question. Baslandze et al. (2026) demonstrate empirically that due to immense upfront costs and lagged efficiency gains, massive corporate investments in AI are not yet reflected in measured macroeconomic productivity data. The study thus points toward a productivity paradox.[5]

Table 1: Transformative technologies and their impact on economic growth

Technology	Hype	Long-run breakthrough
Steam Engine (Patent: 1769)	1760–1800 (approx. 40 years): The contribution of steam power to British productivity growth was below 0.01% per year.[6]	1830–1850 (60–80 years later): The breakthrough came with high-pressure steam engines. The contribution to productivity growth rose to 0.2–0.3% per year.
Electricity (Market maturity 1890)	1890–1910 (20 years): Productivity growth in US factories remained flat at below 1.0% per year.[7]	1920s (30–40 years later): The shift to decentralised motors and assembly lines drove productivity growth above 5.0% per year.
PC Boom (starting from 1973)	1973–1995 (22 years): The Solow paradox. Despite heavy IT investment, US productivity growth fell from 2.87 to 1.35% per year.[8]	1995–2000 (over 20 years later): The breakthrough came via the internet and enterprise software. Growth roughly doubled to 2.67% per year, with a marked acceleration after 2000.

The timeline and magnitude of measurable productivity gains derived from AI remain a subject of intense debate in the literature. Placed within a historical context, this development could take significantly longer to unfold than many forecasters currently anticipate, as illustrated in Table 1.

Historical comparison indicates that general-purpose technologies only achieved their full productivity impact through subsequent complementary innovations, such as the assembly line or the internet. In contrast, Artificial Intelligence could represent an exception, as it builds upon an already fully digitalised world and gargantuan computing power. Consequently, it may function not as a new baseline technology but as the final catalyst that abruptly enhances the efficiency of existing infrastructure and accelerates the productivity surge. Nevertheless, AI projections regarding productivity and economic growth vary significantly in part, as shown in Table 2.

Table 2: The AI forecast spectrum

Pessimistic	Moderate	Optimistic
Acemoglu (2024): Annual AI-driven productivity growth (TFP): +0.064 pp.[9] Maximum effect: +0.66% after 10 years.	*CBO (2026):* Annual AI-driven GDP growth: +0.1 pp (baseline scenario) +1.0% higher GDP level by 2036.[10]	*Dallas Fed (2025):* Annual AI-driven GDP growth: +0.3 pp.[11] *Goldman Sachs:* (2023, 2026): Annual growth: +0.3 pp.[12] but not until 2027.

AI productivity and US debt sustainability

Whether the potential productivity gains from AI will actually materialise is also highly relevant to the sustainability of US sovereign debt. In a recently published study, Kung et al. (2026) illustrate how AI-induced growth could exert a structurally positive effect on US debt sustainability and interest rate levels.[13] Purchasing a 10-year US Treasury note de facto constitutes a claim on the future solvency of the US government. This solvency, in turn, depends on government revenues and expenditures over the coming decades. Should the US economy grow faster because AI renders labour more productive, tax revenues will rise. The US tax system is structured progressively and higher wages push employees into higher tax brackets, thereby allowing the state to benefit disproportionately from economic growth. Experts refer to this effect as 'bracket creep'. Kung et al. (2026) quantify the long-term effective revenue elasticity at approximately 1.53, meaning that each percentage point of additional GDP growth generates a 1.53 percent revenue increase for the US Treasury.

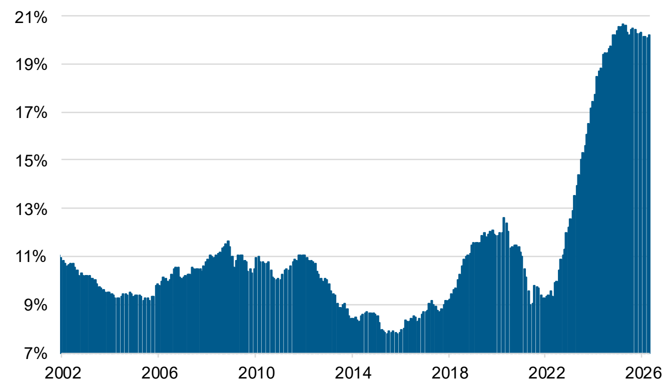
Government expenditures, by contrast, respond much more sluggishly to growth. The two largest public health programs, Medicaid and Medicare, are determined by the number of retirees, not by the level of GDP. Although pensions are initially linked to wages, once an individual retires, they receive only an inflation adjustment rather than a share of economic growth. The result of this asymmetry could be substantial, as the treasury fills disproportionately when growth accelerates, while expenditures only lag behind slowly. This divergence flows directly into the government budget and improves debt sustainability.[14] Since, at least in theory, the market value of US public debt equals the present value of all future primary surpluses, discounted at the Treasury rate plus a macroeconomic risk premium, a reduction in this risk premium should also translate into declining yields on government bonds.[15]

The Fiscal Starting Point: America Living on Credit

The fiscal position of the United States has deteriorated markedly in recent years. In 2001, the Congressional Budget Office was still projecting cumulative surpluses of USD 5.6 trillion. Tax cuts, two wars, the financial crisis and the pandemic have since rendered those projections obsolete. Currently, the debt-to-GDP ratio (Debt Held by the Public) stands at 101%. Under its latest long-run baseline, the CBO projects a further rise to 120% by 2036 and 172% by 2056. What makes the situation particularly acute is the dynamics of interest payments. In 2025, the US paid nearly one trillion US dollars in net interest, corresponding to approximately 20% of total government revenues (Figure 2). Since these interest payments are themselves debt-financed, total indebtedness continues to compound, which in turn drives the interest burden ever higher.

Figure 2: Interest payments on outstanding government debt

As a percentage of total government revenues, 12-month moving average.



Source: Bloomberg.

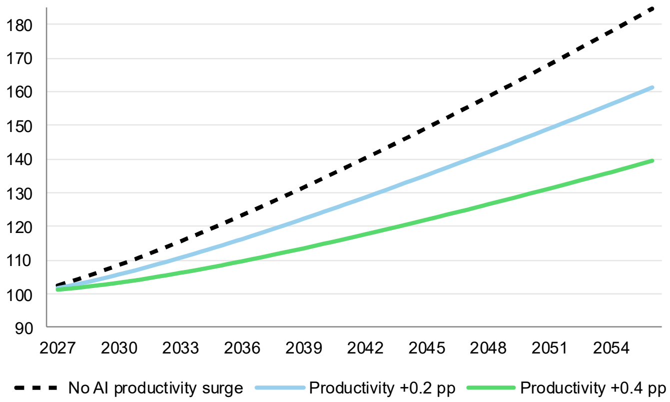
A simulation into the fiscal future

Below, three productivity scenarios and their effects on public debt are examined. The model calibration and baseline parameters for the debt-to-GDP ratio, interest payments, growth prospects and inflation are sourced from the CBO Budget and Economic Outlook: 2026 to 2036 published in February 2026 and the Long-Term Budget Outlook published in March 2026. The expenditure and revenue elasticities are taken from the study by Kung et al. (2026).[16] The first scenario represents a world without AI productivity gains, represented by the CBO baseline projection adjusted for the incorporated annual AI effect of 0.1 percentage points. The second scenario assumes a moderate productivity gain of 0.2 percentage points per year. The third scenario assumes a productivity gain of 0.4 percentage points per year, which is consistent with the more optimistic estimates in Table 2.

The simulation results illustrate that AI productivity growth would act as an extraordinarily powerful fiscal tailwind. In the scenario devoid of AI productivity gains, the debt-to-GDP ratio rises from 101% (2026) to 123% (2036) and reaches 185% by 2056. In the moderate AI scenario (+0.2 percentage points annually), the paths diverge steadily. By 2036, the debt-to-GDP ratio stands at 116%, approximately 7 percentage points below the baseline scenario; by 2056, the delta amounts to 24 percentage points (161 versus 185%). In the more optimistic scenario (+0.4 percentage points), debt accumulation decelerates even more pronouncedly, resulting in a debt-to-GDP ratio of 139% in 2056. Consequently, technological progress could alleviate the sovereign debt problem without a single percentage point of tax hikes or spending cuts.

Figure 3: US government debt trajectory

As a percentage of GDP.

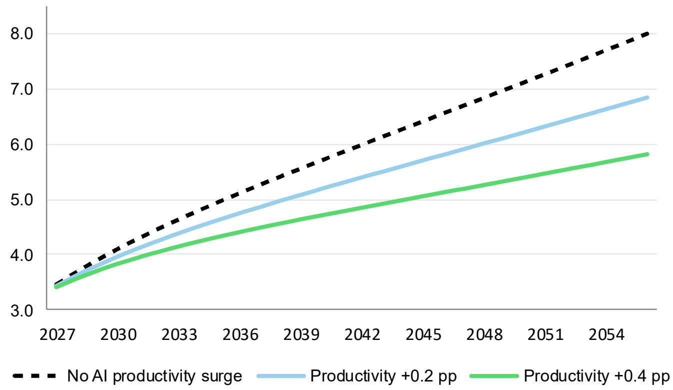


Source: KfW Research, own simulations.

As Figure 4 illustrates, the interest burden also decreases significantly as a result of AI-induced growth. While the interest burden relative to GDP rises from 3.2 to 5.1% in 2036 and to 8.0% in 2056 in the scenario without AI, higher productivity mitigates the severity of this increase. In the scenario assuming a 0.4 percentage point productivity gain, the interest-to-GDP ratio in 2056 stands at 5.8% of GDP; although this is significantly above today's ratio, it remains 2.2 percentage points below the projection of the scenario without AI gains.

Figure 4: US interest burden trajectory

As a percentage of GDP.

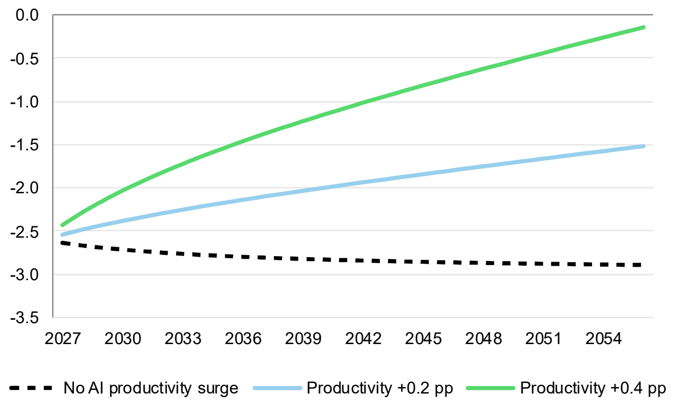


Source: KfW Research, own simulations.

Since the interest rate was held constant at 4.3% in the preceding simulation, the positive effect arises purely from the improved fiscal position and a reduction in the gap between revenues and expenditures, as illustrated in Figure 5. In the baseline scenario, the difference between revenues and primary expenditures (excluding interest payments) averages −2.8% of GDP. In the moderate AI scenario, the primary deficit decreases to −1.5% of GDP by 2056, whereas in the optimistic scenario, government revenues even trend toward a balanced primary budget.

Figure 5: US primary balance trajectory

As a percentage of GDP.



Source: KfW Research, own simulations.

Productivity growth and bond yields

In the preceding simulation, bond yields were assumed to be constant (at 4.3%). This assumption is conservative, as it ignores a second transmission channel that Kung et al. (2026) identify as pivotal: productivity growth enhances the fundamental fiscal value of sovereign bonds, which — in efficient markets — should trigger an immediate decline in yields and could provide additional relief to debt dynamics. This transmission to interest rates operates via three concurrent channels, which have been empirically derived from market reactions to AI model announcements: (1) lower inflation expectations, (2) a compressed term premium for long-duration maturities and (3) an increasing convenience yield on government bonds, since the AI boom reduces the necessity for new debt issuance, thereby tightening the supply of safe-haven assets.

A theoretical perspective

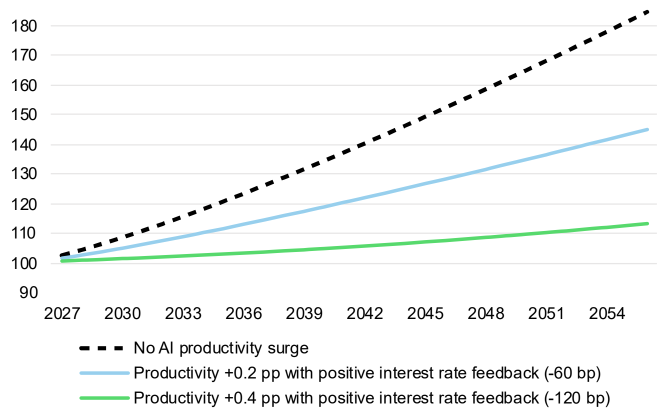
The differential between the real interest rate (r) and the real economic growth rate (g) is a core formula for determining a country's debt sustainability. It indicates whether a sovereign state can reduce its debt-to-GDP ratio purely through economic growth or whether it must actively generate budget surpluses. If the interest rate exceeds the growth rate, debt accumulates faster than the economy expands, even with a balanced primary budget. If r is below g, the debt ratio contracts automatically. AI can influence this equation via two channels: through higher productivity-induced growth, or through a lower interest rate level as financial markets price in the improved fiscal outlook.[17]

Below, the simulation assumes an interest rate sensitivity of 30 basis points; that is, if AI permanently increases productivity by 0.1 percentage points per year, the 10-year Treasury yield declines by 0.3 percentage points.[18] With an AI-driven growth increment of +0.2 percentage points, this would amount to 60 basis points, and at +0.4 percentage points, 120 basis points. Accordingly, the yield in the more optimistic scenario would fall from 4.3 to 3.1%. From the perspective of economic literature, this implicit elasticity falls within a highly optimistic range, marking the upper bound of potential AI impacts on interest rate levels. This assumption stands in tension with economic theory: classical growth theory postulates that higher productivity leads to rising interest rates, as households save less in anticipation of future prosperity and firms increase investment. A drastic decline in interest rates can therefore only be justified by a massive, disinflationary supply shock — an effect discussed by institutions such as the BIS regarding the initial phases of AI leaps.[19] Given that long-term empirical studies (such as Lunsford & West[20]) historically show only a weak coupling between productivity and real interest rates, the selected coefficient describes a tail scenario in which the deflationary force of AI entirely dominates any investment-driven interest rate pressure. Nevertheless, this extreme assumption gains substantial real-world relevance due to the recent leadership change at the helm of the Federal Reserve. The future monetary policy stance could increasingly align with this scenario of a dominant disinflationary productivity wave, thereby justifying the simulation of this specific tail risk spectrum over the projection period.

Figure 6 illustrates that the interest rate channel significantly amplifies the fiscal relief effect. In the scenario with +0.2 percentage points of productivity growth, the debt-to-GDP ratio drops to 145% by 2056, compared to 161% without interest rate feedback. In the scenario with +0.4 percentage points, the debt ratio increases only very sluggishly, reaching 113% in 2056.

Figure 6: US government debt trajectory with positive interest rate feedback

As a percentage of GDP.



Source: KfW Research, own simulations.

AI and monetary policy: The Fed's new paradigm?

With Kevin Warsh, who succeeded Jerome Powell as Fed Chair on May 15, 2026, the world's most influential central bank is now led by a policymaker who explicitly invokes AI-driven productivity growth as a pivotal argument for looser monetary policy.[21] Warsh has characterised Artificial Intelligence as 'the most productivity-enhancing wave of our lifetime' and posits that heightened productivity exerts a disinflationary effect, thereby enabling interest rate cuts without stoking inflation risks. With this thesis, he draws a parallel to Alan Greenspan, who famously refrained from raising interest rates in the late 1990s despite a booming economy.[22] Furthermore, Warsh points to the structural dilemma that waiting for statistical proof of productivity gains is, by definition, backward-looking and causes the optimal window for pre-emptive easing to pass.[23]

However, as compelling as this thesis appears on paper, its monetary policy execution in the current environment is fraught with risk. In May 2026, the CPI-inflation rate stood at 4.2%, significantly above the Fed's 2 percent target. Similarly, PCE inflation hovered at 4.1% in May and to date there is no unambiguous, macroeconomically measurable evidence of an AI-induced productivity boom. Consequently, a growing chorus of critics warns that cutting interest rates based on productivity hopes could constitute a monetary policy error, rendering policy overly expansionary.[24] This is further compounded by US tariff policy and geopolitical shocks, such as surging oil prices, which aggravate price pressures and narrow the fiscal headroom for accommodative monetary policy. Ultimately, Warsh also bears an institutional burden: interest rate cuts anticipated by political actors risk compromising the central bank's independence — and its long-term credibility is far more vital than short-term growth gains.

Limitations and risk factors of the simulation

Even if AI generates sustained productivity growth, the fiscal dividend is not guaranteed. The critical transmission channel only functions as long as the progressive tax system remains intact. If Congress responds to growing surpluses by cutting tax rates or indexing tax brackets to wages, the revenue elasticity will be significantly lower. For example, the budget surpluses of the late 1990s were entirely eroded within a few years by tax cuts. The current 'One Big Beautiful Bill Act' repeats this pattern. While tax relief may be politically popular and mobilise voters in the short term, it is fiscally counterproductive to the headroom that AI growth could potentially unlock. The simulations also assume that productivity gains are permanent and broadly anchored. Furthermore, the model neglects potential delays caused by the macroeconomic J-curve, as it assumes immediate effects. If the gains do not materialise until 2030, for instance, the opening years of the projection period would effectively be void of impact, which would noticeably reduce the cumulative relief effects. In this context, the Dallas Fed argues that historical productivity booms often become discernible only 20 years after the technological breakthrough, once approximately half of all enterprises have fully implemented the technology.

Conclusion: Fiscal stability cannot be taken for granted

The simulation demonstrates that AI productivity growth carries significant fiscal weight. Due to a structural asymmetry in the US tax system, tax revenues grow disproportionately, whereas expenditures — driven by demographics — barely respond to productivity gains, thereby substantially lowering future deficits. Even moderate productivity gains of 0.2 percentage points annually could thus mitigate the explosive debt dynamics in the US without requiring a single austerity measure. If bond yields subsequently decline because markets price in the improved fiscal outlook, this positive interest rate effect further amplifies the dynamic. The pivotal uncertainty of this analysis simultaneously constitutes its most crucial insight: the variance between pessimistic and optimistic productivity scenarios is extreme. Furthermore, three risks temper this optimism: first, productivity gains may fail to materialise if AI investments evaporate without generating a macroeconomic impact. Second, there is a risk of political pressure from Congress to deploy fiscal surpluses directly for tax cuts. Third, premature interest rate cuts by the US Federal Reserve based on unfulfilled productivity expectations would constitute a costly, long-term error.

---

1 Solow, R. (1987): We'd better watch out, New York Times Book Review, 12. Juli 1987.

2 Gordon, R. J. (2000): Does the New Economy Measure Up to the Great Inventions of the Past?, Journal of Economic Perspectives, 14(4).

3 Vgl. The Fed - Monitoring AI Adoption in the US Economy.

4 Vgl. Productivity up 2.3 percent in 2024 : The Economics Daily : U.S. Bureau of Labor Statistics, Quarterly Industry-Level Labor Productivity Data for the U.S. - Federal Reserve Bank of Chicago, Productivity and Costs, Fourth Quarter and Annual Averages 2025, Preliminary (PDF).

5 Baslandze, S., Edwards, Z., Graham, J. R., McClure, T., Meyer, B. H., Sparks, M., Waddell, S. R. and Weitz, D. (2026): Artificial Intelligence, Productivity, and the Workforce: Evidence from Corporate Executives, NBER Working Paper No. 34984). National Bureau of Economic Research. Artificial Intelligence, Productivity, and the Workforce: Evidence from Corporate Executives | NBER.

6 Crafts, N. (2004): Steam as a general purpose technology: A growth accounting perspective, The Economic Journal, 114(495), 338–351, https://doi.org/10.1111/j.1468-0297.2003.00200.xDigital Object Identifier (DOI).

7 David, P. A. (1990): The dynamo and the computer: An historical perspective on the modern productivity paradox, The American Economic Review, 80(2), 355–361, The Dynamo and the Computer: An Historical Perspective on the Modern Productivity Paradox on JSTOR.

8 Jorgenson, D. W., Ho, M. S., and K.J. Stiroh (2005): Information technology and the American growth resurgence, MIT Press, EconPapers: Productivity, Volume 3: Information Technology and the American Growth Resurgence, vol 3.

9 Acemoglu, D. (2024): The Simple Macroeconomics of AI, Working Paper No. 32487. Cambridge, MA: National Bureau of Economic Research (NBER).

10 Congressional Budget Office. (2026): The Budget and Economic Outlook: 2026 to 2036, U.S. Government Publishing Office.

11 Wynne, M. A. and L. Derr (2025): Advances in AI will boost productivity, living standards over time, Dallas Fed Economics, https://www.dallasfed.org/research/economics/2025/0624.

12 Goldman Sachs (2023): AI may start to boost US GDP in 2027.AI may start to boost US GDP in 2027 | Goldman Sachs.

13 The Two Cents (2026): U.S. Treasury Investors' Massive Bet on AI, Substack, https://thetwocents.substack.com/p/us-treasury-investors-massive-bet.

14 Kung, H., Lustig, H. and J. Paron (2026): U.S. Treasury Investors Are Long in AI, Working Paper, Stanford GSB / London Business School.

15 Jiang, Z., Lustig, H., Van Nieuwerburgh, S. and M.Z.Xiaolan (2022): Measuring U.S. Fiscal Capacity Using Discounted Cash Flow Analysis. Brookings Papers on Economic Activity, 53(2), BPEA-FA22_WEB_Jiang-et-al.pdf.

16 The simulation model projects US public finances over a 30-year horizon based on the CBO baseline data for 2026. Every year, four variables are extrapolated: gross domestic product, tax revenues, government expenditures, and the national debt. GDP grows at a fixed nominal rate, comprising real growth, inflation, and the respective AI productivity premium, which constitutes the sole difference between the scenarios. Tax revenues grow faster than GDP because the progressive tax system ensures that rising wages lead disproportionately to higher tax revenues. Government expenditures, on the other hand, follow demographic patterns and barely participate in economic growth. The difference between these two variables yields the primary balance. Interest is applied to the previous year's debt level at the average portfolio interest rate, which is then divided by the increased GDP and adjusted for the new primary balance. This portfolio rate responds sluggishly to market shifts because a major share of outstanding bonds still runs on historical terms and is only rolled over to current market rates over a period of approximately six years — in the case of constant interest rates, the market rate remains at 4.3 percent for the entire projection period.

17 Blanchard, O. (2019): Public Debt and Low Interest Rates, American Economic Review, 109(4), https://doi.org/10.1257/aer.109.4.1197.

18 The value is based on the findings of Gómez-Cram et al. (2024), according to which an unexpected increase of 1% in the expected debt ratio leads to a 31 basis point rise in the yield on 10-year government bonds.

19 Bank for International Settlements (2024): The impact of artificial intelligence on output and inflation, BIS Working Papers No 1179. Basel: Bank for International Settlements, The impact of artificial intelligence on output and inflation.

20 Lunsford, K. G. and K.D. West (2019): Some Evidence on Secular Drivers of U.S. Safe Real Rates, American Economic Journal: Macroeconomics, 11(4), S. 113–139.

21 Timiraos, N. (2026): Kevin Warsh Pitched a Case for Fed Rate Cuts. His Future Colleagues Are Skeptical, The Wall Street Journal, https://www.wsj.com/economy/central-banking/fed-interest-rates-warsh-ai-bc92f894.

22 Greenspan, A. (1997): Current monetary policy, Federal Reserve Board Speeches, https://www.federalreserve.gov/boarddocs/speeches/1997/19970508.htm.

23 Brookings Institution (2026): Rate cuts of 100 basis points in 2026 under Warsh plausible.

24 Taylor, J.B. (2014): Productivity Prospects and the Rules of Monetary Policy, Stanford, CA.