Disaggregating Innovation: Labor Productivity Gains from Biologic vs. Small Molecule Drugs and Implications of U.S. Drug Pricing Policy

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Abstract

Background: Prior research has demonstrated that pharmaceutical innovations can yield substantial societal benefits beyond traditional health outcomes, including improved labor productivity and wages. However, these studies have not disaggregated productivity gains by drug class.

Objectives: This study extends the work of Chen and Goldman (2018)[1] by separately analyzing the productivity and wage effects of biologic and small molecule drug innovations. We also assess how current and proposed pharmaceutical pricing reforms under the Inflation Reduction Act (IRA) may impact future labor-sector benefits tied to drug development.

Methods: Using a dataset of U.S.-based randomized controlled trials (RCTs) between 2000 and 2015 that include labor productivity measures, combined with survey data from the Medical Expenditure Panel Survey (MEPS), we quantify productivity and wage gains attributable to biologic and small molecule drugs. We adopt the same statistical methodology and categorization framework used in the original Chen study, with an added classification of drug types.

Results: Biologic drugs produced concentrated productivity gains in high-burden, lower-prevalence disease areas, while small molecule drugs contributed more broadly to national-level wage and hour gains. Overall, drug innovation during the study period was associated with 4.8 million additional work days and $221 billion in annual wages in 2016 and $296 billion in 2025, after adjusting for inflation, with varying contributions by drug class. Disaggregating the effect of small molecule drugs, we find that the annual wage gains are $163.4 billion 2016 and $219 billion in 2025 dollars.

Conclusions: The findings underscore the role pharmaceutical innovations can play in labor productivity Drug pricing policies, including differential price negotiation timelines under the IRA for small molecule medicines, should consider the consequences of inadvertently shifting innovation incentives in ways that can slow economic growth and undermine societal productivity gains.

Introduction

Medical innovation is often evaluated through the lens of clinical outcomes—such as survival gains, disease progression, and quality-adjusted life years (QALYs)—yet these metrics omit broader societal benefits, particularly in the labor market. The Second Panel on Cost-Effectiveness in Health and Medicine emphasizes the need to adopt a societal perspective in economic evaluations, urging the inclusion of work-related outcomes such as productivity and earnings. In this context, Chen and Goldman (2018)[1] offered an important contribution by empirically linking new drug treatments to gains in labor productivity and wages among working-age adults in the United States.

While Chen and Goldman quantified national productivity and wage benefits attributable to new pharmaceutical therapies, they did not differentiate between drug types—a meaningful omission given the distinct biological mechanisms, therapeutic targets, regulatory pathways, and cost profiles of biologic versus small molecule drugs. Biologics, often more complex and costly, are typically developed for targeted conditions, whereas small molecule drugs are more prevalent in primary care and chronic disease management. Understanding how each class contributes to productivity gains is essential for developing innovation-supportive policies.

This paper extends Chen and Goldman's framework by separately analyzing the labor market impacts of biologic and small molecule drug innovations, using the same data sources, methodology, and time horizon (2000–2015). In doing so, we aim to uncover differences in the societal returns to innovation across drug classes and assess how these returns are likely to be affected by drug pricing provisions within the Inflation Reduction Act (IRA).

The IRA represents a landmark shift in U.S. drug pricing regulation, introducing direct federal negotiation of drug prices for the first time. Notably, the IRA imposes earlier price negotiation timelines for small molecule drugs (9 years post-approval) than for biologics (13 years). These differential incentives may unintentionally distort the future trajectory of pharmaceutical innovation. By quantifying labor productivity and wage gains associated with each drug class, this study provides a data-driven rationale for incorporating labor-sector benefits into policy design.

Methods

Study Design and Data Sources

This study builds upon the framework developed by Chen and Goldman (2018)[1] to evaluate labor productivity gains associated with new pharmaceutical treatments in the United States. We replicate their empirical strategy using randomized clinical trial (RCT) data from 2000 to 2015 that include work productivity measures, linked with nationally representative data from the Medical Expenditure Panel Survey (MEPS). In contrast to the original study, we further disaggregate drug innovations into two distinct classes—biologic drugs and small molecule drugs—to examine their respective impacts on labor market outcomes.

Identification of Relevant Clinical Trials

Following the same methodology as Chen and Goldman, we systematically searched ClinicalTrials.gov and peer-reviewed literature for U.S.-based Phase 3 and 4 RCTs that:

Were completed between 2000 and 2015,

Included adults aged 18–64,

Reported data on work ability, absenteeism, or productivity using validated survey instruments (e.g., WPAI, WLQ, SF-HLQ).

A total of 78 trials with productivity outcomes were identified. These were further classified based on the type of pharmaceutical intervention.

Classification of Drug Types

Each pharmaceutical intervention was classified as either a biologic or a small molecule drug based on FDA definitions, approval pathway (BLA vs. NDA), and molecular characteristics. Classification was manually verified and is documented in the accompanying data supplement.

Biologics: typically large-molecule therapies derived from living organisms (e.g., monoclonal antibodies).

Small molecules: chemically synthesized, low-molecular-weight compounds.

Linkage with National Survey Data

To estimate the broader labor market implications of trial-level effects, we used MEPS data (2000–2015), which provide detailed information on employment, wages, and healthcare utilization. Individuals were grouped into the same 14 disease categories used in the trial data. We computed average annual changes in:

Hours worked,

Annual wages (2015 dollars), for disease-affected individuals with and without access to new drug treatments.

Statistical Analysis

We estimated the percent change in productivity using the difference-in-difference method, comparing pre- and post-treatment changes between intervention and control groups across trials. National-level impacts were scaled using disease prevalence estimates and labor force participation rates from MEPS.

Results

1. Labor Productivity Gains by Drug Class

Figure 1 illustrates the average percentage change in worker productivity by disease group across all drug types.

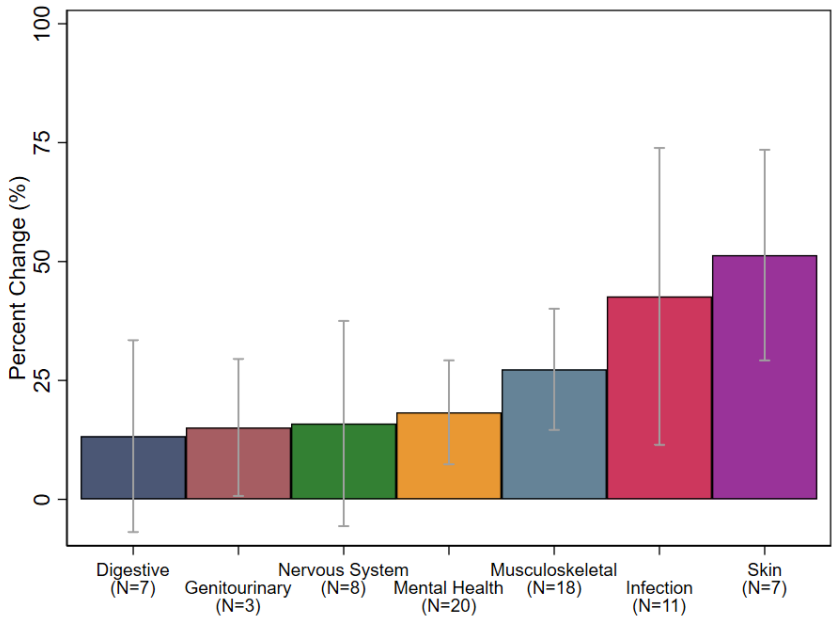

Figure 1 – Percent Change in Worker Productivity by Disease Group: All Drugs

Figure 1 illustrates the average percent change in worker productivity by disease group across all drug types. Consistent with Chen and Goldman[1]'s findings, large gains were observed in musculoskeletal (27%) and mental health (18%) conditions. Infectious diseases showed particularly high gains (43%), largely attributable to antiviral innovations like simeprevir.

Figure 2 presents productivity effects for small molecule drugs. These interventions accounted for the majority of observed trials and were responsible for more consistent gains across a wider range of diseases, including: Mental health disorders (e.g., SSRIs, SNRIs), Metabolic diseases (e.g., Type 2 diabetes), Digestive and genitourinary disorders.

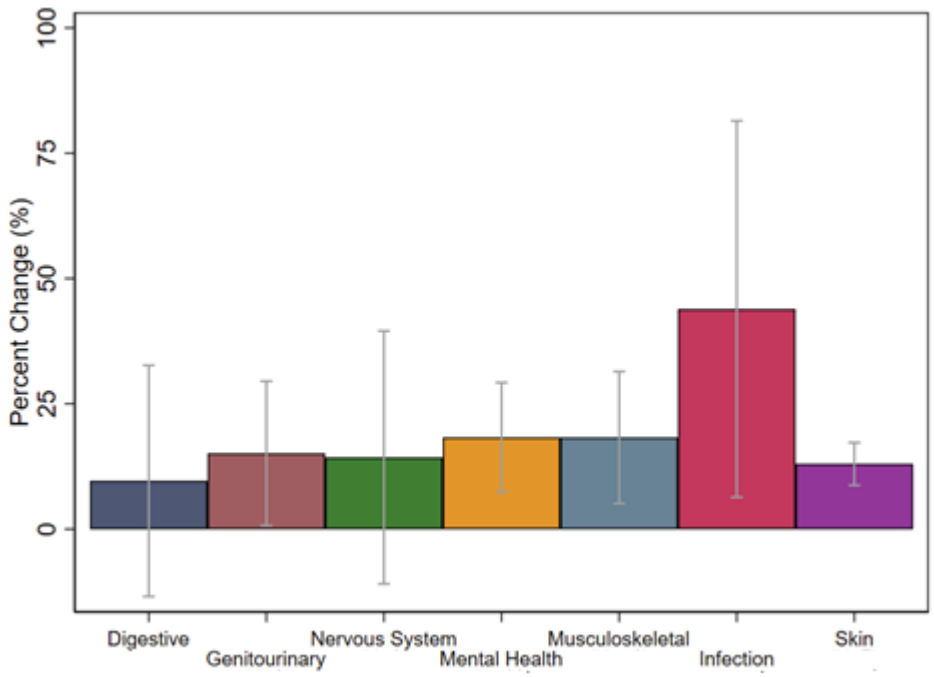

Figure 2 – Percent Change in Worker Productivity by Disease Group: Small Molecule Drugs

Percent gains in productivity from small molecule medicines reached up to 43%and had a broader reach across common conditions translated into significant aggregate labor productivity gains.

2. National Labor Market Implications

Using MEPS-linked modeling, we estimate that drug innovations introduced between 2000 and 2015 resulted in 4.8 million additional work days annually (assuming 40-hour work weeks), $221 billion in annual wage gains for the U.S. working population. Inflation adjusted, this would be $296 billion in 2025. In Figure 3, small molecule drugs provide more consistent productivity in terms of hours worked per year.

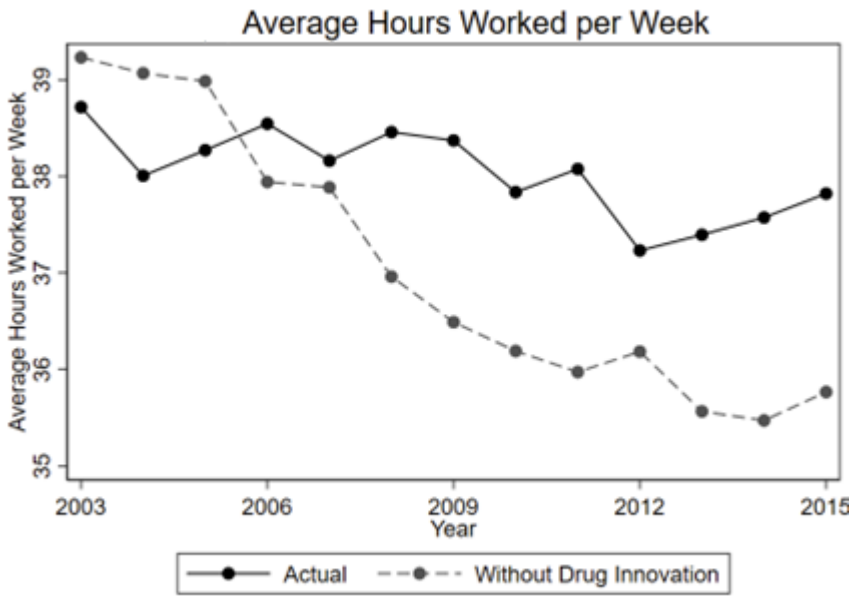

Figure 3 – Productivity Hours per week from Small Molecule Drugs

These results reinforce the notion that both drug types offer distinct yet complementary labor market benefits.

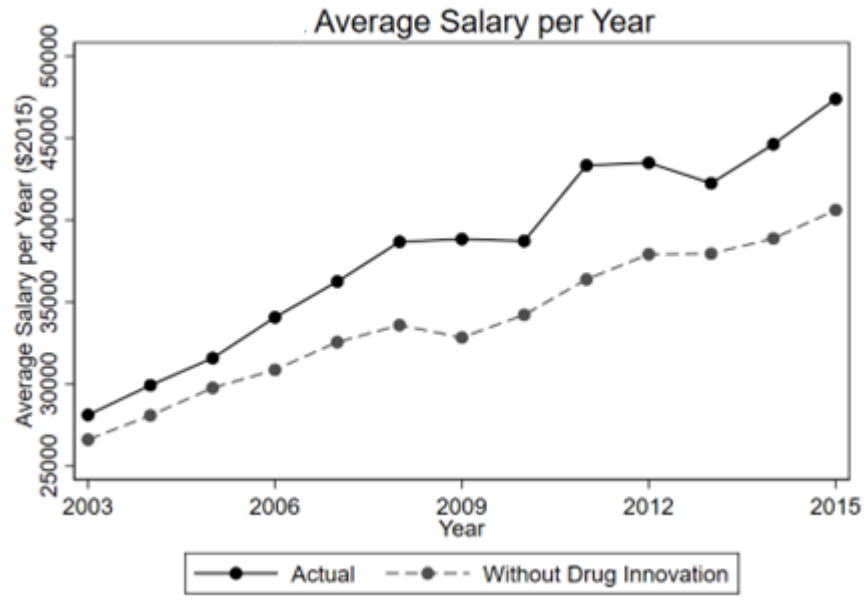

Figure 4 – Average Salary per Year With vs. Without Small Molecule Drug Innovation

Figure 4 displays the trend in average annual salaries among U.S. workers between 2003 and 2015, comparing actual income levels with a counterfactual scenario in which small

molecule drug innovations had not occurred. The solid black line represents observed average wages, while the dashed gray line estimates wages without productivity improvements attributable to small molecule therapies. The widening gap over time suggests that small molecule drugs played a significant role in boosting earnings, particularly during the economic recovery following the Great Recession.

Discussion

This study expands on prior work by Chen and Goldman (2018)[1] by disaggregating the productivity gains of pharmaceutical innovations into biologic and small molecule drug types. Our findings reveal that while both types of innovation contribute to improved labor productivity and wage growth in the United States, they do so in distinct and complementary ways. Biologic drugs, often target serious and lower-prevalence conditions, while small molecule drugs are more commonly used across widespread chronic and mental health conditions and contributed to broader and more evenly distributed gains across the working population.

These results have critical implications for the evaluation of pharmaceutical value and the design of drug pricing policy—particularly in light of the Inflation Reduction Act (IRA). The IRA introduces a mechanism for Medicare to negotiate drug prices, starting in 2026, with different time thresholds for biologics (13 years post-approval) and small molecule drugs (9 years post-approval). While designed to curb excessive drug spending, these provisions may unintentionally distort future innovation incentives.

Differential Policy Effects on Innovation Incentives

The earlier negotiation timeline for small molecule drugs may disincentivize investment in therapeutic areas with high population burden but moderate pricing power—precisely the conditions under which many of the productivity-enhancing small molecule drugs operate. Mental health, metabolic disorders, and musculoskeletal conditions—all associated with major economic losses from absenteeism and presenteeism—may see reduced future investment if manufacturers perceive a compressed revenue horizon.

In contrast, biologics benefit from a longer period before price negotiation and often serve niche or high-value markets. However, these treatments tend to cost the health system more. If innovation is pushed disproportionately toward biologics, society risks underinvesting in more common, treatable conditions with higher aggregate productivity impacts.

Labor Productivity: A Missing Piece in Drug Evaluation

Current frameworks for cost-effectiveness and value-based pricing rarely include downstream economic returns from improved labor participation. This omission is critical. Chen and Goldman estimated over $221 billion in annual wage gains ($296 billion in 2025) and nearly 5 million additional workdays per year attributable to drug innovation—figures that dwarf traditional health care savings and rival broader macroeconomic policy impacts.

Disaggregating the effect of small molecule drugs, we find that the annual wage gains are $163.4 billion. This estimate is for 2016. If we were to adjust for inflation you have dollars in 2025 the impact annual wage gains from small molecule drugs would be $219 billion.

Including labor market outcomes in value assessments or policy analyses would more accurately reflect the social return on investment in pharmaceutical R&D and could guide more efficient allocation of public and private research funding. Moreover, these results support arguments for pricing and coverage frameworks that preserve the ability of drug innovators to recover investment costs, especially for therapies that restore work function and economic independence.

Implications for Policy and Practice

Reform IRA Implementation: To avoid stifling innovation in high-productivity-impact conditions, policymakers should consider increasing the IRA's timeline for small molecules to the 13 years given to large molecules or providing exemptions for drugs that show quantifiable labor market returns—especially for small molecule innovations treating prevalent, economically disruptive diseases.

Incorporate Productivity into HTA: Health technology assessment (HTA) agencies, including ICER and CMS, should integrate labor productivity metrics into drug evaluations alongside QALYs and clinical endpoints.

Support for Real-World Productivity Data: Regulatory and funding bodies should incentivize the inclusion of work ability and wage data in clinical trials. Only 2% of trials in our sample included such data—a major blind spot in understanding total drug value.

Encourage Cross-Sector Collaboration: Labor economists, employers, and health policy

stakeholders should collaborate on tools that quantify and communicate the economic benefits of medical innovation. Integrating workforce data into benefit design could align payer incentives with societal welfare.

Conclusion

Pharmaceutical innovation delivers value far beyond clinical endpoints, contributing significantly to labor force participation, productivity, and earnings. This study adds to prior evidence by demonstrating that both biologic and small molecule drugs generate substantial, yet distinct, gains in labor productivity and wages among working-age Americans.

The Inflation Reduction Act, while a landmark in drug pricing reform, introduces differential negotiation timelines that may unintentionally penalize innovation in high-prevalence therapeutic areas. If pricing pressure disproportionately affects small molecule therapies, the long-term societal benefits of improved work ability—especially in economically vulnerable populations—may be diminished.

Our findings reinforce the need for a broader, more holistic approach to drug valuation and policy design. Labor market returns, such as increased hours worked and higher earnings, represent a major share of the total value created by pharmaceutical advancements. These productivity gains should be formally incorporated into health technology assessments, cost-effectiveness frameworks, and pricing negotiations to ensure that innovation is aligned with the full spectrum of societal benefit.

As health systems and policymakers continue to grapple with rising drug costs and sustainability, it is essential to preserve incentives for therapies that restore not only health, but also human productivity and economic independence. Failing to do so risks undervaluing innovation that empowers patients to participate fully in work and life.

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