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IEO2021 Issues in Focus: Changes in Composition of Economic Growth in China

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Executive Summary

Absent any additional policies, our analysis in this alternative *International Energy Outlook 2021* (IEO2021) case indicates that an increase in wages in China does not lead to a large increase in energy consumption. Somewhat unexpectedly, the largest increases in energy consumption in the Higher China Wages case are outside of China as China increases its demand for relatively lower-cost imports and exports less.

In this paper, we explore an IEO2021 case in which we assume higher incomes in China relative to the Reference case. We maintain all other Reference case assumptions so we can see the effects of wage changes in China in isolation. We analyze the resulting impacts on China's economy and trade, as well as energy consumption in China and other regions.

Our assumed level of higher incomes in China increases global energy consumption by only 1.4% above 2050 Reference case levels. The largest global sectoral increase, 2.0%, occurs in the industrial sector. Regionally, the largest energy consumption increases across all sectors occur in China at 1.3% higher, and in India at 3.0%, higher. In this case, the higher wage assumptions increase the share that consumer expenditures make up in China's economy and decrease the share of investment expenditures. We generally found that higher wages in China not only increase consumer demand, but also the production cost of domestic outputs. As a result, China's exports decrease and imports increase—a shift that affects other regions in the global trade system, notably India.

Introduction

In this paper summarizing the results of an IEO2021 alternative case, we explore the assumption of higher wages and salaries in China, which lead to a greater share of the economy allocated to consumer expenditures and a smaller share allocated to investment expenditures. We analyze the resulting effects on China's economy and trade, as well as energy consumption in China and other regions. Because wages, the production of goods, and trade are so interconnected, this analysis provides a unique perspective by isolating the effects of wage increases from industrial or trade policy changes.

One approach to measuring a country's economy is by summing the expenditure components of gross domestic product (GDP), which include personal consumption expenditures, gross fixed private investment, government consumption expenditures, and net exports. The relative shares of these expenditure components of GDP significantly affect energy production and consumption. In particular, the balance between generally less energy-intensive consumption-led growth and more energy-intensive investment-led growth usually affects both the quantity of energy used and how it is consumed.

Another way to calculate GDP is the output approach—which focuses on the production side of the economy; for this approach, we sum the net value of the output of services, of manufacturing, of construction, of mining, and of agriculture. The composition of industries on the production side of the economy is important when analyzing projections because of the crucial role that energy and labor play in producing outputs.

In this IEO2021 alternative case analysis, higher wages in China lead to two main drivers of changes from the Reference case: greater disposable income and increased production costs for domestic products and services. Greater disposable income drives higher personal consumption expenditures. Higher production costs for domestic products increase China's imports and lower exports as production costs in other regions become more competitive. Both drivers (greater disposable incomes and production costs) affect global trade, and because the economic structures of regions outside of China and the production side of economies (including China) remain unchanged from the Reference case (no additional assumptions are made about trade dynamics), change in global trade is the primary driver for change in energy markets in other regions in this analysis.

Right now, China is a large, fast-growing economy that influences energy systems at the global level, and as such, it is a prime country in which to explore wage effects. Although the IEO2021 Reference case projects a shift to greater consumption expenditure in China's economy,¹ this analysis explores how a faster shift to a consumption-led economy could affect China's energy consumption and how that outcome would translate to the energy sector globally.

Our analysis shows that higher wage assumptions in China increase primary energy consumption above the Reference case's level globally by 1.4%, or 12.2 quadrillion British thermal units (Btu) by 2050. The

¹ Supported by a number of the objectives in China's 14th *Five-Year Plan* (FYP) spanning 2021–2025.

largest sectoral impacts occur in the industrial sector (7.5 quadrillion Btu), and the largest effects regionally (across all sectors) occur in China (2.6 quadrillion Btu) and India (3.6 quadrillion Btu).

Market Description

Economic growth in China has outpaced world economic growth every year since at least 1981. For 32 of those 40 years, the rate of economic growth in China was above 7% per year, which is notably large for a country that grew to a population of about 1.4 billion in 2021.

Partly because of its historical development patterns, China currently has a unique GDP structure. In 2020, investment as a percentage of GDP was about 43%, and the consumption share of GDP was relatively small, at 38%.² These shares are markedly different compared with many countries. In countries with developed economies (for example, Organization for Economic Cooperation and Development (OECD) member countries) consumption as a percentage of GDP typically ranges from 50% to 70%, and the investment share of GDP is closer to 20% to 25%. As China's economy and other emerging economies grow, we expect these shares to more closely reflect those in developed economies for structural targets and goals.

For more than four decades, much of China's economic growth has been based on low-cost labor. Recently, policymakers in China publicly stated concerns that income and wealth are unevenly distributed and that this degree of inequality could generate social challenges in the future. To that effect, leaders in China have called for more "common prosperity"³ and have suggested China's business leaders "adjust excessive incomes."⁴

The economic development path of low-cost labor that China has maintained over the last several decades has been made possible by an abundant supply of labor, or by what Nobel Price-winning economist Arthur Lewis called, "an unlimited supply of labor" produced by massive rural-urban migration. However, this path is facing its own internal constraints and empty, or *ghost*, cities have popped up across the country.

Furthermore, China's slowing population growth and aging population affect the labor market. To address this, the government has changed child birth policies, first ending its one-child policy and allowing two children per family in 2016 and now by allowing families to have up to three children.⁵ Even with these changes, population growth in China will likely continue to slow, with its population hitting a peak of about 1.5 billion people by 2031. At the same time, the working-age population—people 15 to 64 years old—has been declining since 2016 and is not projected to grow, putting more pressure on China's labor supply and driving up wages.

From the 1980s through the 2000s, China experienced double-digit growth rates in real GDP, and its energy consumption more than tripled. In the past decade, however, economic growth has slowed and

² The structure of any economy can be measured by the expenditure components of GDP—personal consumption expenditures, gross fixed private investment, government consumption expenditures, and net exports.

³ For example, see "[Assessing China's 'common prosperity' campaign](#)," Brookings, September 9, 2021.

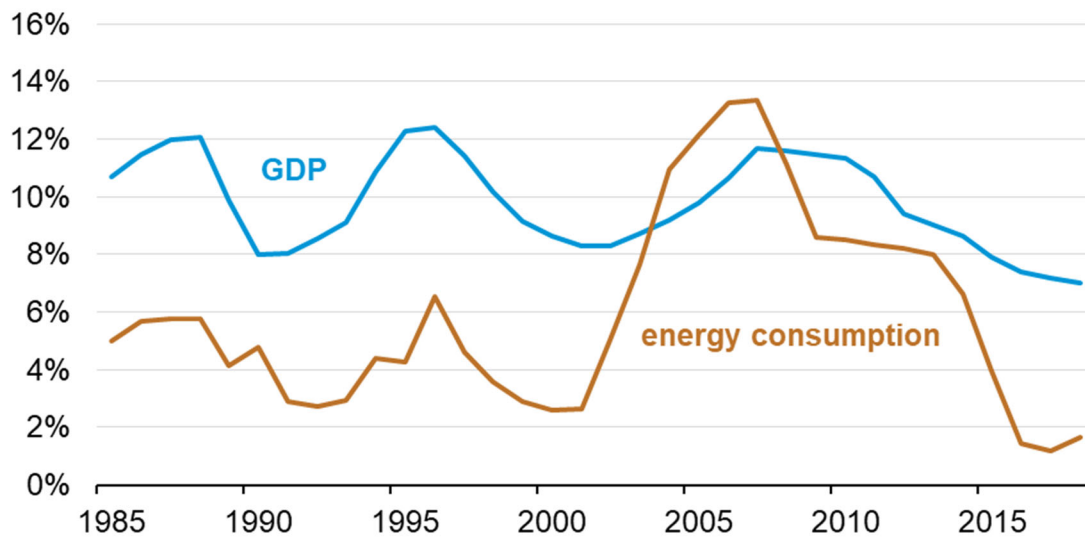
⁴ "[Chinese president vows to 'adjust excessive incomes' of super rich](#)," The Guardian, August 18, 2021.

⁵ "[China allows three children in major policy shift](#)," BBC, May 31, 2021.

so has energy consumption (Figure 1). However, China's economy has become the second-largest in the world in nominal terms and the largest economy in terms of purchasing power parity (PPP)—the dollar value conversion used throughout this analysis. Further, the size of its population, about 1.4 billion individuals, makes its consumer sector a major driver of economic growth for industries as well as for countries around the world. So even with the recent slower growth, China's energy consumption has been very important in shaping global energy market trends because of its large population and the size of its economy.

Figure 1.

Five-year average annualized growth rate, China
percentage



Source: U.S. Energy Information Administration, *International Energy Outlook 2021*

Note: real GDP as measured in 2015 U.S. dollars using purchasing power parity

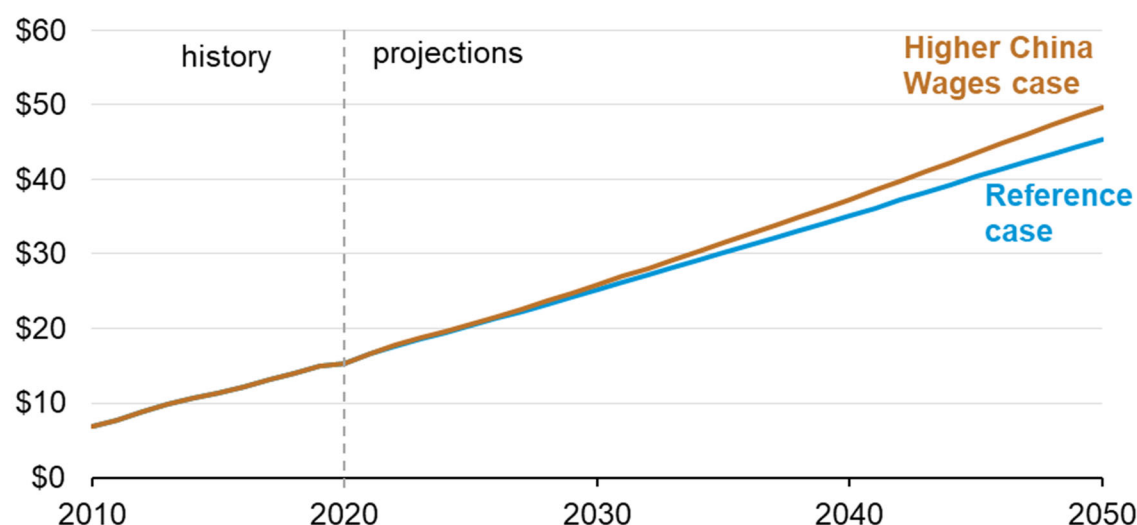
Case Description

To better understand the uncertainty of China's economic development and the associated energy consumption, we compared a case with higher wages in China to the Reference case. In the Higher China Wages case, two complementing trends could push wages and salaries higher than in the Reference case: the slowdown of rural-urban migration and the decline in the working-age population. This case assumes the smaller working-age population will have a larger effect on China's wages compared with the Reference case. Workers in China earn higher wages and salaries because companies pay more to attract candidates from the shrinking working-age population. Higher wages and salaries will also make urban living more appealing for rural workers and increase rural-urban migration, mitigating some labor constraints. In 2020, U.S. hourly nominal wages were 6.2 times higher than hourly nominal wages in China. In our Reference case, this ratio is reduced to 2.2 times higher by 2050; in the Higher China Wages case, the ratio versus U.S. hourly nominal wages is reduced further, to 1.5 times higher in 2050. This difference increases consumption in China as well as disposable income (Figure 2).

Figure 2.

Disposable income, China

trillion 2015 dollar



Source: U.S. Energy Information Administration, *International Energy Outlook 2021*

Note: 2015 U.S. dollars using purchasing power parity

The economic structure in China might change in other ways, namely on the production side of the economy (which includes outputs of services, manufacturing, construction, mining, and agriculture) and in trade dynamics. Each of these two specific economic activities—production and trade—are often addressed by separate policies. The Higher China Wages case does not make any changes to either of these systems, so any existing relationships simply respond as they would in the Reference case. For example, if consumer demand for higher-value goods increases and those goods are not currently a growing industry in China’s production economy (meaning they are typically imported when purchased), then China will import more manufactured goods rather than produce them domestically.

Results and Discussion

One result of the Higher China Wages case is increased consumer demand (personal consumption expenditures in the national accounts), so domestic consumption makes up a larger percentage of GDP than in the Reference case. The combination of higher wages and additional consumption leads to higher inflation, which pushes the *renminbi*, China’s currency, lower over time. Because consumers in China are consuming more and domestic prices for products are increasing, export growth slows down relative to the Reference case.

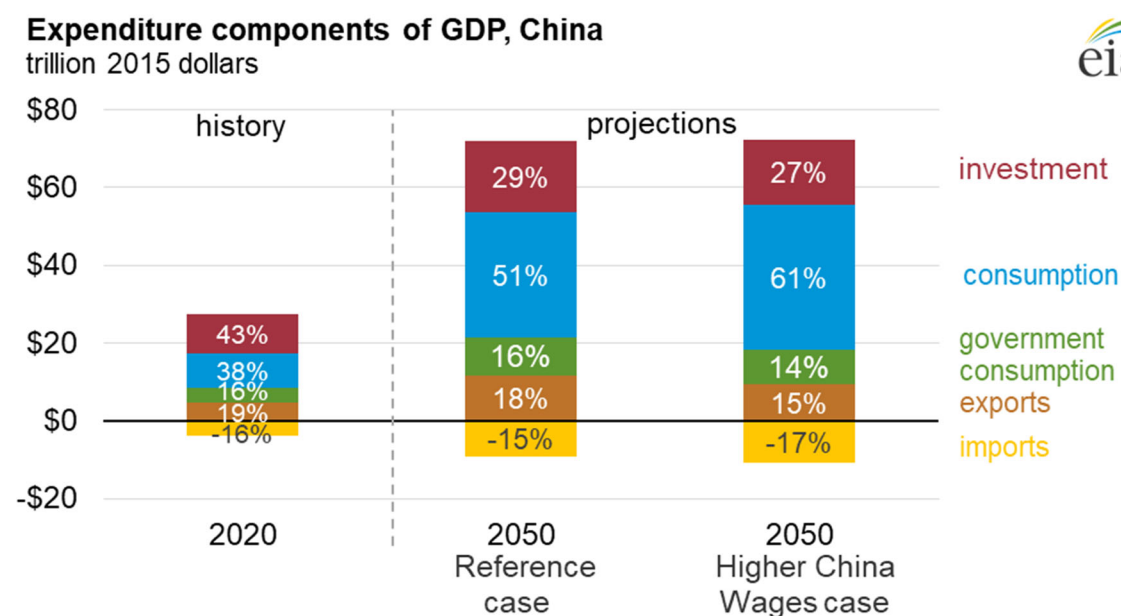
Real investment grows more slowly in the Higher China Wages case than in the Reference case, but real imports grow at a slightly higher rate than in the Reference case as foreign producers take advantage of higher prices in China—reflecting a development strategy that emphasizes domestic consumption as an important driver of GDP growth. In the Higher China Wages case, the dynamics of the production side of the economy remain stable, but they can still respond to the relatively higher production costs.

Restructuring of industries does not occur because we made no explicit changes to assumptions in the

industry model. So, most of the energy effects from the Higher China Wages case are attributable to global trade. In the Higher China Wages case, China's exports grow more slowly because production becomes more expensive and domestic consumption of some products increases. Imports grow faster as foreign producers become more competitive compared with the Reference case. Similar to industries, though, these trade relationships are not modified for this analysis and respond in the same way as the Reference case.

Historically, many economies encouraged growth and raised the average standard of living by transitioning economic activity toward the production of higher-value, more-finished products and services to be used by domestic consumers. By examining the expenditure shares (Figure 3), we can show the shift away from investment and export-led growth and toward more consumption-led growth. Expenditure shares are the ratios of the individual expenditure components of GDP—personal consumption expenditures, gross fixed private investment, government consumption expenditures, and net exports (exports minus imports)—to total GDP, using real 2015 dollars in purchasing power parity.

Figure 3.

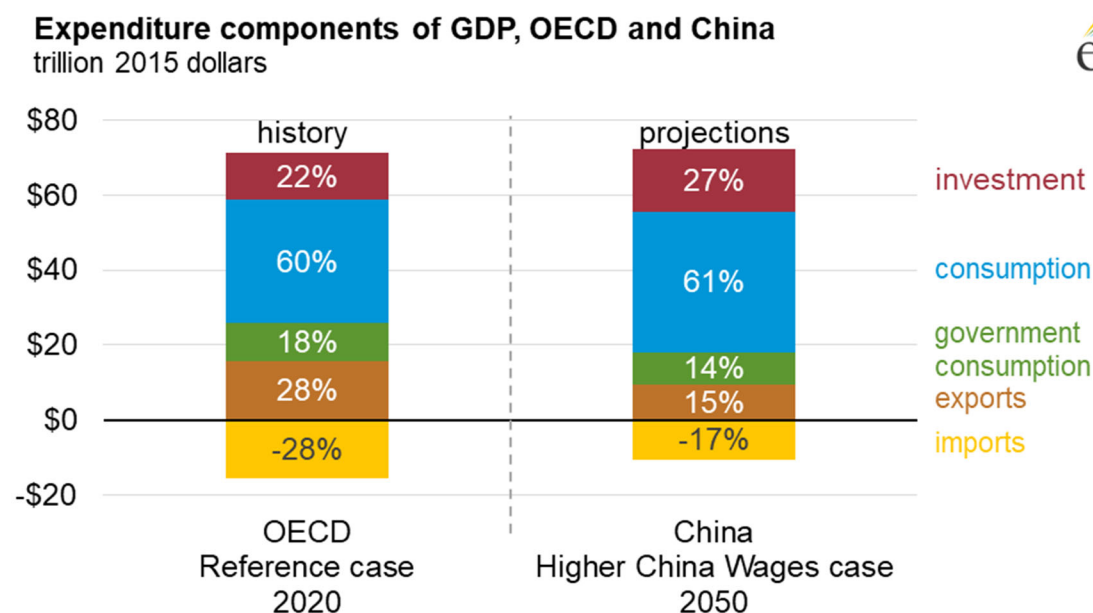


Source: U.S. Energy Information Administration, *International Energy Outlook 2021*

Note: 2015 U.S. dollars using purchasing power parity

Our analysis shows the increased share of consumption in the Higher China Wages case brings the 2050 economic composition in China closer to the current OECD average share of consumption, which was approximately 60% in 2020 (Figure 4). Notably, the average share of investment in 2020 for the OECD was 22%, but the investment share for China in 2050 in the Higher China Wages case was 27%.

Figure 4.

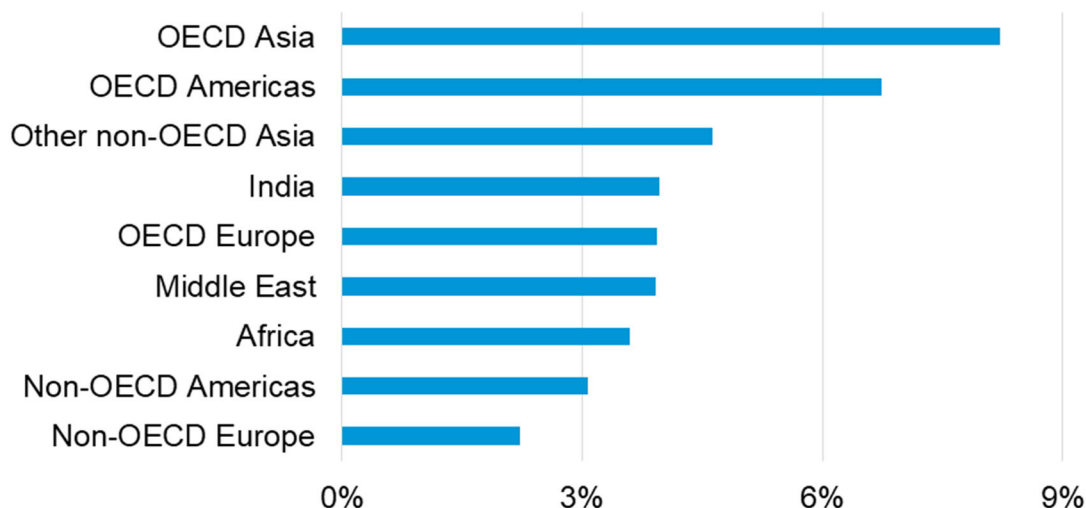


A review of exports from regions other than China shows the effects of higher demand from consumers in China (Figure 5). Slower export growth from China compared with the Reference case and more import growth due to stronger wages and consumption in China increase global trade flows. Although OECD Europe continues to have the most exports in 2050 (as in the Reference case), the relative increase in exports in the Higher China Wages case is greatest in several IEO2021 Asian regions,⁶ which highlights the importance of China's regional partners in trade.

⁶ https://www.eia.gov/outlooks/ieo/pdf/IEO2021_ChartLibrary_References.pdf

Figure 5.

Difference in 2050 total exports, Higher China Wages case
percentage



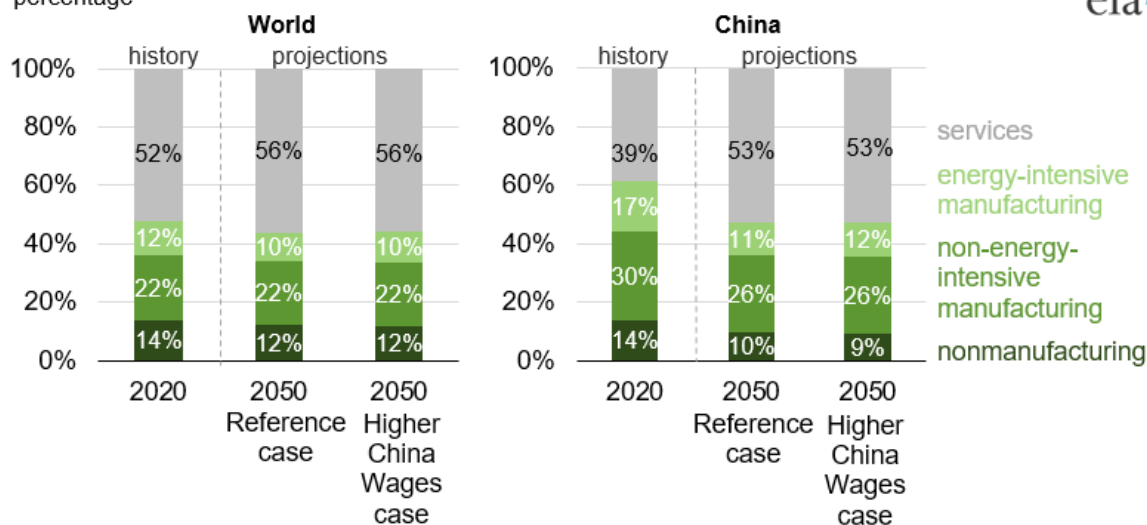
Source: U.S. Energy Information Administration, *International Energy Outlook 2021*

Note: real exports as measured in 2015 U.S. dollars using purchasing power parity; percentage difference in 2050 between the Higher China Wages case compared with the Reference case

On the production side of the economy, measured by output, the broadest sectoral composition of all regions remains mostly the same between the Reference case and the Higher China Wages case (Figure 6). This stability is largely because the Higher China Wages case has no additional assumptions or inputs for industries and production. Because the production side of the economy is the most energy intensive, leaving these relationships the same has the potential to limit energy effects, but the largest energy changes are still in the goods-producing sectors—what we call the industrial sector (manufacturing, construction, mining, and agriculture).

Figure 6.

Output shares by sector percentage



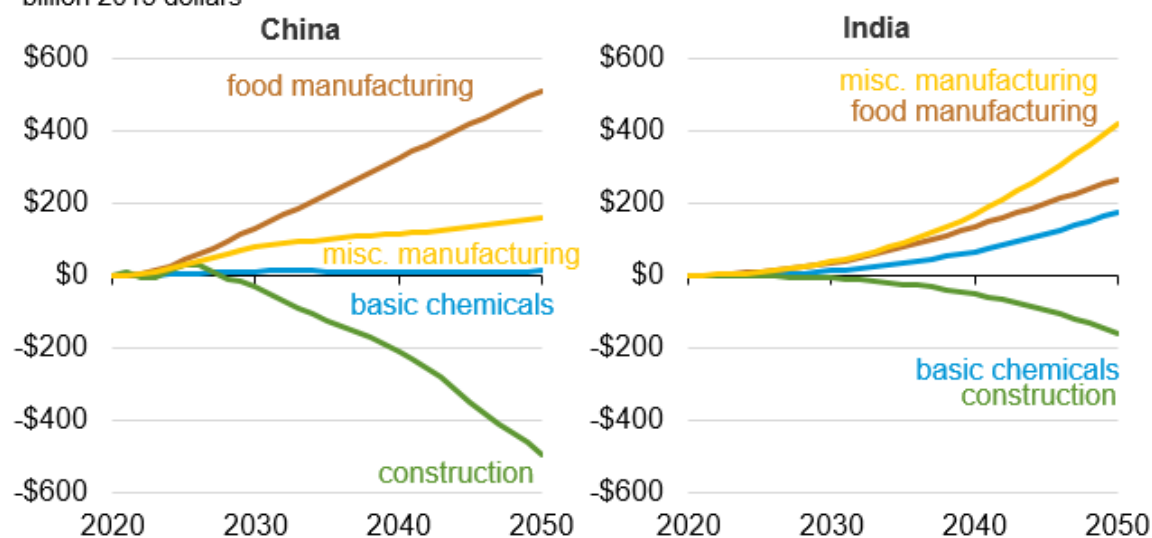
Source: U.S. Energy Information Administration, *International Energy Outlook 2021*

Note: real gross output as measured in 2015 U.S. dollars using purchasing power parity

After looking at the detailed industry estimates underlying sectoral output, we see the most notable industrial output changes in the Higher China Wages case are the increased growth of food manufacturing and the decreased growth in construction in China, which is driven by relatively lower investment expenditures. As a result of changes in trade, other regions outside of China also experience changes in different industries (Figure 7), especially in India.

Figure 7.

Difference in gross output, select industries billion 2015 dollars



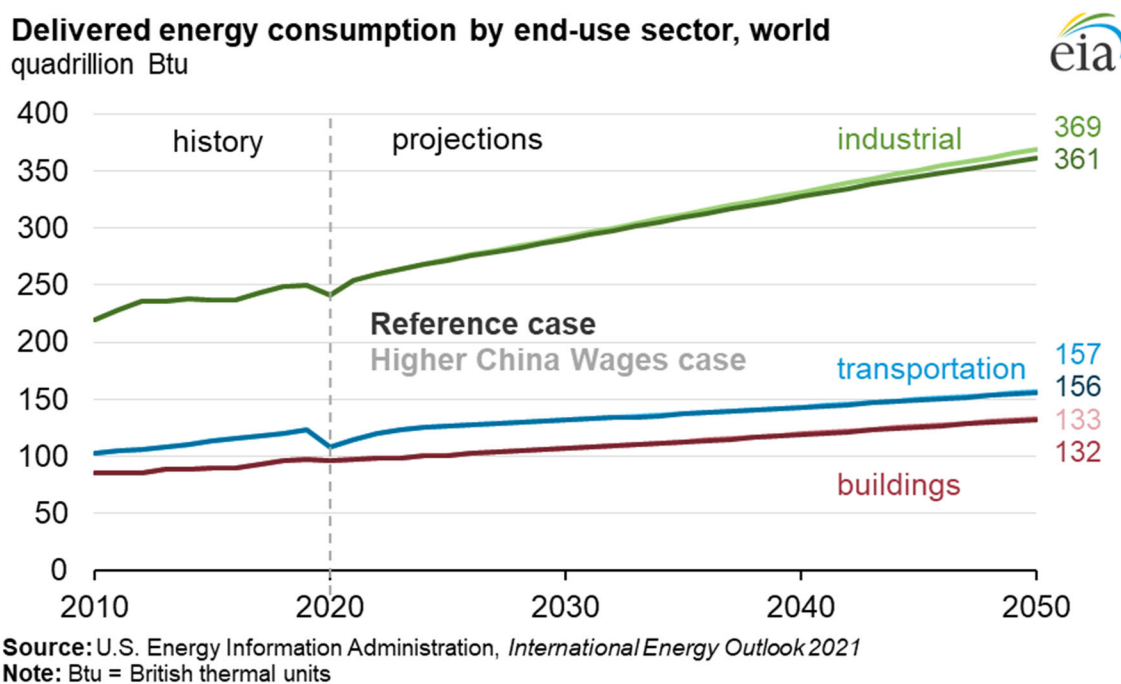
Source: U.S. Energy Information Administration, *International Energy Outlook 2021*

Note: 2015 U.S. dollars using purchasing power parity; dollar amounts reflect the difference between the Higher China Wages case compared with the Reference case

Similar to gross outputs, the largest changes in energy consumption are directly related to the industrial sector in the Higher China Wages case (**Error! Reference source not found.**), where global energy consumption in that sector in 2050 is 7.5 quadrillion Btu (2%) greater than in the Reference case. Of this global total increase in the industrial sector, the largest regional increments are in China and India, which are 0.21 (0.3%) and 3.23 (5.6%) quadrillion Btu greater than 2050 Reference case levels, respectively.

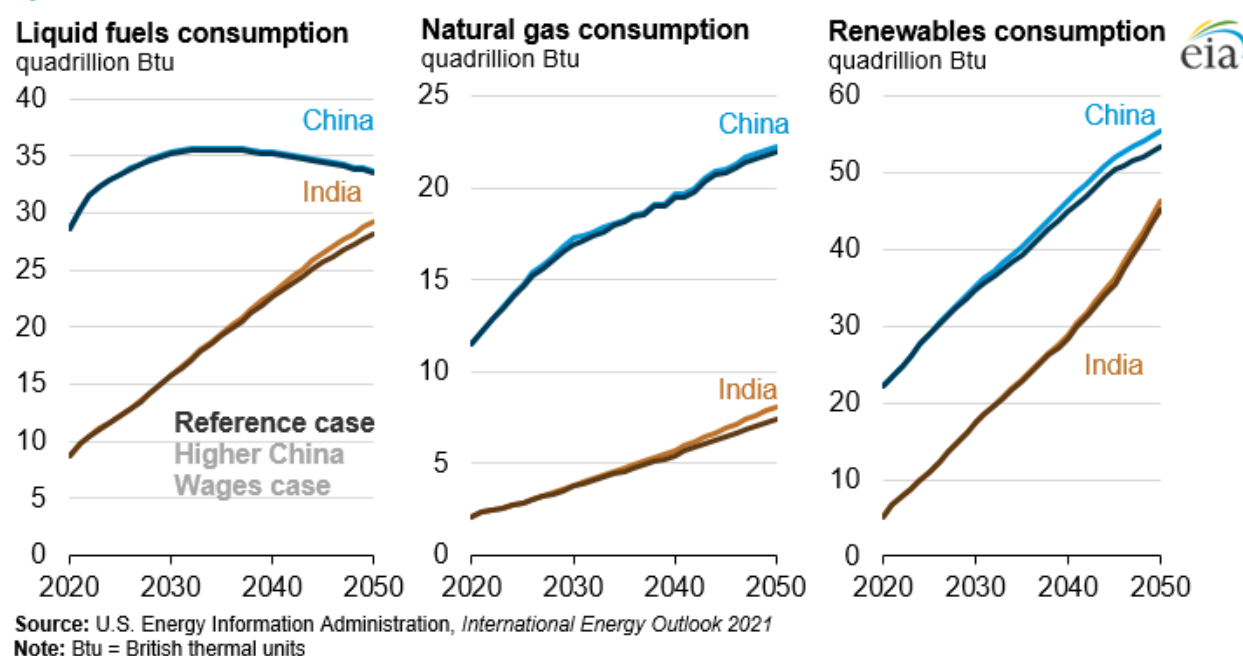
Although changes are noticeable in the industrial sector, the total global primary energy consumption increase across all sectors in 2050 in the Higher China Wages case is relatively small—12.2 quadrillion Btu (1.4%) greater than in the Reference case. This result indicates that increased disposable income in China, with no additional changes in the dynamics of industry and trade, has a limited impact on the level of global energy demand.

Figure 8.



The regions with the largest increases in energy consumption in the Higher China Wages case are China and India, and the fuels with the largest changes are liquid fuels, natural gas, and renewables (**Error! Reference source not found.**). In India, the 1.2 quadrillion Btu increase from the Reference case in liquid fuels, the 0.7 quadrillion Btu increase in natural gas, and the 1.2 quadrillion Btu increase in renewables are mostly from growth in output in industries that use large amounts of all three fuels. China's energy consumption increase in the Higher China Wages case relative to the Reference case is mostly attributed to renewables—2.1 quadrillion Btu—because of increased electricity demand, especially for buildings. More solar consumption, in particular, occurs in the electric power sector due to favorable economics and policy in the mid- to long-term.

Figure 9.



Conclusion

This study shows that higher incomes in China drive a faster shift to personal consumption expenditures when compared with the IEO2021 Reference case. As a result, the consumption share of GDP in China in 2050 approaches the current OECD country average in the Higher China Wages case.

The Higher China Wages case also results in an increase in energy consumption, both in China and in other countries. This increase in energy consumption is driven only by higher wages and salaries in China because we made no changes to the assumptions on trade dynamics nor the structure of industries; we did not assume a concurrent shift in gross outputs beyond what is needed to match the change in the expenditure components of GDP.

The increase in energy consumption in the Higher China Wages case is led by the industrial sector, both in China and, notably, India. Because wages increased in China, production costs of goods and services also increased, making production costs in other countries more competitive, particularly India. As such, production of goods, and consequently energy consumption, increased in India to meet the increased global need for outputs, particularly increased consumer demand in China. In general, higher production costs in China increased the country's imports and decreased exports.

While notable, the resulting 12.2 quadrillion Btu (1.4%) increase in 2050 global energy consumption in the Higher China Wages case, relative to the Reference case, is a small fraction of global energy consumption. In China, we observed a 2.6 quadrillion Btu (1.3%) increase in 2050 compared with Reference case levels. This result shows that absent any additional policies, an increase in wages in China does not have large energy effects. In addition, this result demonstrates that the increase in the personal consumption expenditure share of China's economy is tempered by a relative increase in the

cost of labor in China. That is, while demand for products increased in the Higher China Wages case, production costs in China also increased, shifting production activity (and hence energy consumption) outside of China.

Somewhat surprisingly, the largest energy impacts in the Higher China Wages case are outside of China. Energy changes outside of China are caused by its higher production costs, due to higher wages. These energy changes result from a decrease in exports from China and an increase in imports to China, requiring additional trade from other regions to balance demand globally—particularly for India, where production costs are relatively low. As such, primary energy consumption in India in 2050 increased by 3.6 quadrillion Btu (3%) in the Higher China Wages case compared with Reference case levels.

This analysis uniquely highlights the impacts that changes in wage assumptions in China, when analyzed independently of other factors, can have, both in China and throughout the world. Changes in China's consumption and production of outputs can influence global trade and energy consumption. China's role in the global trading system reinforces the importance of modeling assumptions about China because of its direct and indirect impacts on global projected energy consumption.