

Inflation and Shortages: An Exploration of the Chip Shortage's Macroeconomic Effects

Introduction

“Pandemics and other biological threats, cyber-attacks, climate shocks and extreme weather events, terrorist attacks, geopolitical and economic competition, and other conditions can reduce critical manufacturing capacity and the availability and integrity of critical goods, products, and services,” so President Biden’s executive order, which supported chip technological development, acknowledged in February 2021.¹ While often overlooked as an intermediate good, computer chips play an important role in electronic products; at a macro-level, the market for such chips affects America’s “economic prosperity and national security.”

An unprecedented demand in chips shock led to a significant shortage, contributing to supply chain issues. From October 2020 to October 2021, wait times increased from 12.8 weeks to 21.9 weeks for chip buyers' orders to arrive.² Car manufacturers General Motors and Ford reported substantial drops in their 2021 Q3 earnings as a result of the computer-chip shortage.³ Philip Morris estimated to have lost hundreds of thousands of unit sales of its smoking devices as a result of the chip sales, which could grow to 1.5 million by the second half of the year.⁴ Utility-monitoring devices company PowerX lost millions of dollars and has paid up to five times the typical prices for small batches of chips.

This paper will explore the macroeconomic effects of the chip shortage on the United States’ economy and suggest a few policy recommendations to improve efficiency and expand economic growth.

¹ “Executive Order on America’s Supply Chains.”

² Stephanie Yang and Jiyoung Sohn, “Global Chip Shortage ‘Is Far From Over’ as Wait Times Get Longer.”

³ Stephanie Yang and Jiyoung Sohn.

⁴ Stephanie Yang and Jiyoung Sohn.

Theory

Because chips act as an intermediate good, the shortage does not cause the fundamental problem in the macroeconomy as much as reflect aggregate supply and demand congestion. Specifically, the increase in demand for chips reflects a positive demand shock for those goods requiring chips for production: cars, computing systems, and technological programs.

The pandemic played a major role. Demand for chips increased dramatically: personal computer purchases skyrocketed, data center infrastructure expanded to meet the widespread use of video-streaming, the car industry changed its outlook when vaccination development progressed, and cryptocurrencies expanded.⁵ Meanwhile, the millions of Americans who remained at home saved transportation money and reduced their in-person shopping expenditures; as a result, households' savings increased, driving an increase in investment spending. Such increases contributed to increases in aggregate demand. Additionally, infrastructure bottlenecks prevented the efficient transportation of products like chips, which contributed to a decline in imports. Such a decline also increased the aggregate demand: a positive demand shock, shifting the aggregate demand curve AD_1 to the right AD_2 (see: AD-AS Model of the US Economy with a Chip Shortage). Finally, the Federal Reserve's quantitative easing stimulus continues to shift the aggregate demand to the right (see shifting AD_2).

Additionally, several international issues led to a chip supply congestion during the pandemic. For example, Taiwan experienced the largest drought in sixty-seven years, which required water caps by 15% in regions where major semi-conductor fabrication plants of TSMC and Micron existed.⁶ ⁷ In the past two years, three Japanese chip manufacturing facilities also saw fires that disrupted production.⁸ These disruptions also contribute to a reduction in aggregate supply, shifting the short-run aggregate supply curve $SRAS_1$ to the left $SRAS_2$.

⁵ "Why Is There a Shortage of Semiconductors?"

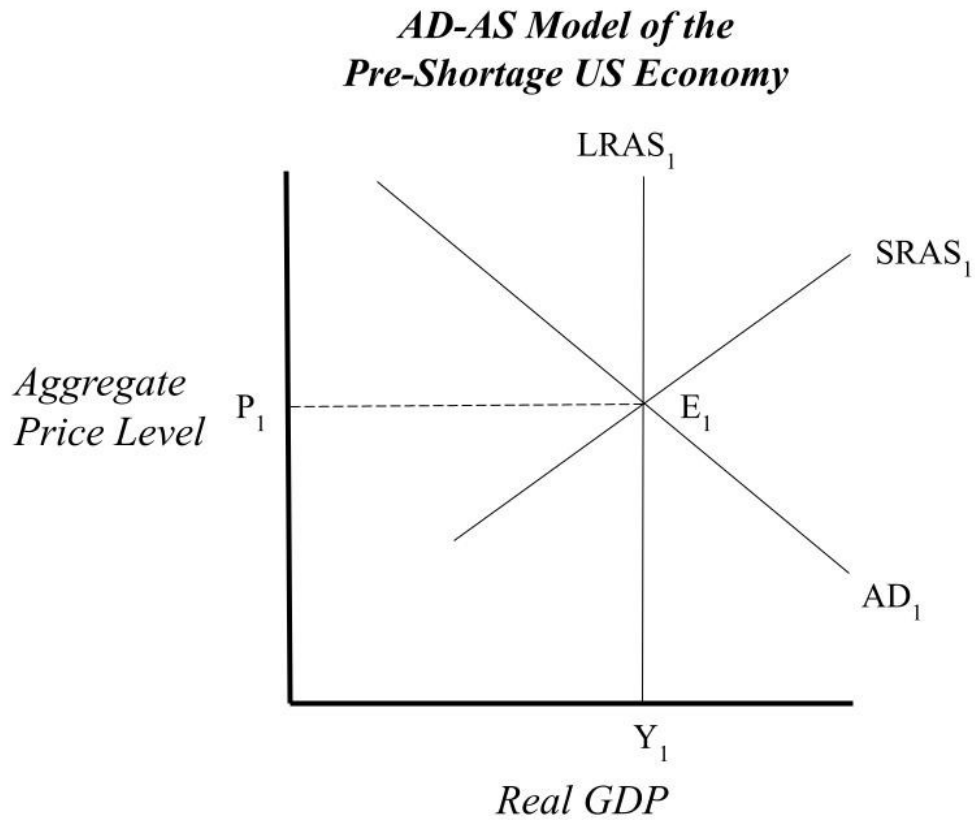
⁶ Plants extensively use water, as TSMC uses 41 million gallons of water per day

⁷ Tim De Chant, "Fab Fires and Drought Threaten to Make Chip Shortages Worse."

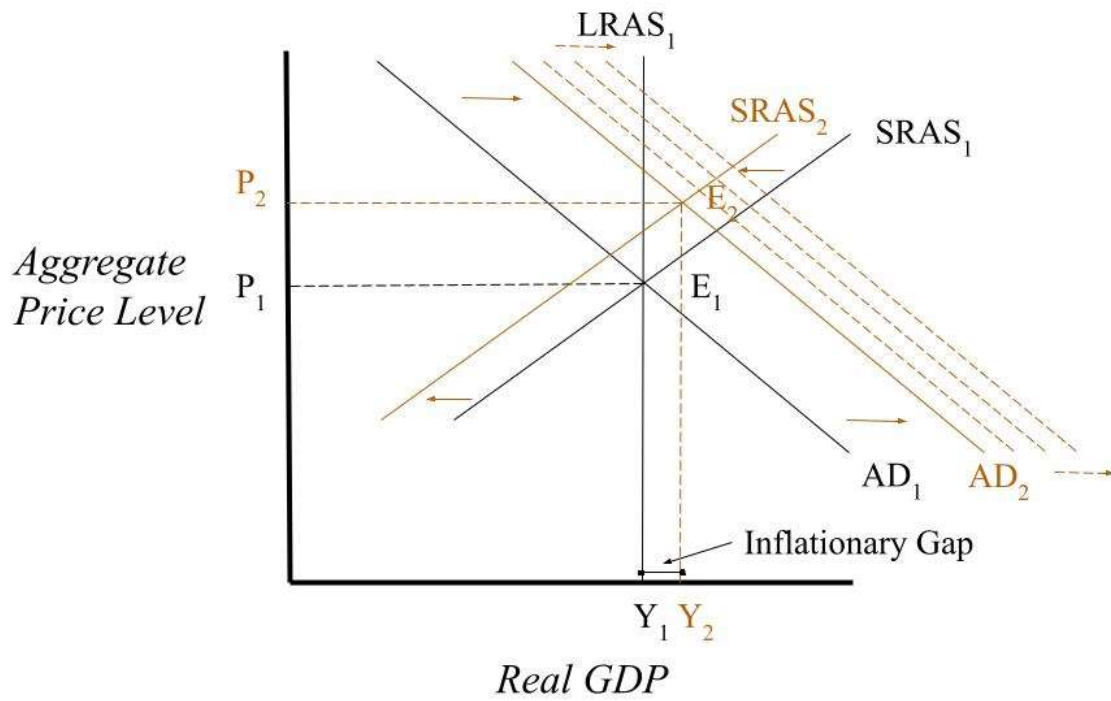
⁸ Tim De Chant.

In response, the aggregate price level increased, reducing short-term unemployment.

Additionally, because the new real GDP Y_2 exceeded potential GDP Y_1 , an inflationary gap emerged.



*AD-AS Model of the US
Economy with a Chip Shortage*



Policy Recommendations

The chip shortage creates two bifurcating problems: inflation and the shortage itself. Policies can reduce inflation in the short term as well as sustain long-term economic growth by reducing the Federal Reserve's pandemic recessionary monetary policy and supporting domestic chip technological development.

Short-term recommendations aim to close the inflationary gap through monetary policy. The Federal Reserve's continued stimulus continues to increase aggregate demand, so it ought to take a more hawkish stance. If its quantitative easing program ends, the inflationary gap's rightward shift should stop, or at the least, slow. Importantly, the Fed would not shift the aggregate demand curve towards the left so much as stop it from *continuing* to shift towards the right. That said, the Federal Reserve should hold off from raising interest rates, given that the omicron variant could pose further threats to the economy. Further evaluation should follow when data such as vaccine efficacy and infection rates about this new variant emerges.

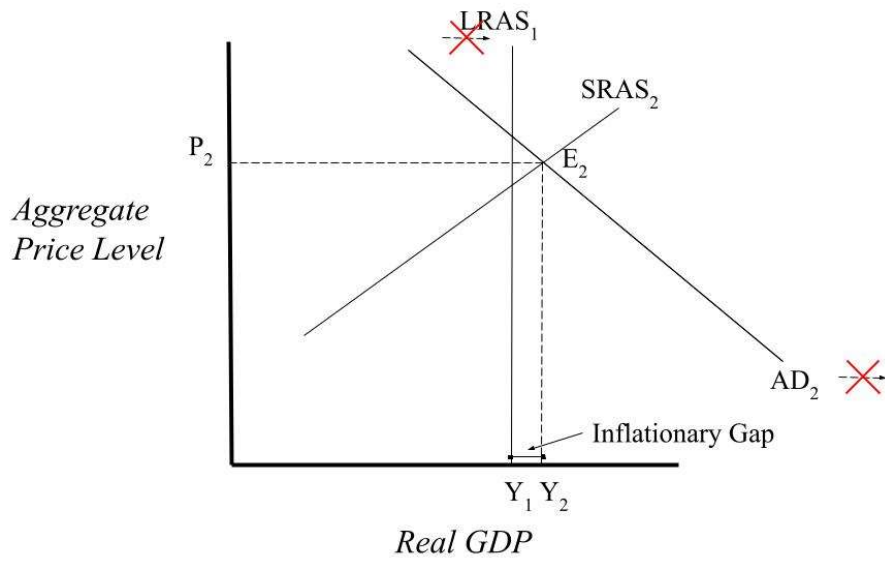
While an SRAS left-ward shift might initially seem like an attractive response towards inflation, chip supply reduction would further exacerbate the shortage problem. Fiscal side taxes on any actors in the chip market would come across as unpopular. This hesitation to shift the SRAS curve results from the coexistence of these dual problems: chip supply reduction would lower inflation but exacerbate the shortage itself while expanding short-run aggregate supply would address the shortage but fail to respond to inflation.

Long-term recommendations aim to expand the GDP potential through infrastructure development as well as chip innovation investments. For example, funding from the Bi-Partisan Infrastructure Bill should target long-term transportation and shipping infrastructure lines critical to national shipping lines. Investments in this infrastructure can provide new and improved means for goods to move across the country. Additionally, the government can employ subsidies for research and development, aiming to

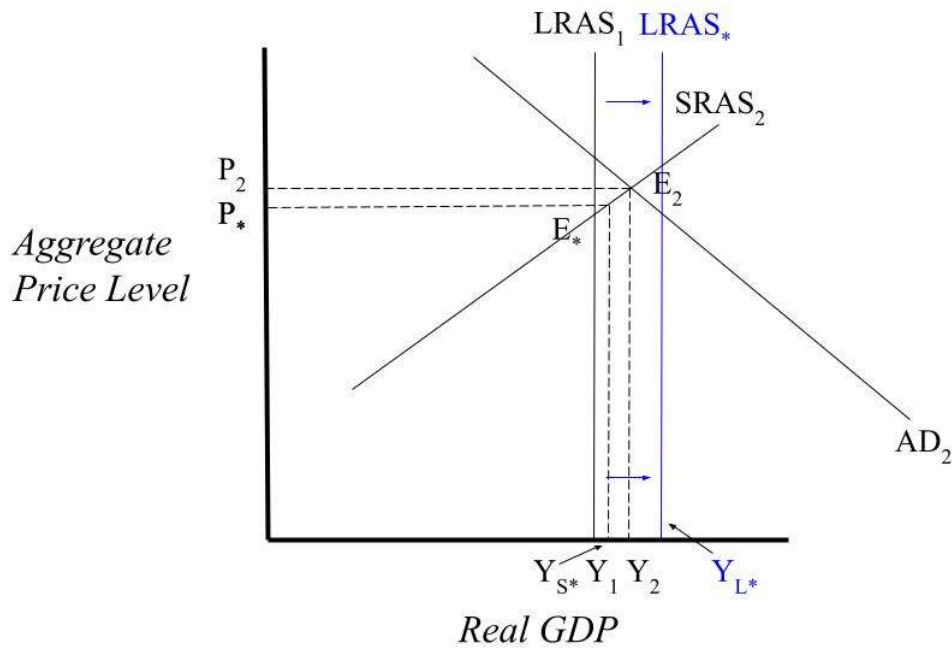
shorten the chip development timeline in addition to promoting domestic production.⁹ Chip technology grants for research institutions can dramatically change the chip industry and shift the GDP potential further to the right. Tax credits for semiconductor fabrication plants can encourage domestic production in the United States, increasing greater employment. Domestic chip industry development would also lower imports spending.

⁹ Some critics contend that subsidies for chip R&D would create unnecessary waste. However, given the current trends of technological development—the forecast in demand for electric vehicles, artificial intelligence, and quantum computing, among others—the demand for chips only appears to trend higher over the next several decades. Additionally, as the Biden Administration pointed out in his executive order, chips play a role not only in “economic prosperity” but also in “national security.” Greater domestic production of chips would have a positive externality in that the United States can reduce its reliance on foreign markets.

***AD-AS Model of the Short Term
Policy Effects on the US Economy***



***AD-AS Model of the Long Term
Policy Effects on the US Economy***



Conclusions and Future Research

The demand for goods that require chips for production created a global shortage that led to an increase in inflation. In response, the federal government can take both short- and long-term measures to not only prevent the inflationary gap from widening but also expand GDP potential. For example, the Federal Reserve can take more aggressive measures to taper down its current quantitative easing stimulus (yet hold off on raising interest rates). Moreover, subsidies for chip research and domestic technological development would not only expand the potential GDP and increase employment but also reduce the United States' reliance on foreign markets: a step that would bolster its national security.

A further extension of this study could compare the macroeconomic effects of the chip shortage in the United States with those in China, Taiwan, and Korea—the largest chip exporters. Additionally, this extended study could also evaluate how US chip subsidies could affect bilateral trade relationships with the countries. Any domestic policy to address global issues will have global effects.

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