# Impact of the amino acids industry on the U.S. Economy

## *Sino Domination of American Amino Acid Market Empowers China; Federal Response Warranted*

**Ike Brannon, Ph.D.**
**Russell Kashian, Ph.D.**

***Capital Policy Analytics***
***July 2021***

## Executive summary

### *BACKGROUND ON CHINESE SUBSIDIZED AMINO ACIDS IN THE U.S.*

- Until late 2018, most of China's amino acid sales occurred in Asia. However, after the African Swine Fever in 2019 and 2020 led to the destruction of nearly half of China's pig population, China's subsidized amino acid industry turned to the United States to sell their products.
- In 2019, the total U.S. imports of Lysine — a key amino acid — from China tripled over a four-month period, and a year later it doubled again. While China's pig population almost recovered, U.S. sales of amino acids imported from China remain elevated, especially for threonine, which is typically used for pigs and poultry. China has already established global dominance in threonine, with over 85% of global capacity for this important amino acid.

### *THE IMPACT OF CHINESE SUBSIDIZED AMINO ACIDS IN THE U.S.*

- Left unchecked, Chinese domination of key sectors of the U.S.'s amino acids industry would severely damage U.S. production. We estimate that the demise of critical sectors of the U.S. amino acid industry would destroy nearly 30,000 jobs of people in the U.S. who are either involved in amino acid production or have a direct or indirect connection to its production. It would also reduce domestic economic activity by $15 billion a year, with tax revenues at the federal, state and local levels reduced by nearly $9 billion over the next ten years.
- The above trends have created the potential for Chinese manipulation of the markets for these key inputs, which could result in reduced choice for producers and food security issues for U.S. consumers.

### *U.S. POLICY RESPONSE TO CHINESE SUBSIDIZED AMINO ACIDS*

- In 2019, the U.S. International Trade Commission (ITC) declined to declare that the actions of Chinese producers of threonine and lysine warranted inclusion in the Section 301 process. However, this decision predates the African Swine Fever incident and the collapse of China's pork industry. Potential U.S. policy responses to the continued subsidized Chinese amino acids imports include a renewed Commerce Department-ITC antidumping investigation or an Executive Branch Section 301 investigation.

## Issue Background

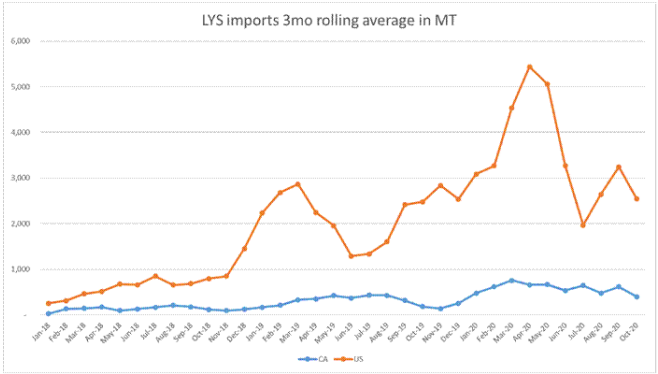
### *Growing Use of Amino Acids in the U.S.*

Most American farmers supplement their animal feed with a variety of amino acids, which can help livestock boost their productivity, improve their health, and reduce emissions of wastes that can pollute the groundwater or air. The market for amino acids has grown quickly in the last thirty years as more farmers have come to realize their benefits. Over $20 billion of amino acids were sold worldwide in 2020, and U.S. sales in 2021 will total $3.2 billion.

The U.S. and China are the two biggest producers of amino acids. Until late 2018 most of China's sales occurred in Asia; however, after the African Swine Fever led to the destruction of over thirty percent of China's pig population, the country's amino acids producers pivoted to the United States market.

In fact, as African Swine Fever decimated Chinese pork production, the total U.S. imports of Lysine — a key amino acid — from China tripled over a four-month period, and a year later it had doubled again. While China's pig population has begun to recover and is 14 percent above last year's output, U.S. sales of amino acids imported from China remain elevated, especially for threonine, which is one typically used for pigs. Figure One shows Chinese lysine imports into the U.S. in the last three years.

### *Fallout to U.S. Amino Acid Market*




China's greatly increased imports of amino acids sharply reduced prices and could threaten the viability of the domestic amino acid industry. At a minimum, increased subsidized imports will curtail future investments in U.S. production. A diminution or collapse of the domestic amino acid industry would significantly impact the U.S. farm economy.

We estimate that the industry's demise would destroy nearly 30,000 jobs of people in the U.S. who are either involved in its production or have a direct or indirect connection to its production. It would also reduce domestic economic activity by $15 billion a year, with tax revenues at the federal, state and local levels reduced by nearly $9 billion over the next ten years.

### *China's Worrying Economic Expansion into U.S. Markets*

The exit of domestic producers from the market would subject U.S. farmers to the vicissitudes of Chinese producers and — by extension — the Chinese government. Given Beijing's proclivity to use their economic leverage to pursue geopolitical objectives, such an occurrence would expose the American farm industry to undue risk of being collateral damage in a broader dispute between the two countries. The nature of the amino acids market makes it particularly ripe for exploitation by an organized cartel of sellers if Chinese companies dominate this important market

### *ITC Commission Decision Outdated*

The U.S. International Trade Commission declined to declare that the actions of Chinese producers in 2018-2019 constituted dumping, and no Section 301 tariffs were imposed on lysine or threonine. But this analysis is somewhat outdated, because it mostly predates the African Swine Fever incident and the collapse of China's pig industry, which ultimately led the Chinese to turn to the U.S. to sell their amino acids they no longer needed for domestic pig production. We also attribute the IDC decision in part to the fact that livestock producers were ambivalent about the rapid increase in Chinese imports, as it served to bring down the prices of amino acids.

### *The Real Costs of Cheap Chinese Amino Acids*

Any minimal cost savings accrued through low price amino acids are seriously outweighed by the long-term costs of the United States losing a vital industry, leaving our food supply and agricultural economies at the mercy of Chinese central government planners. A robust domestic amino acid market would ultimately help to moderate food prices and bolster food security.

It is also our understanding, based on confidential conversations with industry insiders, that domestic producers of amino acids are deeply reluctant to speak out against China's attempt to control the amino acids industry, because they also operate in China, and fear retaliatory measures from Chinese government operatives.

### *Federal intervention Wouldn't Raise Food Prices*

Finally, should the U.S. government put tariffs on imported Chinese amino acids, it would not dramatically increase costs for domestic livestock producers because amino acids are such a small portion of the cost of animal feed.

# The Impact of Amino Acids on the U.S. Economy

## *Amino Acids*

To maintain optimal health, most animals — as well as humans — benefit from having a certain amount of amino acids in their diet. Amino acids are organic compounds that combine to form proteins. Animals with sufficient amino acids have a healthier immune system and more muscle mass than those who are deficient.

Besides improving health and increasing lean muscle mass, amino acids also improve the efficiency of their feed, which means animals can reach their optimal size with less food. What's more, amino acids also make animals more productive: Pigs grow better and their food costs less with amino acids in their diet and chickens lay more and bigger eggs.

The use of amino acids with animal feed can also provide significant environmental benefits by reducing the amount of nitrogen excreted into the environment. While animals need protein to live, if they get too much it passes through their feces or urine as excess nitrogen, which can leach into the water. As it flows downstream it can lead to eutrophication, which is when an environment becomes enriched with nutrients, causing an excessive growth of plants and algae in downstream lakes, rivers, and oceans. This excessive growth serves to create dead zones that inhibit or prevent life altogether. It is a very large problem in coastal areas around the world these days.

There are three types of amino acids: Essential amino acids cannot be made by the body itself and must come from food. Nonessential amino acids are produced by the body even if it is not in the food consumed by it. Conditional amino acids are not essential except in times of illness and stress.

People can usually get the amino acids they need from their diet; for instance, turkey, eggs, and quinoa are foods rich in amino acids, but nearly all foods from animal-based protein provide humans with the amino acids they need for proper health.

However, farm animals typically have a narrow diet, which can preclude them getting the proper amino acids, and it rarely includes animal protein. While soybean meals are rich in protein, it lacks the proper balance of amino acids. Farmers prefer to use more corn, which is less expensive, whenever possible. To replace the amino acids animals lose from corn and soy, farmers supplement each with isolated amino acids in livestock production. The necessary amino acids differ across animals: Pigs and chickens need methionine, threonine and lysine.

### *The ITC Process*

Dumping is defined as a foreign producer selling products in the United States at "less than fair value." Simply selling products at prices lower than those of American producers is not necessarily dumping. However, it is dumping when foreign producers are deliberately selling at prices below the prices they would receive in their home market, or at prices below the cost of production. Since it is often difficult to determine whether prices are lower than the cost of production, the prices of the products in the home market are typically used to determine whether dumping is occurring.

Dumping can harm domestic industries as foreign producers undercut U.S. firms and potentially drive domestic firms out of the market, giving the foreign producers increased market share and eventual market dominance.

A separate but related issue is countervailing subsidies. Foreign governments often subsidize industries through direct payments, tax credits, or favorable loans. Similar to dumping, this allows foreign producers to sell products in the United States at prices that undercut domestic firms and potentially lead to injury to the U.S. firms.

A determination of dumping or subsidizing by foreign manufacturers requires two findings: first, that the foreign producers are selling their products at less than fair value; and that the dumping is causing injury to U.S. industry.

The first finding — that the product is being sold at less than fair value — is under the jurisdiction of the U.S. Department of Commerce. The Department determines whether the product is being sold at less than the normal price, and determines the dumping margin or the amount of the subsidy.

The U.S. International Trade Commission is responsible for determining whether the dumping or subsidizing is injurious to U.S. industry or whether there is a threat of injury. If it is determined that foreign producers are dumping or receiving government production subsidies, the remedy is to impose anti-dumping or countervailing duty on the product. The duty is the dumping margin or the amount of the subsidy.

For example, if the Department of Commerce determines that foreign producers are selling a product for 10 percent less than the fair value, the duty on the product would be 10 percent of the value of the product when it is imported into the United States. This duty makes up for the difference in price and encourages additional investment in the U.S.

### *ITC Affirms Chinese Glycine Dumping*

An important example of an ITC investigation into alleged dumping or foreign subsidies is the 2019 investigation into the amino acid glycine imported from China, India, and Japan. The U.S. glycine manufacturing industry alleged that Chinese, Indian, and Japanese producers were undercutting their

prices and damaging the industry. They petitioned the ITC and the Commerce Department to investigate these allegations. The Commerce Department determined that Japanese and Indian producers were selling glycine at lower than fair value. China, which had already been subject to antidumping duties since 1998, was found to be subsidizing its glycine manufacturers.

The ITC determined that glycine imported from the three countries was materially injurious to the U.S. glycine industry. It found that while demand for glycine and the domestic costs of production were increasing, the domestic prices were decreasing. This suggested that foreign suppliers were underselling the U.S. manufacturers through unfair competition. The impact of this unfair competition was lower revenues and a decline in the domestic industry.

As a result of the ITC's findings, The U.S. imposed antidumping duties on glycine imported from India and Japan and countervailing duties were imposed on glycine imported from China. The ITC is currently scrutinizing methionine from Japan, France and Spain to discern whether it also constitutes dumping.

### *Unfair Chinese Government Subsidization of Amino Acids*

The Chinese government provides key subsidies to its country's amino acids producers that have resulted in exports to the U.S. that jeopardize the vitality of amino acid producers and its domestic supply chain. These subsidies greatly impact the cost structure for amino acid production. Both its corn--which provides the sugar source for amino acid fermentation--and the electric power are subsidized by the Chinese government. What's more, since the Chinese banking system is effectively a state-owned enterprise, controlled by the government, it can ensure that it receives sufficient and affordable, low-cost capital to pursue its export growth strategies.

### *Lessons from the U.S. Vitamin and Dietary Supplement Industry*

The U.S. vitamin and dietary supplement industry provides an instructive example of how unfettered Chinese importation and dumping can harm domestic firms. Beginning in the early 2000s, subsidized Chinese vitamin producers were able to undercut U.S. businesses by forming a price-fixing cartel. Using predatory pricing, they captured the world vitamin market.

By 2007, 90 percent of vitamin C sold in the United States was manufactured in China. Today, over 80 percent of the ingredients used to manufacture vitamins and dietary supplements in the United States come from China. This has left these domestic industries reliant on China and gives China important leverage in trade negotiations and disputes with the United States. This potentially creates food security and health risk for the United States.

Similarly, as the Covid-19 pandemic has highlighted, Chinese subsidized businesses have managed to corner the market for many pharmaceutical products. 90 percent of vitamin C, antibiotics, and ibuprofen in the United States are manufactured in China. Allowing China to capture the amino acid market in the

same way would lead to the same result: dominance over a key industry and an important lever in trade negotiations.

### *Long-term Impact on the Broader U.S. Economy and Domestic Industry*

The nature of the market for amino acids is such that the exit of U.S. producers from the market would give the remaining producers a significant amount of latitude to raise prices — more so than in most comparable markets. An important economic law explains why.

The Hicks-Marshall Laws — a theorem discovered and amended by two of the seminal figures in the history of economic thought — spells out the situations in which sellers are able to leverage their market power to raise the price of a good or service sold as an intermediate good to a producer with minimal impact on demand. Three of the four laws aptly describe a domestic amino acids market without U.S. producers, which means that a coordinated Chinese market, unburdened by domestic competition, would find it possible to significantly increase profits and prices.

The first rule that applies is that suppliers have more collective power if there are fewer good substitutes for what it sells. The fact that there is no cost-effective alternative to amino acids means that if Chinese producers were to corner the U.S. market and conspire to raise prices — perhaps abetted by the Chinese government — U.S. farmers would have little recourse but to continue to buy amino acids, as there is no practical alternative to cost-effectively achieve the same gains in health, size, and productivity for their farm animals.

By itself, this means that the amino acid producers altogether face price-inelastic demand, and could raise prices and increase total revenue. Economists would say that the substitution effect is low.

Another tenet of the Hicks-Marshall laws is that the smaller the share of an input in the total cost of production, the less elastic is the demand for that input.

The $3.2 billion that U.S. farmers will spend on amino acids in 2021 pales in comparison to the overall size of the market for pork, chicken and beef. U.S. pork producers sold 115 million pigs in 2020, generating nearly $25 billion in revenue. The sale of chickens, eggs, and broilers exceeded $60 billion, and beef sales totaled $65 billion. The total revenue from the sale of all animals and products for the year was $175 billion.

The fact that amino acids are such a small proportion of total inputs implies that demand for them is not very sensitive to the price.
A third tenet of Hicks-Marshall is that the owners of the input have more power to raise prices if the price elasticity of demand for the final good is lower. That is, if consumer demand for pork, beef, or chicken is not sensitive to the price change of meat, increases in the price of inputs — like amino acid — will not have a big impact on the quantity sold. As a result, meat producers would be able to pass on

most of their cost increases from higher amino acid prices to the customer. And that does seem to describe the broader market for meat.

A meta-analysis by Craig Gallet, a professor in the California State University system, compiled 419 different studies looking at the elasticity of beef, lamb, pork, and meat in general and found a consensus that the price elasticity of demand to be quite low.

The median elasticity of demand in the 623 regression estimations he examines in those studies is -.71. (A negative number means that as price increases, quantity demanded falls. A number below one — in absolute value terms — means it fits the definition of price inelasticity: quantity demanded changes less than the price.)

The median price elasticities of demand for pork, beef, and lamb are higher, which makes sense: price elasticity of demand varies inversely with specificity of a good. They too are below one, however. The one exception is chicken, which has by itself an average measured price elasticity of demand of -.65. In other words, consumers will not stop eating meat if prices were to go up because a key input in the raising of animals for meat were to increase.

Taken together, these three suggest that steady price increases coordinated by producers in an amino acid feed market would not significantly diminish demand and would lead to sharply higher profits for amino acid producers that were able to coordinate their pricing strategies.

## *The Economic Impact Study*

### *a. Methodology*

We did our analysis of the aggregate impact of the domestic amino acid industry on the broader U.S. economy using the IMPLAN economic modeling system. IMPLAN allows us to incorporate a wide variety of data and construct a model that links the various sectors of the economy together. This interconnection allows us to infer how changes in one sector of the economy impact the rest of the economy.

Part of the intuition built into its model is that a firm's contributions to the economy go beyond its narrow industry sector: the people it employs, the contractors and suppliers it works with, and the various economic actors with whom its employees interact all must be considered. As a result, the aggregate economic activity it generates can be quite diffuse and difficult to capture directly.

Our model breaks down the impact of the economic activity in the amino acid market first by analyzing how its impact in the labor market affects the regional and national economy and then by estimating how its capital expenditures impact the broader economy.

Estimating the regional impact — which we do in order to estimate state and local taxes paid — is complicated for a variety of reasons. For instance, not all of the ancillary impacts from the investments of

a company that produces amino acids (such as the money it spends on expanding or upgrading its factory) remain in the local economy, as some of its impact propagates beyond its region or state borders, either via taxes paid to the federal government or another state or spending that migrates elsewhere.

The IMPLAN model can distinguish between the relative economic impact of a company in the amino acid industry expanding its output either by hiring more workers, via new investment, or a combination of the two. Delineating the roots of an expansion allows us to more precisely model how a company's expansion — or contraction — might impact the broader economy.

This propagation of spending means that the actual impact of an expenditure in the domestic amino acids industry is some multiple of what occurs in the industry itself. The IMPLAN model helps us estimate that multiplier.

This report evaluates the economic impact of amino acid production nationally. The analysis utilizes the IMPLAN economic modeling system. The model produces an economic multiplier, a quantitative measure of economic impact that recognizes that all levels of economies are interconnected networks of interdependent activity. Events and changes in one part of the economy influence the rest of the economy. This usually results in a greater total impact than the impact caused by the original injection of activity into the economy.

*b. The Data*

IMPLAN derives its data from the Quarterly Census of Employment and Wages produced by the Bureau of Labor Statistics. We also used data from the County Business Patterns, collected by the U.S. census, that provides our measures of local economic activity. Finally, we obtained data contained in the Regional Economic Accounts, produced by the Bureau of Economic Analysis, for information on the geographic distribution of economic activity across the country.

*c. The Analysis*

IMPLAN captures three distinct effects resulting from the event it is attempting to model:

*Direct effect* – What we can directly observe from the companies' own economic activities. It includes its labor and capital expenditures as well as anything paid to subcontractors.

*Indirect effect* – What results from the increase in economic activity — such as employment and capital expenditures — of the suppliers to the companies that produce amino acids. When an amino acid producer increases its investment or hires more workers to increase its output, its suppliers must typically do the same, and the model estimates this increase.

*Induced effect* – This is the impact from increases in household spending resulting from the increased employment caused — either directly or indirectly — by the economic activity of the industry. If a U.S.

company that produces amino acids hires new employees and pays them a total of $10 million, how and where they spend that income impacts the economy.

### *The Model*

The estimated U.S. production of amino acids in 2021 will total approximately $6 billion. Our model estimates the additional economic activity — that is, the incremental changes to employment, labor income, and output — that have arisen from the production and sale of amino acids.

Table 1 presents the economic impact of the production of amino acids across the U.S. Table 2. illustrates the top ten industries affected by the production of amino acids.

**Table 1:** *The Aggregate Economic Impact of the Amino Acid Industry on the U.S. Economy*

| Impact Type | Employment | Labor Income | Output |
|---|---|---|---|
| Direct Effect | 2,100 | $305,900,000 | $6,000,000,000 |
| Indirect Effect | 15,300 | $1,138,000,000 | $6,234,000,000 |
| Induced Effect | 11,900 | $689,000,000 | $2,181,000,000 |
| Total Effect | 29,300 | $2,133,000,000 | $14,416,000,000 |

**Table 2:** *Top Industries impacted by the Amino Acids Industry*

| Industry | Employment | Labor Income | Output |
|---|---|---|---|
| Organic and Inorganic Chemical Manufacturing | 2,900 | $428,000,000 | $6,295,000,000 |
| Finance, Insurance, and Real Estate | 2,800 | $177,000,000 | $981,000,000 |
| Transportation and Warehousing | 2,600 | $188,000,000 | $453,000,000 |
| Crop Farming | 2,200 | $69,000,000 | $400,000,000 |
| Retail | 2,000 | $76,000,000 | $222,000,000 |
| Wholesale | 2,000 | $183,000,000 | $674,000,000 |
| Administrative, Management and Business Support Services | 2,000 | $148,000,000 | $270,000,000 |
| Healthcare | 1,800 | $136,000,000 | $247,000,000 |
| Professional, Scientific, and Technical Services | 1,800 | $170,000,000 | $319,000,000 |
| Restaurants and related services | 1,600 | $45,000,000 | $122,000,000 |

The model estimates that the production of amino acids in the U.S. sustains more than 29,000 jobs, generates over $2 billion in labor income, and contributes nearly $14.5 billion to the gross domestic product. The average income per job created or sustained is approximately $72,000, which is well above the U.S. median household income of $63,000.[1]

Table 2 lists the ten industries that are the most affected by the amino acids industry. It's worth noting that six of these industries — Organic and Inorganic Chemical Manufacturing, Finance, Insurance, and Real Estate, Transportation and Warehousing, Administrative, Management, and Business Support Services, Healthcare, and Professional, Scientific, and Technical Services — are industries that generate high-income employment on average.

### *Tax Revenue Generated by the Production of Amino Acids*

In addition to the impacts on employment, income, and output, our model allows us to estimate the tax revenue generated at both the state and federal level.

We consider only sales and property taxes, personal income tax, and corporate profit tax as state taxes. For federal taxes, we only consider social insurance taxes (employee and employer), excise and custom duty taxes, personal income taxes, and corporate taxes.

We estimate that in 2020 the U.S. amino acids industry generated nearly $300 million revenue at the state and local level and nearly $500 million for the federal government.
Table 3 depicts the breakdown of the total state taxes and Table 4 illustrates the total federal tax revenue generated.

*Table 3: State and Local Taxes Generated by the Amino Acids Industry*

| Tax Type | Amount |
|---|---|
| **Sales and Property Tax** | **$237,000,000** |
| **Personal Income Tax** | **$44,000,000** |
| **Corporate Profit Tax** | **$18,000,000** |
| **Total** | **$298,000,000** |

[1] Per capita and median household data were obtained from the U.S. Census Bureau. https://www.census.gov/quickfacts/fact/table/US/SEX255219

*Table 4: Federal Taxes Generated by the Amino Acid Industry*

| Tax Type | Amount |
|---|---|
| Payroll Taxes | $220,000,000 |
| Excise and Custom Duty Taxes | $34,000,000 |
| Personal Income Tax | $167,000,000 |
| Corporate Profit Tax | $55,000,000 |
| Total | $476,000,000 |

## *CONCLUSIONS*

The domestic amino acid market makes a considerable contribution to the U.S. economy that amounts to nearly $15 billion and it also supports nearly 30,000 well-paying jobs. The importance of amino acids in the farm economy will only grow in the next decade as farmers domestically and around the world continue to strive for ways to further increase productivity and provide a stable supply of healthy, affordable food.

The recent move by Chinese producers to significantly increase imports of amino acids into the U.S. market has the potential of displacing much of the domestic production capacity. Two domestic producers have already announced decreased U.S. production as a result of these subsidized imports into the U.S. We show that the nature of the domestic amino acid market is such that it would be particularly susceptible to sharply higher prices if the market came to be dominated by producers that could potentially coordinate their behavior.

We believe that the extent of the increase in Chinese imports and the broader importance of the market to the U.S. economy, means that it has the potential to impact our food security, and the market's susceptibility to price manipulation behooves the ITC to begin a 301 investigation of the behavior of Chinese producers in the U.S.

## *AUTHORS*

***Ike Brannon*** is president of Capital Policy Analytics, a consultancy in Washington DC. Brannon previously served as senior adviser for tax policy in the U.S. Treasury, senior economist for the Office of Management and Budget, chief economist for the House Energy and Commerce Committee, and chief economist for the Congressional Joint Economic Committee.

***Russell Kashian*** is professor of economics and co-director of the Fiscal and Economics Research Center at the University of Wisconsin Whitewater. He served as a consulting economist for Capital Policy Analytics for this project.