The Economic Benefits of Bitcoin Mining to the United States and Top States

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THE PERRYMAN GROUP

Contents

Executive Summary

- Once a novelty, digital assets such as cryptocurrencies have now emerged as a trillion-dollar industry. Although companies in the industry engage in a variety of activities, Bitcoin mining remains a primary function for most of the largest market participants. These enterprises serve as important employers and taxpayers in their local communities, which are often relatively small and rural, as well as providing peripheral benefits to the areas in which they operate. They also support the utility sector.

- The Perryman Group estimates that when multiplier effects are considered, the US bitcoin mining industry and related utility activity generates total economic benefits of more than **$4.1 billion** in gross product each year and over **31,000** jobs (including multiplier effects).

- Twelve states comprise the majority of the US Bitcoin mining industry.

    - Texas is by far the largest, with estimated benefits of approximately **$1.7 billion** in gross product and over **12,200** jobs (including multiplier effects).

    - Other leading states include Georgia (with **$316.8 million** in annual gross product and **2,300** jobs) and New York (**$225.9 million** in annual gross product and **1,600** jobs).

- The positive effects of the industry extend beyond jobs and ongoing operations. For example, miners can help stabilize electric grids due to their flexible power needs. They also invest in their local communities, providing monetary donations as well as sponsoring events and community initiatives. Many Bitcoin mining companies provide on-the-job training and prioritize a diverse workforce.

- Firms in the industry are committed to the areas where they are located and to operating in an environmentally responsible manner. It is likely that the industry will continue to grow and serve as an important partner in future prosperity.

Introduction

Although digital currencies can trace their roots back to as early as 1990, it was not until the emergence of Bitcoin in 2009 that cryptocurrencies began to become more widely recognized. Once a novelty, these digital assets have now emerged as a trillion-dollar industry. Moreover, it appears that cryptocurrencies will play an increasingly important role in the global financial system, with central banks (including the Federal Reserve) considering how they might be utilized.

Bitcoin remains the most recognized cryptocurrency worldwide, and it is decentralized in nature such that it is not under the control of any one entity. The digital currency is built on blockchain technology, and miners serve an important role in confirming the transactions on the blockchain. Bitcoin mining involves using sophisticated computers to solve extremely complex mathematical problems to verify transactions for the currency, for which the reward is some quantity of Bitcoin. The process requires immense computing power and electricity, but the potential profits are significant.

> Bitcoin mining companies serve as important employers and taxpayers in their local communities, which are often relatively small and rural, as well as providing peripheral benefits to the areas in which they operate.

Bitcoin mining companies also serve as important employers and taxpayers in their local communities, which are often relatively small and rural. The top Bitcoin mining companies employ hundreds of individuals and see hundreds of millions of dollars in earnings each year, providing opportunities for a variety of jobs in small communities. They also add substantially to local property tax rolls. The direct and induced economic benefits of the industry are immense.

Additionally, mining companies provide peripheral benefits such as community involvement, charitable donations, and support for improved electric grid reliability to their areas of operation. Many Bitcoin mining companies supply meaningful monetary donations to local organizations, and several have made investments in local infrastructure to improve the quality of life for residents in their communities. Their steady but interruptible demand for power can help with electricity demand predictability, thereby helping to stabilize the electric grid and permit greater investments in generation assets. Companies in the industry are also working to reduce the environmental impacts of the electric power they use, and many have found innovative methods to mitigate emissions concerns.

Although companies in the industry engage in a variety of activities, Bitcoin mining remains a primary function for most major market participants. The Perryman Group (TPG) was recently asked to assess the economic impact of the industry (referred to as "Bitcoin mining" in this report for simplicity). This report presents the results of TPG's analysis.

Economic Benefits

Any economic stimulus leads to dynamic responses across the economy. The Perryman Group has developed complex and comprehensive models over the past four decades to measure these dynamic responses in order to estimate the total economic effects (not only direct, but also indirect and induced) associated with direct sources of stimulus.

Any economic stimulus leads to dynamic responses across the economy.

As noted, the Bitcoin mining industry generates significant economic benefits. Mining companies are important employers in many communities, and they also support utility industries in the states where they have operations. The Perryman Group measured these two primary aspects of the industry's economic benefits. Input information was derived from a variety of public and private data sources as well as from detailed information provided by some of the largest US firms. The effects associated with incremental power generation and transmission were derived from an econometric modeling system maintained by The Perryman Group (see Appendix A for a more detailed description).

Results are presented for the United States as a whole as well as for the states with the largest presence in the industry. Methods used in this analysis are summarized on the following page, with additional information provided in Appendix A.

Measuring Economic Benefits

Any economic stimulus, whether positive or negative, generates multiplier effects throughout the economy. In this instance, the mining companies provide jobs and operational spending in the areas where they are located, as well as supporting electric utilities.

The Perryman Group's dynamic input-output assessment system (the US Multi-Regional Impact Assessment System, which is described in further detail in the Appendices to this report) was developed by the firm about 40 years ago and has been consistently maintained and updated since that time. The model has been used in thousands of analyses for clients ranging from major corporations to government agencies and has been peer reviewed on multiple occasions. The impact system uses a variety of data (from surveys, industry information, and other sources) to describe the various goods and services (known as resources or inputs) required to produce another good/service. This process allows for estimation of the total economic impact (including multiplier effects) of the industry and related activity. The models used in the current analysis reflect the specific industrial composition and characteristics of the United States and each state analyzed. A companion system (the US Multi-Regional Econometric Model) was used to estimate the effects of the associated incremental electric power resources.

Total economic effects are quantified for key measures of business activity (further explained in the Appendix). Note that these measures are alternative means of expressing the same effects; they are not additive.

- **Total expenditures** (or total spending) measure the dollars changing hands as a result of the economic stimulus.
- **Gross product** (or output) is production of goods and services that will come about in the area as a result of the activity. This measure is parallel to the gross domestic product numbers commonly reported by various media outlets and is a subset of total expenditures.
- **Personal income** is dollars that end up in the hands of people in the area; the vast majority of this aggregate derives from the earnings of employees, but payments such as interest and rents are also included.
- **Job effects** are expressed on a full-time-equivalent basis.

Monetary values were quantified on a constant (2024 dollars) basis to eliminate the effects of inflation.

The Perryman Group estimates that when multiplier effects are considered, the US Bitcoin mining industry and related utility activity generates total economic benefits of more than **$4.1 billion** in gross product each year and over **31,000** jobs (including multiplier effects).

Twelve states comprise the majority of the US Bitcoin mining industry. Texas is by far the largest, with estimated benefits of approximately **$1.7 billion** in gross product and over **12,200** jobs (including multiplier effects). Other leading states include Georgia (with **$316.8 million** in annual gross product and **2,300** jobs) and New York (**$225.9 million** in annual gross product and **1,600** jobs).

Results by state are presented in the following table, with industry detail presented in Appendix B.

The Annual Economic Benefits of Bitcoin Mining				
	Total Expenditures (Millions of 2024 Dollars)	**Gross Product** (Millions of 2024 Dollars)	**Personal Income** (Millions of 2024 Dollars)	**Employment** (Jobs)
Georgia	$811.22	$316.83	$196.10	2,334
Kentucky	$222.73	$88.05	$54.86	641
North Carolina	$157.77	$61.27	$38.05	448
North Dakota	$546.41	$215.42	$133.36	1,538
Nebraska	$142.99	$56.23	$34.57	409
New York	$567.66	$225.89	$140.23	1,639
Ohio	$127.35	$49.92	$31.10	366
Pennsylvania	$428.27	$169.28	$105.36	1,242
South Carolina	$66.28	$25.45	$15.75	184
Tennessee	$228.37	$87.53	$54.02	636
Texas	$4,231.17	$1,665.03	$1,029.55	12,219
Washington	$46.69	$18.40	$11.39	134
Rest of US	$2,987.62	$1,160.32	$738.78	9,230
UNITED STATES	**$10,564.53**	**$4,139.62**	**$2,583.12**	**31,020**

Based on estimated employment in Bitcoin mining, related incremental utility-industry activity, and The Perryman Group's estimates of related multiplier effects. The "Rest of US" includes spillover to other states from activity in the top producing states as well as the relatively small amounts of Bitcoin mining happening in other areas. Additional explanation of terms and methods may be found elsewhere in this report and in Appendix A, with results by industry in Appendix B.

Source: US Multi-Regional Impact Assessment System, The Perryman Group

Other Benefits

Beyond the economic impacts including jobs, output, and up- and down-stream effects discussed previously, Bitcoin mining companies often provide significant local benefits to the areas where they operate. In addition, they may have other operations such as warehouses in various areas, and they may utilize a variety of other types of businesses such as logistics firms.

Many companies include sophisticated environmental and energy use plans, partnerships with local schools and organizations, and community improvement initiatives as a part of their core values. Charitable donations are another important benefit provided by many mining companies.

> Bitcoin mining companies provide benefits such as energy grid stability, community investment, and charitable donations, in addition to their economic impact.

As significant energy users, these organizations are aware of their impact on the electric grid and related emissions and take action to minimize any negative effects of their operations. Bitcoin miners are unique in that they can adjust power usage in times of extreme grid stress. In fact, in some states many of these companies have agreements in place to allow their power to be interrupted if supplies become constrained. During normal conditions, miners require a consistent base level of energy, which supports energy demand predictability and provides a rationale for generation and transmission investments.

In some cases, electric utilities are seeing Bitcoin miners as important partners in ensuring the future adequacy and stability of power supplies. For example, the Electric Reliability Council of Texas (ERCOT), which manages 90% of the state's load, has faced substantial electric grid challenges in recent years due to population and economic growth and views Bitcoin miners as potentially useful partners in maintaining stability on the grid.

Many companies in the industry are committed to using renewable, cleaner energy and to taking steps to mitigate any potential negative environmental impacts. For example, one company has built infrastructure to harness the heat generated by Bitcoin mining for use in greenhouses in the Nordics, and another has successfully converted methane gas from oil fields into electricity. In many cases, Bitcoin mining operations are located proximate to energy sources which might otherwise be unable to be optimally and efficiently utilized.

As noted, many Bitcoin mining companies provide significant monetary contributions and otherwise invest in their communities. As these organizations are often located in relatively small towns, their commitments can significantly improve the quality of life for local residents, beyond the increased job opportunities the organizations provide. For example, companies are involved with school supply drives, holiday celebrations, and public infrastructure focused on improving the community. There are also instances of hiring and retraining employees from other sectors for work in crypto mining as well as providing specialized safety training, and many companies are dedicated to hiring a diverse workforce.

Conclusion

Bitcoin mining is a growing industry with a significant impact on local economies. The economic impact of Bitcoin mining and related activities in the US is estimated to be nearly **$4.1 billion** in annual gross product and more than **31,000** jobs, with the top 12 states comprising 71% of the total. Texas, Georgia, and New York are the states with the highest impact.

The positive effects of the sector extend beyond jobs and ongoing operations. In addition to the economic impact, Bitcoin mining companies have other benefits to their communities. For example, miners can help stabilize electric grids due to their flexible power needs, such that during times of grid stress they can shut off immediately, but they provide a baseline demand during less congested conditions, helping significantly with demand predictability and facilitating infrastructure development. They also invest in their local communities, providing monetary donations as well as sponsoring events and community initiatives. Many Bitcoin mining companies provide on-the-job training and prioritize a diverse workforce.

> Bitcoin mining is a growing industry with a significant impact on local economies, in addition to other positive effects.

Bitcoin mining generates a variety of positive effects including jobs, local spending, grid stability, and investment in local causes. Firms in the industry are committed to the areas where they locate as well as operating in an environmentally responsible manner. It is likely that the industry will continue to grow and serve as an important partner in future prosperity.

Appendix A: Methods Used

US Multi-Regional Impact Assessment System

The US Multi-Regional Impact Assessment System (USMRIAS) measures multiplier effects of economic stimuli. The USMRIAS was developed and is maintained by The Perryman Group. This model has been used in thousands of diverse applications across the country and has an excellent reputation for accuracy and credibility; it has also been peer reviewed on multiple occasions and has been a key factor in major national and international policy simulations.

The basic modeling technique is known as dynamic input-output analysis, which essentially uses extensive survey data, industry information, and a variety of corroborative source materials to create a matrix describing the various goods and services (known as resources or inputs) required to produce one unit (a dollar's worth) of output for a given sector. Once the base information is compiled, it can be mathematically simulated to generate evaluations of the magnitude of successive rounds of activity involved in the overall production process.

There are two essential steps in conducting an input-output analysis once the system is operational. The first major endeavor is to accurately define the levels of direct activity to be evaluated. The second phase involves model simulation to determine total (not only direct, but also indirect and induced) effects. Additional detail is provided in the following sections.

Estimation of Direct Effects

A variety of sources were utilized to estimate the current overall size and operational characteristics of the Bitcoin mining industry. Although many companies are publicly traded and therefore subject to Securities and Exchange Commission (SEC) filings requirements, others are privately held. Public information from SEC filings and other documents (available on corporate websites, for example), various trade publications and resources, and other sources of information were compiled and assessed. In addition, several companies provided detailed information regarding their operations on a confidential basis. These datasets were used in The Perryman Group's modeling process together with public information to estimate the industrywide direct effects of Bitcoin mining firms. The direct effects related to the utilities were estimated using TPG's US Multi-Regional Econometric Model along with data from the Department of Energy and Depart of Commerce in order to estimate the incremental operational effects of the industry's electricity usage.

Model Simulation

The direct inputs were then implemented in a series of simulations of the USMRIAS to measure total (not only direct, but also indirect and induced) economic effects of the direct stimulus. The systems used reflect the unique industrial structures of the Untied States and each state economy analyzed.

The USMRIAS is somewhat similar in format to the Input-Output Model of the United States which is maintained by the US Department of Commerce. The model developed by TPG, however, incorporates several important enhancements and refinements. Specifically, the expanded system includes (1) comprehensive 500-sector coverage for any county, multi-county, or urban region; (2) calculation of both total expenditures and value-added by industry and region; (3) direct estimation of expenditures for multiple basic input choices (expenditures, output, income, or employment); (4) extensive parameter localization; (5) price adjustments for real and nominal assessments by sectors and areas; (6) comprehensive measurement of the induced impacts associated with payrolls and consumer spending; (7) embedded modules to estimate multi-sectoral direct spending effects; (8) estimation of retail spending activity by consumers; and (9) comprehensive linkage and integration capabilities with a wide variety of econometric, real estate, occupational, and fiscal impact models.

The impact assessment (input-output) process essentially estimates the amounts of all types of goods and services required to produce one unit (a dollar's worth) of a specific type of output. For purposes of illustrating the nature of the system, it is useful to think of inputs and outputs in dollar (rather than physical) terms. As an example, the construction of a new building will require specific dollar amounts of lumber, glass, concrete, hand tools, architectural services, interior design services, paint, plumbing, and numerous other elements. Each of these suppliers must, in turn, purchase additional dollar amounts of inputs. This process continues through multiple rounds of production, thus generating subsequent increments to business activity. The initial process of building the facility is known as the *direct effect*. The ensuing transactions in the output chain constitute the *indirect effect*.

Another pattern that arises in response to any direct economic activity comes from the payroll dollars received by employees at each stage of the production cycle. As workers are compensated, they use some of their income for taxes, savings, and purchases from external markets. A substantial portion, however, is spent locally on food, clothing, health care services, utilities, housing, recreation, and other items. Typical purchasing patterns in the relevant areas are obtained from the Center for Community and Economic Research *Cost of Living Index*, a privately compiled inter-regional measure which has been widely used for several decades, and the *Consumer Expenditure Survey* of the US Department of Labor. These initial outlays by area residents generate further secondary activity as local providers acquire inputs to meet this consumer demand. These consumer spending impacts are known as the *induced effect*. The USMRIAS is designed to provide realistic, yet conservative, estimates of these phenomena.

Sources for information used in this process include the Bureau of the Census, the Bureau of Labor Statistics, the Regional Economic Information System of the US Department of Commerce, and other public and private sources. The pricing data are compiled from the US Department of Labor and the US Department of Commerce. The verification and testing procedures make use of extensive public and private sources.

Impacts are typically measured in constant dollars to eliminate the effects of inflation.

The USMRIAS is also integrated with a comprehensive fiscal model, which links the tax payments by industry to the specific rates and structures associated with the relevant State and local governmental authorities.

Measures of Business Activity

The USMRIAS generates estimates of total economic effects on several measures of business activity. Note that these are different ways of measuring the same impacts; they are not additive.

The most comprehensive measure of economic activity is **Total Expenditures**. This measure incorporates every dollar that changes hands in any transaction. For example, suppose a farmer sells wheat to a miller for $0.50; the miller then sells flour to a baker for $0.75; the baker, in turn, sells bread to a customer for $1.25. The Total Expenditures recorded in this instance would be $2.50, that is, $0.50 + $0.75 + $1.25. This measure is quite broad but is useful in that (1) it reflects the overall interplay of all industries in the economy, and (2) some key fiscal variables such as sales taxes are linked to aggregate spending.

A second measure of business activity is **Gross Product**. This indicator represents the regional equivalent of Gross Domestic Product, the most commonly reported statistic regarding national economic performance. In other words, the Gross Product of Texas is the amount of US output that is produced in that state; it is defined as the value of all final goods produced in a given region for a specific period of time. Stated differently, it captures the amount of value-added (gross area product) over intermediate goods and services at each stage of the production process, that is, it eliminates the double counting in the Total Expenditures concept. Using the example above, the Gross Product is $1.25 (the value of the bread) rather than $2.50. Alternatively, it may be viewed as the sum of the value-added by the farmer, $0.50; the miller, $0.25 ($0.75 - $0.50); and the baker, $0.50 ($1.25 - $0.75). The total value-added is, therefore, $1.25, which is equivalent to the final value of the bread. In many industries, the primary component of value-added is the wage and salary payments to employees.

The third gauge of economic activity used in this evaluation is **Personal Income**. As the name implies, Personal Income is simply the income received by individuals, whether in the form of wages, salaries, interest, dividends, proprietors' profits, or other sources. It may thus be viewed as the segment of overall impacts which flows directly to the citizenry.

The final aggregates used are **Jobs and Job-Years,** which reflect the full-time equivalent jobs generated by an activity. For an economic stimulus expected to endure (such as the ongoing operations of a facility), the Jobs measure is used. It should be noted that, unlike the dollar values described above, Jobs is a "stock" rather than a "flow." In other words, if an area produces $1 million in output in 2023 and $1 million in 2024, it is appropriate to say that $2 million was achieved in the 2023-24 period. If the same area has 100 people working in 2023 and 100 in 2024, it only has 100 Jobs. When a flow of jobs is measured, such as in a construction project or a cumulative assessment over multiple years, it is appropriate to measure employment in Job-Years (a person working for a year, though it could be multiple individuals working for partial years). This concept is distinct from Jobs, which anticipates that the relevant positions will be maintained on a continuing basis.

US Multi-Regional Econometric Model

Overview

The US Multi-Regional Econometric Model was developed by Dr. M. Ray Perryman, President and CEO of The Perryman Group (TPG), about 40 years ago and has been consistently maintained, expanded, and updated since that time. It is formulated in an internally consistent manner and is designed to permit the integration of relevant global, national, state, and local factors into the projection process. It is the result of four decades of continuing research in econometrics, economic theory, statistical methods, and key policy issues and behavioral patterns, as well as intensive, ongoing study of all aspects of the global, US, state, and metropolitan area economies. It is extensively used by scores of federal and State governmental entities on an ongoing basis, as well as hundreds of major corporations. It can be integrated with The Perryman Group's other models and systems to provide dynamic projections.

This section describes the forecasting process in a comprehensive manner, focusing on both the modeling and the supplemental analysis. The overall methodology, while certainly not ensuring perfect foresight, permits an enormous body of relevant information to impact the economic outlook in a systematic manner.

Model Logic and Structure

The Model revolves around a core system which projects output (real and nominal), income (real and nominal), and employment by industry in a simultaneous manner. For the purposes of illustration, it is useful to initially consider the employment functions. Essentially, employment within the system is a derived demand relationship obtained from a neo-Classical production function. The expressions are augmented to include dynamic temporal adjustments to changes in relative factor input costs, output and (implicitly) productivity, and technological progress over time. Thus, the typical equation includes output, the relative real cost of labor and capital, dynamic lag structures, and a technological adjustment parameter. The functional form is logarithmic, thus preserving the theoretical consistency with the neo-Classical formulation.

The income segment of the model is divided into wage and non-wage components. The wage equations, like their employment counterparts, are individually estimated at the 3-digit North American Industry Classification System (NAICS) level of aggregation. Hence, income by place of work is measured for approximately 90 production categories. The wage equations measure real compensation, with the form of the variable structure differing between "basic" and "non-basic."

The basic industries, comprised primarily of the various components of Mining, Agriculture, and Manufacturing, are export-oriented, i.e., they bring external dollars into the area and form the core of the economy. The production of these sectors typically flows into national and international markets; hence, the labor markets are influenced by conditions in areas beyond the borders of the particular region. Thus, real (inflation-adjusted) wages in the basic industry are expressed as a function of the corresponding national rates, as well as measures of local labor market conditions (the reciprocal of the unemployment rate), dynamic adjustment parameters, and ongoing trends.

The "non-basic" sectors are somewhat different in nature, as the strength of their labor markets is linked to the health of the local export sectors. Consequently, wages in these industries are related to those in the basic segment of the economy. The relationship also includes the local labor market measures contained in the basic wage equations.

Note that compensation rates in the export or "basic" sectors provide a key element of the interaction of the regional economies with national and international market phenomena, while the "non-basic" or local industries are strongly impacted by area production levels. Given the wage and employment equations, multiplicative identities in each industry provide expressions for total compensation; these totals may then be aggregated to determine aggregate wage and salary income. Simple linkage equations are then estimated for the calculation of personal income by place of work.

The non-labor aspects of personal income are modeled at the regional level using straightforward empirical expressions relating to national performance, dynamic responses, and evolving temporal patterns. In some instances (such as dividends, rents, and others) national variables (for example, interest rates) directly enter the forecasting system. These factors have numerous other implicit linkages into the system resulting from their simultaneous interaction with other phenomena in national and international markets which are explicitly included in various expressions.

The output or gross area product expressions are also developed at the 3-digit NAICS level. Regional output for basic industries is linked to national performance in the relevant industries, local and national production in key related sectors, relative area and national labor costs in the industry, dynamic adjustment parameters, and ongoing changes in industrial interrelationships (driven by technological changes in production processes).

Output in the non-basic sectors is modeled as a function of basic production levels, output in related local support industries (if applicable), dynamic temporal adjustments, and ongoing patterns. The inter-industry linkages are obtained from the input-output (impact assessment) system which is part of the overall integrated modeling structure maintained by The Perryman Group. Note that the dominant component of the econometric system involves the simultaneous estimation and projection of output (real and nominal), income (real and nominal), and employment at a disaggregated industrial level. This process, of necessity, also produces projections of regional price deflators by industry. These values are affected by both national pricing patterns and local cost variations and permit changes in prices to impact other aspects of economic behavior. Income is converted from real to nominal terms using relevant Consumer Price Indices, which fluctuate in response to national pricing patterns and unique local phenomena.

Several other components of the model are critical to the forecasting process. The demographic module includes (1) a linkage equation between wage and salary (establishment) employment and household employment, (2) a labor force participation rate function, and (3) a complete population system with endogenous migration. Given household employment, labor force participation (which is a function of economic conditions and evolving patterns of worker preferences), and the working-age population, the unemployment rate and level become identities.

The population system uses Census information, fertility rates, and life tables to determine the "natural" changes in population by age group. Migration, the most difficult segment of population dynamics to track, is estimated in relation to relative regional and extra-regional economic conditions over time. Because evolving economic conditions determine migration in the system, population changes are allowed to interact simultaneously with overall economic conditions. Through this process, migration is treated as endogenous to the system, thus allowing population to vary in accordance with relative business performance (particularly employment).

Real retail sales is related to income, interest rates, dynamic adjustments, and patterns in consumer behavior on a store group basis. It is expressed on an inflation-adjusted basis. Inflation at the state level relates to national patterns, indicators of relative economic conditions, and ongoing trends. As noted earlier, prices are endogenous to the system.

A final significant segment of the forecasting system relates to real estate absorption and activity. The short-term demand for various types of property is determined by underlying economic and demographic factors, with short-term adjustments to reflect the current status of the pertinent building cycle. In some instances, this portion of the forecast requires integration with the US Multi-Regional Industry-Occupation System which is maintained by The Perryman Group. This system also allows any employment simulation or forecast from the econometric model to be translated into a highly detailed occupational profile.

The overall US Multi-Regional Econometric Model contains numerous additional specifications, and individual expressions are modified to reflect alternative lag structures, empirical properties of the estimates, simulation requirements, and similar phenomena. Moreover, it is updated on an ongoing basis as new data releases become available. Nonetheless, the above synopsis offers a basic understanding of the overall structure and underlying logic of the system.

Model Simulation and Multi-Regional Structure

The initial phase of the simulation process is the execution of a standard non-linear algorithm for the state system and that of each of the individual sub-areas. The external assumptions are derived from scenarios developed through national and international models and extensive analysis by The Perryman Group.

Once the initial simulations are completed, they are merged into a single system with additive constraints and interregional flows. Using information on minimum regional requirements, import needs, export potential, and locations, it becomes possible to balance the various forecasts into a mathematically consistent set of results. This process is, in effect, a disciplining exercise with regard to the individual regional (including metropolitan and rural) systems. By compelling equilibrium across all regions and sectors, the algorithm ensures that the patterns in state activity are reasonable in light of smaller area dynamics and, conversely, that the regional outlooks are within plausible performance levels for the state as a whole.

The iterative simulation process has the additional property of imposing a global convergence criterion across the entire multi-regional system, with balance being achieved simultaneously on both a sectoral and a geographic basis. This approach is particularly critical on non-linear dynamic systems, as independent simulations of individual systems often yield unstable, non-convergent outcomes.

It should be noted that the underlying data for the modeling and simulation process are frequently updated and revised by the various public and private entities compiling them. Whenever those modifications to the database occur, they bring corresponding changes to the structural parameter estimates of the various systems and the solutions to the simulation and forecasting system. The multi-regional version of the econometric model is re-estimated and simulated with each such data release, thus providing a constantly evolving and current assessment of state and local business activity.

The Final Forecast

The process described above is followed to produce an initial set of projections. Through the comprehensive multi-regional modeling and simulation process, a systematic analysis is generated which accounts for both historical patterns in economic performance and inter-relationships and the best available information on the future course of pertinent external factors. While the best available techniques and data are employed in this effort, they are not capable of directly capturing “street sense,” i.e., the contemporaneous and often non-quantifiable information that can materially affect economic outcomes. In order to provide a comprehensive approach to the prediction of business conditions, it is necessary to compile and assimilate extensive material regarding current events and factors both across the state of Texas and elsewhere.

This critical aspect of the forecasting methodology includes activities such as (1) daily review of hundreds of financial and business publications and electronic information sites; (2) review of major newspapers and online news sources in the state on a daily basis; (3) dozens of hours of direct telephone interviews with key business and political leaders in all parts of the state; (4) face-to-face discussions with representatives of major industry groups; and (5) frequent site visits to the various regions of the state. The insights arising from this “fact finding” are analyzed and evaluated for their effects on the likely course of the future activity.

Another vital information resource stems from the firm's ongoing interaction with key players in the international, domestic, and state economic scenes. Such activities include visiting with corporate groups on a regular basis and being regularly involved in the policy process at all levels. The firm is also an active participant in many major corporate relocations, economic development initiatives, and regulatory proceedings.

Once organized, this information is carefully assessed and, when appropriate, independently verified. The impact on specific communities and sectors that is distinct from what is captured by the econometric system is then factored into the forecast analysis. For example, the opening or closing of a major facility, particularly in a relatively small area, can cause a sudden change in business performance that will not be accounted for by either a modeling system based on historical relationships or expected (primarily national and international) factors.

The final step in the forecasting process is the integration of this material into the results in a logical and mathematically consistent manner. In some instances, this task is accomplished through "constant adjustment factors" which augment relevant equations. In other cases, anticipated changes in industrial structure or regulatory parameters are initially simulated within the context of the Multi-Regional Impact Assessment System to estimate their ultimate effects by sector. Those findings are then factored into the simulation as constant adjustments on a distributed temporal basis. Once this scenario is formulated, the extended system is again balanced across regions and sectors through an iterative simulation algorithm analogous to that described in the preceding section.

Appendix B: Results by Industry

The Economic Impact of Bitcoin Mining and Related Activities: US

The Economic Impact of Bitcoin Mining and Related Activities: US
Results by Industry

Industry	Total Expenditures	Gross Product	Personal Income	Jobs
Agriculture	+$127.1 m	+$42.1 m	+$27.6 m	+342
Mining	+$388.2 m	+$97.7 m	+$74.8 m	+377
Utilities	+$3,131.1 m	+$755.1 m	+$329.5 m	+1,134
Construction	+$254.4 m	+$146.3 m	+$120.5 m	+1,340
Manufacturing	+$2,015.7 m	+$500.9 m	+$275.7 m	+3,293
Wholesale Trade	+$251.5 m	+$170.0 m	+$98.1 m	+883
Retail Trade*	+$899.3 m	+$671.8 m	+$390.1 m	+9,532
Transportation & Warehousing	+$295.9 m	+$192.0 m	+$127.0 m	+1,370
Information	+$161.9 m	+$99.8 m	+$42.6 m	+303
Financial Activities*	+$920.4 m	+$245.2 m	+$100.8 m	+827
Business Services	+$1,503.6 m	+$863.4 m	+$704.3 m	+6,789
Health Services	+$209.3 m	+$146.4 m	+$123.8 m	+1,619
Other Services	+$406.0 m	+$208.9 m	+$168.4 m	+3,212
Total, All Industries	**+$10,564.5 m**	**+$4,139.6 m**	**+$2,583.1 m**	**+31,020**

Source: US Multi-Regional Impact Assessment System, The Perryman Group

Notes: Monetary values given in millions of 2024 US dollars per year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate.

The Economic Impact of Bitcoin Mining and Related Activities by State

The Economic Impact of Bitcoin Mining and Related Activities: Georgia

Results by Industry

Industry	Total Expenditures	Gross Product	Personal Income	Jobs
Agriculture	+$8.8 m	+$2.9 m	+$1.9 m	+24
Mining	+$31.1 m	+$7.7 m	+$5.7 m	+29
Utilities	+$278.5 m	+$67.3 m	+$29.4 m	+101
Construction	+$21.7 m	+$12.6 m	+$10.3 m	+115
Manufacturing	+$117.5 m	+$28.2 m	+$15.7 m	+184
Wholesale Trade	+$20.8 m	+$14.1 m	+$8.1 m	+73
Retail Trade*	+$71.3 m	+$53.4 m	+$31.0 m	+756
Transportation & Warehousing	+$22.2 m	+$14.3 m	+$9.5 m	+102
Information	+$12.3 m	+$7.6 m	+$3.2 m	+23
Financial Activities*	+$71.4 m	+$19.0 m	+$7.8 m	+64
Business Services	+$107.7 m	+$61.9 m	+$50.5 m	+487
Health Services	+$16.9 m	+$11.8 m	+$10.0 m	+131
Other Services	+$31.0 m	+$16.0 m	+$12.9 m	+245
Total, All Industries	**+$811.2 m**	**+$316.8 m**	**+$196.1 m**	**+2,334**

Source: US Multi-Regional Impact Assessment System, The Perryman Group

Notes: Monetary values given in millions of 2024 US dollars per year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate.

The Economic Impact of Bitcoin Mining and Related Activities: Kentucky

Results by Industry

Industry	Total Expenditures	Gross Product	Personal Income	Jobs
Agriculture	+$2.6 m	+$0.9 m	+$0.6 m	+7
Mining	+$9.3 m	+$2.4 m	+$1.8 m	+9
Utilities	+$83.1 m	+$20.1 m	+$8.8 m	+30
Construction	+$6.2 m	+$3.6 m	+$2.9 m	+33
Manufacturing	+$26.7 m	+$6.9 m	+$3.9 m	+46
Wholesale Trade	+$5.6 m	+$3.8 m	+$2.2 m	+20
Retail Trade*	+$19.1 m	+$14.3 m	+$8.3 m	+202
Transportation & Warehousing	+$6.8 m	+$4.4 m	+$2.9 m	+32
Information	+$3.3 m	+$2.0 m	+$0.9 m	+6
Financial Activities*	+$16.4 m	+$4.6 m	+$2.0 m	+16
Business Services	+$30.5 m	+$17.5 m	+$14.3 m	+138
Health Services	+$4.6 m	+$3.2 m	+$2.7 m	+35
Other Services	+$8.6 m	+$4.4 m	+$3.6 m	+67
Total, All Industries	**+$222.7 m**	**+$88.1 m**	**+$54.9 m**	**+641**

Source: US Multi-Regional Impact Assessment System, The Perryman Group

Notes: Monetary values given in millions of 2024 US dollars per year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate.

The Economic Impact of Bitcoin Mining and Related Activities: North Carolina
Results by Industry

Industry	Total Expenditures	Gross Product	Personal Income	Jobs
Agriculture	+$1.7 m	+$0.6 m	+$0.4 m	+5
Mining	+$5.9 m	+$1.5 m	+$1.1 m	+6
Utilities	+$54.8 m	+$13.2 m	+$5.8 m	+20
Construction	+$4.3 m	+$2.5 m	+$2.0 m	+23
Manufacturing	+$24.4 m	+$5.6 m	+$3.1 m	+36
Wholesale Trade	+$3.9 m	+$2.6 m	+$1.5 m	+14
Retail Trade*	+$13.3 m	+$10.0 m	+$5.8 m	+141
Transportation & Warehousing	+$4.7 m	+$3.0 m	+$2.0 m	+22
Information	+$2.4 m	+$1.5 m	+$0.6 m	+4
Financial Activities*	+$12.0 m	+$3.2 m	+$1.3 m	+11
Business Services	+$21.1 m	+$12.1 m	+$9.9 m	+95
Health Services	+$3.2 m	+$2.3 m	+$1.9 m	+25
Other Services	+$6.0 m	+$3.1 m	+$2.5 m	+47
Total, All Industries	**+$157.8 m**	**+$61.3 m**	**+$38.0 m**	**+448**

Source: US Multi-Regional Impact Assessment System, The Perryman Group

Notes: Monetary values given in millions of 2024 US dollars per year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate.

The Economic Impact of Bitcoin Mining and Related Activities: North Dakota
Results by Industry

Industry	Total Expenditures	Gross Product	Personal Income	Jobs
Agriculture	+$5.8 m	+$1.9 m	+$1.3 m	+16
Mining	+$21.3 m	+$5.4 m	+$4.1 m	+21
Utilities	+$221.0 m	+$53.3 m	+$23.3 m	+80
Construction	+$13.3 m	+$7.7 m	+$6.3 m	+70
Manufacturing	+$53.9 m	+$14.6 m	+$8.2 m	+99
Wholesale Trade	+$13.3 m	+$9.0 m	+$5.2 m	+47
Retail Trade*	+$45.8 m	+$34.4 m	+$20.0 m	+485
Transportation & Warehousing	+$16.5 m	+$10.7 m	+$7.1 m	+76
Information	+$7.9 m	+$4.9 m	+$2.1 m	+15
Financial Activities*	+$39.4 m	+$11.2 m	+$4.8 m	+40
Business Services	+$77.3 m	+$44.4 m	+$36.2 m	+349
Health Services	+$10.9 m	+$7.6 m	+$6.4 m	+84
Other Services	+$20.0 m	+$10.4 m	+$8.3 m	+156
Total, All Industries	**+$546.4 m**	**+$215.4 m**	**+$133.4 m**	**+1,538**

Source: US Multi-Regional Impact Assessment System, The Perryman Group

Notes: Monetary values given in millions of 2024 US dollars per year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate.

The Economic Impact of Bitcoin Mining and Related Activities: Nebraska
Results by Industry

Industry	Total Expenditures	Gross Product	Personal Income	Jobs
Agriculture	+$1.6 m	+$0.5 m	+$0.4 m	+4
Mining	+$3.1 m	+$0.7 m	+$0.3 m	+1
Utilities	+$52.9 m	+$12.8 m	+$5.6 m	+19
Construction	+$3.7 m	+$2.1 m	+$1.8 m	+20
Manufacturing	+$19.8 m	+$4.7 m	+$2.6 m	+31
Wholesale Trade	+$3.6 m	+$2.4 m	+$1.4 m	+13
Retail Trade*	+$12.4 m	+$9.3 m	+$5.4 m	+131
Transportation & Warehousing	+$4.6 m	+$3.0 m	+$2.0 m	+21
Information	+$2.2 m	+$1.4 m	+$0.6 m	+4
Financial Activities*	+$11.0 m	+$3.1 m	+$1.3 m	+11
Business Services	+$20.0 m	+$11.5 m	+$9.4 m	+90
Health Services	+$3.0 m	+$2.1 m	+$1.7 m	+23
Other Services	+$5.1 m	+$2.7 m	+$2.1 m	+40
Total, All Industries	**+$143.0 m**	**+$56.2 m**	**+$34.6 m**	**+409**

Source: US Multi-Regional Impact Assessment System, The Perryman Group

Notes: Monetary values given in millions of 2024 US dollars per year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate.

The Economic Impact of Bitcoin Mining and Related Activities: New York

Results by Industry

Industry	Total Expenditures	Gross Product	Personal Income	Jobs
Agriculture	+$5.1 m	+$1.7 m	+$1.1 m	+14
Mining	+$20.9 m	+$5.2 m	+$3.9 m	+20
Utilities	+$213.3 m	+$51.6 m	+$22.5 m	+77
Construction	+$14.3 m	+$8.2 m	+$6.8 m	+76
Manufacturing	+$61.2 m	+$16.7 m	+$9.6 m	+115
Wholesale Trade	+$14.3 m	+$9.6 m	+$5.6 m	+50
Retail Trade*	+$48.6 m	+$36.5 m	+$21.2 m	+514
Transportation & Warehousing	+$16.2 m	+$10.4 m	+$6.9 m	+74
Information	+$9.1 m	+$5.6 m	+$2.4 m	+17
Financial Activities*	+$48.7 m	+$13.6 m	+$5.8 m	+47
Business Services	+$81.3 m	+$46.8 m	+$38.1 m	+368
Health Services	+$11.4 m	+$8.0 m	+$6.8 m	+88
Other Services	+$23.3 m	+$11.8 m	+$9.6 m	+179
Total, All Industries	**+$567.7 m**	**+$225.9 m**	**+$140.2 m**	**+1,639**

Source: US Multi-Regional Impact Assessment System, The Perryman Group

Notes: Monetary values given in millions of 2024 US dollars per year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate.

The Economic Impact of Bitcoin Mining and Related Activities: Ohio

Results by Industry

Industry	**Total Expenditures**	**Gross Product**	**Personal Income**	**Jobs**
Agriculture	+$1.4 m	+$0.5 m	+$0.3 m	+4
Mining	+$5.4 m	+$1.4 m	+$1.1 m	+5
Utilities	+$45.8 m	+$11.1 m	+$4.8 m	+17
Construction	+$3.6 m	+$2.1 m	+$1.7 m	+19
Manufacturing	+$17.8 m	+$4.4 m	+$2.5 m	+29
Wholesale Trade	+$3.2 m	+$2.1 m	+$1.2 m	+11
Retail Trade*	+$10.9 m	+$8.2 m	+$4.7 m	+116
Transportation & Warehousing	+$3.9 m	+$2.5 m	+$1.7 m	+18
Information	+$1.9 m	+$1.2 m	+$0.5 m	+4
Financial Activities*	+$9.0 m	+$2.5 m	+$1.0 m	+8
Business Services	+$16.9 m	+$9.7 m	+$7.9 m	+76
Health Services	+$2.6 m	+$1.8 m	+$1.5 m	+20
Other Services	+$5.0 m	+$2.6 m	+$2.1 m	+39
Total, All Industries	**+$127.3 m**	**+$49.9 m**	**+$31.1 m**	**+366**

Source: US Multi-Regional Impact Assessment System, The Perryman Group

Notes: Monetary values given in millions of 2024 US dollars per year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate.

The Economic Impact of Bitcoin Mining and Related Activities: Pennsylvania
Results by Industry

Industry	Total Expenditures	Gross Product	Personal Income	Jobs
Agriculture	+$3.9 m	+$1.3 m	+$0.9 m	+11
Mining	+$18.3 m	+$4.6 m	+$3.6 m	+18
Utilities	+$154.8 m	+$37.4 m	+$16.3 m	+56
Construction	+$12.0 m	+$6.9 m	+$5.7 m	+64
Manufacturing	+$55.5 m	+$14.6 m	+$8.3 m	+99
Wholesale Trade	+$10.8 m	+$7.3 m	+$4.2 m	+38
Retail Trade*	+$37.1 m	+$27.8 m	+$16.1 m	+393
Transportation & Warehousing	+$13.2 m	+$8.5 m	+$5.6 m	+61
Information	+$6.5 m	+$4.0 m	+$1.7 m	+12
Financial Activities*	+$33.2 m	+$9.1 m	+$3.8 m	+31
Business Services	+$57.3 m	+$33.0 m	+$26.9 m	+259
Health Services	+$8.8 m	+$6.2 m	+$5.2 m	+68
Other Services	+$16.9 m	+$8.7 m	+$7.0 m	+133
Total, All Industries	**+$428.3 m**	**+$169.3 m**	**+$105.4 m**	**+1,242**

Source: US Multi-Regional Impact Assessment System, The Perryman Group

Notes: Monetary values given in millions of 2024 US dollars per year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate.

The Economic Impact of Bitcoin Mining and Related Activities: South Carolina

Results by Industry

Industry	Total Expenditures	Gross Product	Personal Income	Jobs
Agriculture	+$0.7 m	+$0.2 m	+$0.2 m	+2
Mining	+$2.5 m	+$0.6 m	+$0.5 m	+2
Utilities	+$23.3 m	+$5.6 m	+$2.5 m	+8
Construction	+$1.7 m	+$1.0 m	+$0.8 m	+9
Manufacturing	+$10.4 m	+$2.4 m	+$1.3 m	+15
Wholesale Trade	+$1.6 m	+$1.1 m	+$0.6 m	+6
Retail Trade*	+$5.4 m	+$4.1 m	+$2.4 m	+57
Transportation & Warehousing	+$2.0 m	+$1.3 m	+$0.8 m	+9
Information	+$0.9 m	+$0.6 m	+$0.2 m	+2
Financial Activities*	+$5.2 m	+$1.4 m	+$0.6 m	+5
Business Services	+$8.8 m	+$5.1 m	+$4.1 m	+40
Health Services	+$1.3 m	+$0.9 m	+$0.8 m	+10
Other Services	+$2.4 m	+$1.3 m	+$1.0 m	+19
Total, All Industries	**+$66.3 m**	**+$25.4 m**	**+$15.8 m**	**+184**

Source: US Multi-Regional Impact Assessment System, The Perryman Group

Notes: Monetary values given in millions of 2024 US dollars per year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate.

The Economic Impact of Bitcoin Mining and Related Activities: Tennessee
Results by Industry

Industry	Total Expenditures	Gross Product	Personal Income	Jobs
Agriculture	+$2.5 m	+$0.8 m	+$0.5 m	+7
Mining	+$8.9 m	+$2.2 m	+$1.7 m	+8
Utilities	+$81.2 m	+$19.6 m	+$8.6 m	+29
Construction	+$5.9 m	+$3.4 m	+$2.8 m	+31
Manufacturing	+$35.9 m	+$8.3 m	+$4.6 m	+54
Wholesale Trade	+$5.5 m	+$3.7 m	+$2.1 m	+19
Retail Trade*	+$19.0 m	+$14.2 m	+$8.2 m	+201
Transportation & Warehousing	+$6.5 m	+$4.2 m	+$2.8 m	+30
Information	+$3.4 m	+$2.1 m	+$0.9 m	+6
Financial Activities*	+$17.7 m	+$4.8 m	+$2.0 m	+16
Business Services	+$28.9 m	+$16.6 m	+$13.5 m	+131
Health Services	+$4.5 m	+$3.2 m	+$2.7 m	+35
Other Services	+$8.5 m	+$4.4 m	+$3.5 m	+67
Total, All Industries	**+$228.4 m**	**+$87.5 m**	**+$54.0 m**	**+636**

Source: US Multi-Regional Impact Assessment System, The Perryman Group

Notes: Monetary values given in millions of 2024 US dollars per year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate.

The Economic Impact of Bitcoin Mining and Related Activities: Texas
Results by Industry

Industry	Total Expenditures	Gross Product	Personal Income	Jobs
Agriculture	+$48.2 m	+$16.0 m	+$10.6 m	+133
Mining	+$173.6 m	+$43.1 m	+$31.8 m	+158
Utilities	+$1,491.1 m	+$360.2 m	+$157.2 m	+541
Construction	+$115.0 m	+$66.5 m	+$54.8 m	+610
Manufacturing	+$529.4 m	+$135.5 m	+$76.4 m	+897
Wholesale Trade	+$109.1 m	+$73.8 m	+$42.5 m	+383
Retail Trade*	+$373.7 m	+$279.5 m	+$162.3 m	+3,960
Transportation & Warehousing	+$122.5 m	+$79.1 m	+$52.3 m	+565
Information	+$65.9 m	+$40.6 m	+$17.3 m	+123
Financial Activities*	+$390.8 m	+$102.3 m	+$41.3 m	+339
Business Services	+$559.3 m	+$321.6 m	+$262.4 m	+2,529
Health Services	+$88.5 m	+$61.9 m	+$52.3 m	+684
Other Services	+$164.3 m	+$84.9 m	+$68.2 m	+1,298
Total, All Industries	**+$4,231.2 m**	**+$1,665.0 m**	**+$1,029.6 m**	**+12,219**

Source: US Multi-Regional Impact Assessment System, The Perryman Group

Notes: Monetary values given in millions of 2024 US dollars per year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate.

The Economic Impact of Bitcoin Mining and Related Activities: Washington
Results by Industry

Industry	Total Expenditures	Gross Product	Personal Income	Jobs
Agriculture	+$0.5 m	+$0.2 m	+$0.1 m	+1
Mining	+$1.8 m	+$0.5 m	+$0.3 m	+2
Utilities	+$17.0 m	+$4.1 m	+$1.8 m	+6
Construction	+$1.2 m	+$0.7 m	+$0.6 m	+6
Manufacturing	+$5.8 m	+$1.5 m	+$0.8 m	+10
Wholesale Trade	+$1.2 m	+$0.8 m	+$0.5 m	+4
Retail Trade*	+$4.1 m	+$3.1 m	+$1.8 m	+43
Transportation & Warehousing	+$1.4 m	+$0.9 m	+$0.6 m	+6
Information	+$0.7 m	+$0.4 m	+$0.2 m	+1
Financial Activities*	+$3.9 m	+$1.1 m	+$0.4 m	+4
Business Services	+$6.3 m	+$3.6 m	+$3.0 m	+29
Health Services	+$0.9 m	+$0.7 m	+$0.6 m	+7
Other Services	+$1.8 m	+$0.9 m	+$0.7 m	+14
Total, All Industries	**+$46.7 m**	**+$18.4 m**	**+$11.4 m**	**+134**

Source: US Multi-Regional Impact Assessment System, The Perryman Group

Notes: Monetary values given in millions of 2024 US dollars per year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate.