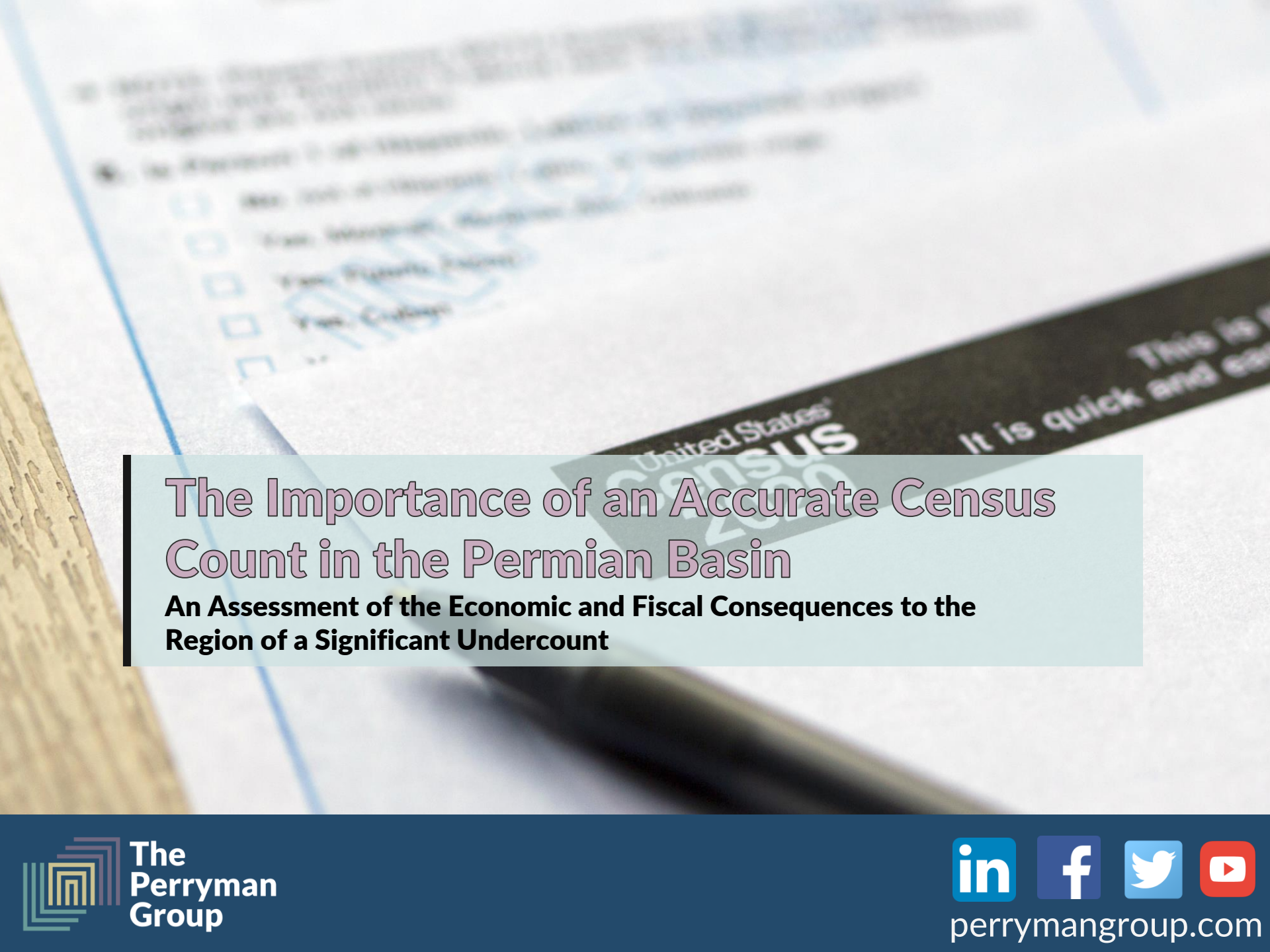


The Importance of an Accurate Census Count in the Permian Basin

An Assessment of the Economic and Fiscal Consequences to the Region of a Significant Undercount

The Perryman Group

perrymangroup.com

Why Does the Census Matter?

Accurate Census counts are important to ensuring the Permian Basin has appropriate representation in the Texas Legislature, receives adequate federal funding for various programs, and understands population trends in order to plan for the future at a time when unprecedented growth and change in the energy sector are creating notable opportunities and challenges for local communities.

Undercounts occur for a variety of reasons, such as failure to realize the importance of the Census, lack of understanding as to whether to respond, inadequate internet access, or fear of providing information. In the Permian Basin, the large Hispanic population (which tends to be particularly difficult to count), transient workers who are sometimes unsure as to whether they should respond, and expansive areas with limited internet access can lead to notable undercounts.

Dozens of states and many metropolitan areas have engaged in proactive efforts to ensure adequate counts, with funding levels including $187 million in California, $30.5 million in Illinois, $20 million in New York, and $15.5 million in Washington.

Purpose of this Study

The Perryman Group (TPG) was recently asked to estimate the economic and fiscal consequences of a significant undercount.

The major phases of the analysis include

- estimating the potential size of the undercount,
- quantifying the associated direct losses in funding based on Census counts,
- calculating the total economic impact of lost funding, and
- estimating the "downstream" effects which are caused by the consequences of funding reductions such as increased hunger and worse educational outcomes.

This presentation and its Appendices provide the results of TPG's analysis.

Summary of Key Findings

Potential Permian Undercounts

Data developed by the US Census Bureau regarding hard to count populations was used to derive an estimate of the weighted anticipated undercount in Texas and New Mexico (about 1.515%).

The model was then adapted to the Permian Basin to account for the specific demographic and distributional characteristics of the region in order to estimate the expected undercount in the Permian Basin area (about 1.986%).

This number is likely conservative in that (1) Census plans do not account for any reluctance to participate as a result of the controversy over the citizenship question and other recent policies and (2) a survey recently conducted by Yellowstone Associates demonstrated that 4% of people residing in the Permian Basin Region would likely not complete the survey, with many more being uncertain.

Because of the manner in which many of the major programs determine eligibility and allocations, the loss of Federal dollars is much greater than the magnitude of the undercount. Moreover, the major categories of funding reductions are in sectors (such as health care, housing, education, and infrastructure) that are critical to the ongoing expansion of the Permian Basin economy.

Direct Costs of an Undercount

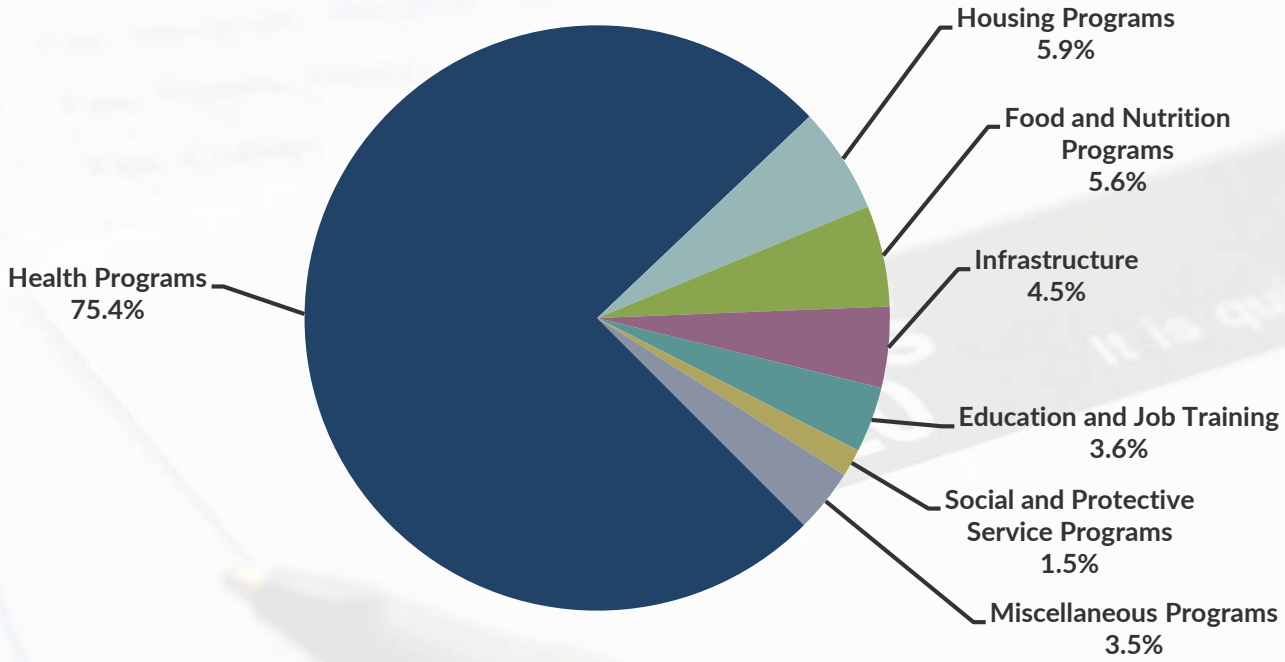
Estimated Direct Potential Losses of Federal Dollars in the Permian Basin

Results in millions of 2020 dollars

	Total: 2021-30	Average Annual
Health Programs	-$539.7	-$54.0
Housing Programs	-$42.3	-$4.2
Food and Nutrition Programs	-$40.3	-$4.0
Infrastructure	-$31.6	-$3.2
Education and Job Training	-$26.2	-$2.6
Social and Protective Service Programs	-$11.1	-$1.1
Miscellaneous Programs	-$25.1	-$2.5
TOTAL	**-$716.3**	**-$71.6**

Notes: Based on The Perryman Group's estimates of potential Permian Basin undercounts and related funding losses. Miscellaneous programs include a variety of funding categories with relatively small allocations, such as several types of block grants, administrative funds, arts and cultural programs, and agricultural and environmental initiatives. The Permian Basin Region for purposes of this study includes Andrews, Borden, Crane, Dawson, Ector, Gaines, Glasscock, Howard, Loving, Martin, Midland, Pecos, Reeves, Terrell, Upton, Ward, Winkler, and Yoakum counties in Texas and Chaves, Eddy, and Lea counties in New Mexico. A detailed explanation of methodology is provided in the Appendices.

Direct Costs of an Undercount



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Total Economic Costs

Direct costs lead to negative ripple effects through the economy, multiplying the overall economic harms of an undercount.

The Perryman Group estimates that potential undercounts in the Permian Basin could lead to total losses of **$1.1 billion** in gross product and **13,135** job-years of employment over the 10 years following the count (including multiplier effects).

On an average annual basis, these losses would total an estimated **$112 million** in gross product per year and **1,314** jobs.

The estimated losses to local governmental entities include **$52.9 million**.

Total Economic Costs by Program

Estimated Total Potential Losses in the Permian Basin due to Undercounts: 2021-2030

Monetary results in millions of 2020 dollars, employment given in job-years

	Gross Product	Job Years
Health Programs	-$882.2	-9,763
Housing Programs	-$54.5	-551
Food and Nutrition Programs	-$57.8	-476
Infrastructure	-$45.8	-461
Education and Job Training	-$40.3	-525
Social and Protective Service Programs	-$17.6	-208
Miscellaneous Programs	-$23.8	-1,151
TOTAL	**-$1,121.9**	**-13,135**

Notes: Based on The Perryman Group's estimates of potential Permian Basin undercounts and related funding losses as well as related multiplier effects. Miscellaneous programs include a variety of funding categories with relatively small allocations, such as several types of block grants, administrative funds, arts and cultural programs, and agricultural and environmental initiatives. A job-year is equivalent to one person working for one year, though it could be multiple people working partial years. The Permian Basin Region for purposes of this study includes Andrews, Borden, Crane, Dawson, Ector, Gaines, Glasscock, Howard, Loving, Martin, Midland, Pecos, Reeves, Terrell, Upton, Ward, Winkler, and Yoakum counties in Texas and Chaves, Eddy, and Lea counties in New Mexico. A detailed explanation of methodology is provided in the Appendices.

Downstream Effects

In addition to these economic costs, there are additional costs due to "downstream" effects of undercounts. For example, having less funding for nutrition, education, social services, health care, and other programs can lead to reduced productivity and efficiency, diminished overall health of the population (further reducing productivity), and increased stress on the social service system.

Similarly, inadequate infrastructure resources impose costs on local businesses and households and reduces efficiency.

The Perryman Group analyzed the potential economic costs of these downstream effects over the 2021 through 2030 period and found that they include an estimated **$1.9 billion** in gross product and approximately **21,450** job-years in the Permian Basin (when multiplier effects are considered).

Economic Costs of Downstream Losses

Estimated Cumulative Potential Losses in the Permian Basin: 2021-30

Monetary results in millions of 2020 dollars, employment in job-years

	Total Expenditures	Gross Product	Personal Income	Job Years
Health Programs	-$1,519.0	-$595.1	-$346.8	-5,292
Housing Programs	-$1,134.7	-$523.6	-$312.4	-5,004
Food and Nutrition Programs	-$122.2	-$48.9	-$30.6	-564
Infrastructure	-$82.9	-$37.7	-$23.4	-1,429
Education and Job Training	-$1,084.8	-$501.1	-$308.1	-6,927
Social and Protective Service Programs	-$506.4	-$233.7	-$139.4	-2,233
TOTAL	**-$4,449.9**	**-$1,940.0**	**-$1,160.5**	**-21,448**

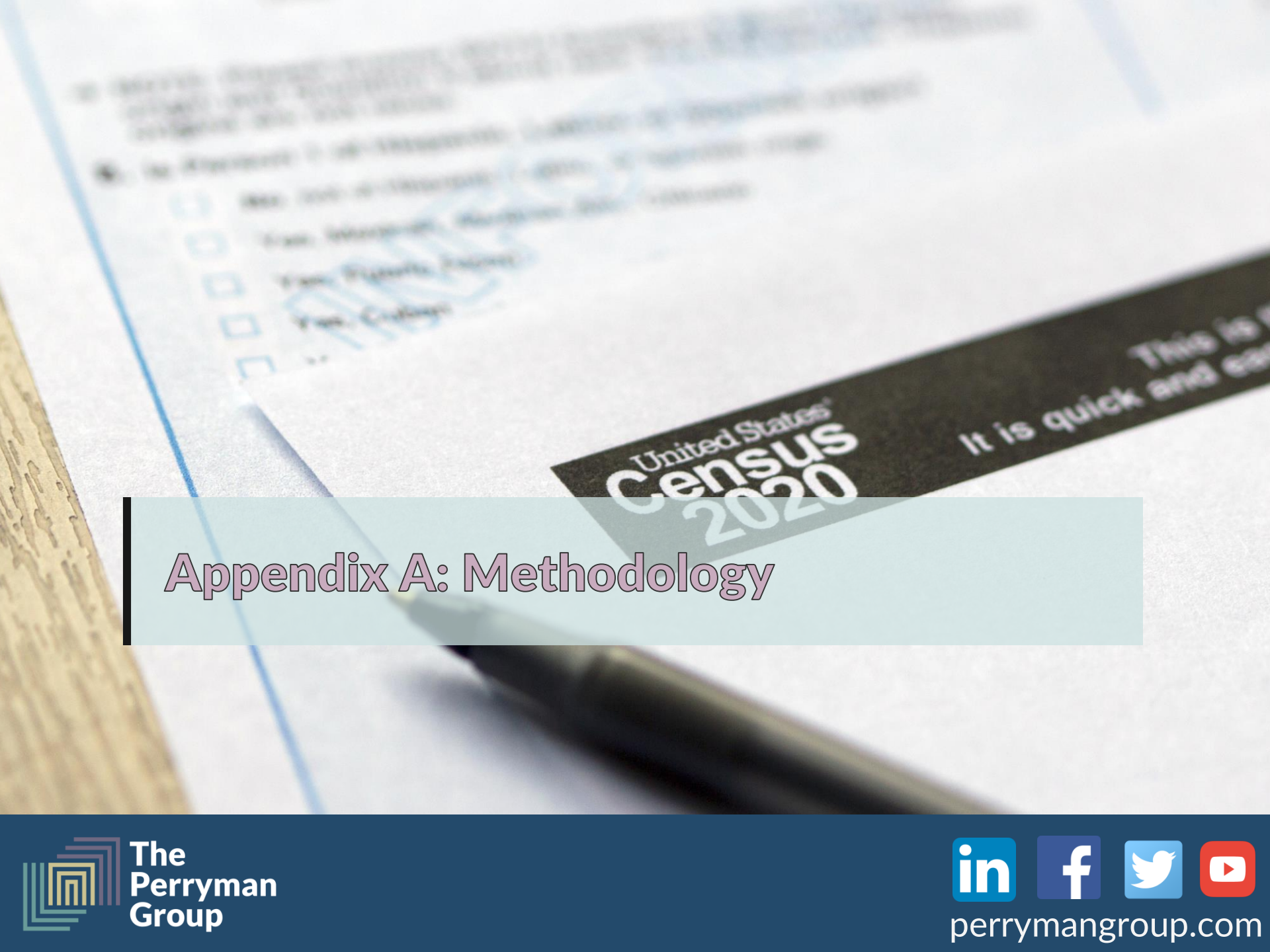
Notes: Based on The Perryman Group's estimates of potential Permian Basin undercounts and resulting funding losses and the related downstream effects such as reduced productivity and economic efficiency. Does not include certain funding categories with relatively small allocations which would further increase economic costs. A job-year is equivalent to one person working for one year, though it could be multiple people working partial years. The Permian Basin Region for purposes of this study includes Andrews, Borden, Crane, Dawson, Ector, Gaines, Glasscock, Howard, Loving, Martin, Midland, Pecos, Reeves, Terrell, Upton, Ward, Winkler, and Yoakum counties in Texas and Chaves, Eddy, and Lea counties in New Mexico. A detailed explanation of methodology is provided in the Appendices.

Conclusion

Undercounting residents of the Permian Basin has a substantial negative effect on the economy. In addition, representation of the region at the Texas Legislature and in Congress can be adversely affected.

Over the 10 years following the Census, lost funding due to potential undercounts in the Permian Basin could lead to total losses of **$1.1 billion** in gross product and **13,135** job-years of employment over the next 10 years (including multiplier effects), with another **$1.9 billion** in gross product and approximately **21,450** job-years in losses due to the related downstream effects.

Ensuring that all residents of the Permian Basin are counted in the 2020 Census is vitally important to the future of this dynamic region.



Appendix A: Methodology

Methods Used: Impact Measurement

The basic modeling technique employed in this study is known as dynamic input-output analysis. This methodology 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. Projections were based on an econometric model designed specifically for the relevant region.

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. In this instance, data developed by the US Census Bureau regarding hard to count populations was used to derive an estimate of the weighted anticipated undercount in Texas and New Mexico (about 1.515%). The model was adapted to the Permian Basin to account for the specific demographic and distributional characteristics of the region in order to estimate the expected undercount in the Permian Basin area (about 1.986%). This number is likely conservative in that (1) the Census planning assessment does not account for any reluctance to participate as a result of the controversy over the citizenship question and other recent policies and (2) a survey recently conducted by Yellowstone Associates demonstrated that 4% of people residing in the region would likely not complete the survey, with many more being uncertain.

All federal programs funded or supported based on local Census counts were examined to determine the types of formulas that were relevant. Initiatives for which the Permian Basin is not eligible for participation were eliminated from the analysis. Allocations to Texas and New Mexico were determined from programs representing well over half of the total funding and all of the major sources of revenue allocations. (See "Counting for Dollars 2020," George Washington Institute of Public Policy.) Comparison of these programs relative to the smaller ones allowed the estimation of the total amount allocated to Texas and New Mexico. The eligible populations in the Permian Basin were then integrated with the applicable formulas to estimate the funds provided to the area as of 2017 (the last year for which the information has been compiled). These amounts were then projected forward to 2021-2030 using The Perryman Group's US Multi-Regional Econometric Model (described below) and converted to constant (2020) dollars to eliminate the effects of inflation. The direct impact of the potential undercount was then computed using the allocation methods applicable to each program. Once the direct effects were compiled and categorized, the total impact was determined by assigning the funds to the appropriate foregone spending categories using The Perryman Group's US Multi-Regional Impact Assessment System (described below).

Methods Used: Downstream Effects

Downstream effects were estimated based on academic studies and economic modeling by The Perryman Group to estimate the impact of reduced funding on underlying issues such as health, social services, homelessness, hunger, education levels, traffic congestion and infrastructure constraints. The Perryman Group has completed many studies of these and similar issues and has developed many of the techniques used in their measurement. The systems have been widely used throughout the country in policy analysis and formulation.

Downstream health costs are based on foregoing potential reductions in morbidity and mortality associated with improved access to health care on an annual basis based on estimates by the Institute of Medicine as part of a major research initiative, and has been fully updated to current price levels and relative income levels in the Permian Basin based on appropriate cost indices from the US Department of Labor and income data from the US Department of Commerce. The Perryman Group developed this model, which has been used in policy analysis related to health care access throughout the United States.

Reduced social and protective services funding leads to increases in issues related to crime and poverty. The Perryman Group developed a method for measuring the cost of poverty based on studies of the effects of poverty on earnings losses, criminal activity and incarceration, incremental educational costs, incremental health care costs, and productivity losses associated with increased morbidity and mortality. This model has been widely used in national and state level studies in all 50 states for policy analysis and implementation related to hunger, child maltreatment, mental health, indigent health care access, and other issues related to social policy and services. The system was fully localized to the Permian Basin Region to reflect the economic characteristics and composition of the area. It has been used by Feeding America, Prevent Child Abuse America, and numerous social service entities throughout the country and has been the basis for testimony before the US Congress and numerous legislative bodies and formed the analytical basis for national policy decisions on numerous occasions.

To estimate downstream costs related to the loss of funding for housing, information from extensive academic and policy research was implemented to develop a system to calculate the incremental economic and social costs uniquely associated with homelessness and housing affordability issues. This model was developed by The Perryman Group and has been used extensively in policy analysis in several states.

Methods Used: Downstream Effects

Downstream effects of increased hunger derive from an increased need for health care and adverse effects on educational performance. Available academic studies which provided information on (1) the relative incidence of various health consequences among the hungry and food insecure population and (2) the costs associated with those outcomes were used as a basis for health-related effects of hunger. In addition, hunger and food insecurity are also associated with substantial adverse effects on **education** costs, outcomes, and, hence, earnings. The direct educational costs were quantified in a study by the Center for American Progress and are updated using current estimates of the number of school-aged persons suffering from hunger and food insecurity and the appropriate price indices. The model was originally developed by The Perryman Group in 2014 and has been used in all 50 states to support food and nutrition initiatives and used by Congress and the US Department of Agriculture in evaluating and implementing public policy. All results were localized to the Permian Basin Region and reflect its industrial composition and economic and demographic characteristics. Additional detail is available in TPG's study of hunger available at www.perrymangroup.com.

Downstream effects of reduced infrastructure funding include, among others, increased congestion on highways, challenges in power and water resource availability, and difficulty in maintaining and expanding municipal services. These effects also raise the cost of doing business in many sectors and constrain capacity for expansion. The Perryman Group has developed models to measure these effects, which were updated and localized to the Permian Basin, for analysis for the Federal Highway Administration, the Federal Energy Regulatory Commission, and numerous state regulatory bodies throughout the country.

Downstream education and job training effects are based on the social returns to educational investment, including higher earnings and productivity and reduced social costs in a variety of areas. Based on extensive academic and professional research, The Perryman Group has developed models to estimate the effects of providing incremental resources for elementary and secondary education, as well as job training and higher education. This research was supported by the Bill and Melinda Gates Foundation and has been implemented in hundreds of studies throughout the United States. These systems were fully localized to the Permian Basin Region.

Methods Used: Model Simulation

The second major phase of the analysis is the simulation of the input-output system to measure overall economic effects as the direct costs of undercounting ripples through the economy. The Perryman Group developed the US Multi-Regional Impact Assessment System for this purpose about 40 years ago and has consistently maintained and updated it since that time. The specific submodels used in the current application reflects the specific structure of the Permian Basin Region economy defined for purposes of this study as Andrews, Borden, Crane, Dawson, Ector, Gaines, Glasscock, Howard, Loving, Martin, Midland, Pecos, Reeves, Terrell, Upton, Ward, Winkler, and Yoakum counties in Texas and Chaves, Eddy, and Lea counties in New Mexico .

The USMRIAS is somewhat similar in format to the Input-Output Model of the United States and the Regional Input-Output Modeling System, both of which are 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) 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. Moreover, the model uses specific local taxing patterns to estimate the fiscal effects of activity on a detailed sectoral basis. The models used for the present investigation reflect the specific industrial characteristics of the Permian Basin Region and have been thoroughly tested for reasonableness and historical reliability.

Methods Used: Model Simulation

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 Council 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.

In this case, because the original stimulus is negative (foregone funding for programs in the region), the overall economic effects are also negative.

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 were measured in constant 2020 dollars to eliminate the effects of inflation.

Methods Used: Definitions of Measures

The USMRIAS generates estimates of the effect on several measures of business activity. The most comprehensive measure of economic activity used in this study 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.

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A second measure of business activity frequently employed in this analysis is that of 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 an area is the amount of US output that is produced in that area; 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.

Methods Used: Definitions of Measures and Fiscal Effects

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 of Employment. The employment measures reflect the full-time equivalent jobs generated or lost due to an economic stimulus. For a stimulus which is anticipated to be ongoing, the Jobs measure is used. 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 2017 and $1 million in 2018, it is appropriate to say that $2 million was achieved in the 2017-18 period. If the same area has 100 people working in 2017 and 100 in 2018, 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 partial years). This concept is distinct from Jobs, which anticipates that the relevant positions will be maintained on a continuing basis.

Business activity generates tax revenue. The economic costs of a census undercount lead to a notable decrease in tax receipts to the State and local government entities including cities, counties, schools, and special districts. For example, retail sales would be negatively affected by the decrease in economic activity due to undercounts measured in this study; the reductions in retail sales were quantified in this study and appear in Appendix B. A portion of these retail sales would have been taxable, and receipts to local taxing entities are thus reduced. Economic harms also affect demand for housing and commercial real estate and, hence, property tax values. When the total economic effects of a potential undercount are considered (such as measured in this study), the reductions in taxes from these sources are significant.

Methods Used: Forecast

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, regional 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. A submodel specifically reflecting the economic structure of the Permian Basin Region of Texas and New Mexico was used in this analysis to generate potential estimated economic effects through 2030.

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 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.”

Methods Used: Forecast

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).

Methods Used: Forecast

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 Texas Consumer Price Index, which fluctuates 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 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.

Methods Used: Forecast

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. The US model, which follows the basic structure outlined above, was used to some extent in the current analysis to define the demand for domestically produced goods on a per capita basis.

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 Texas 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.

Methods Used: Forecast

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 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: Detailed Sectoral Results

The Impact of the Potential Loss of Federal Funding Arising from a 2020 Census Undercount on Business Activity in the Permian Basin

Results for **All Programs**: 2021-2030

Industry	Total Expenditures	Gross Product	Personal Income	Job Years
Agriculture	-$40,745,853	-$11,136,411	-$7,519,552	-100
Mining	-$43,485,463	-$9,999,280	-$4,917,699	-19
Utilities	-$103,909,171	-$23,584,498	-$10,291,645	-40
Construction	-$110,675,987	-$51,270,424	-$42,250,021	-511
Manufacturing	-$178,468,710	-$51,707,802	-$28,495,710	-370
Wholesale Trade	-$105,182,575	-$71,149,412	-$41,025,384	-391
Retail Trade	-$322,378,008	-$242,403,524	-$141,016,685	-3,855
Transportation & Warehousing	-$68,240,151	-$46,002,163	-$30,424,189	-354
Information	-$41,839,286	-$25,851,853	-$11,036,987	-88
Financial Activities	-$207,978,955	-$46,640,850	-$18,273,825	-170
Business Services	-$58,279,427	-$35,543,421	-$28,994,322	-297
Health Services	-$609,262,355	-$419,856,249	-$354,992,349	-5,428
Other Services	-$163,095,898	-$86,711,309	-$71,385,950	-1,514
Total, All Industries	**-$2,053,541,840**	**-$1,121,857,195**	**-$790,624,317**	**-13,135**

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

Notes: Monetary values given in 2020 US dollars per year. A job-year is equivalent to one person working for one year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate. Based on a conservative estimate of the potential undercount derived from the planning model of the US Census Bureau and the resulting implications for more than 300 programs with funding levels tied to the Census findings.

The Impact of the Potential Loss of Federal Funding Arising from a 2020 Census Undercount on Business Activity in the Permian Basin

Results for **Health Programs**: 2021-2030

Industry	Total Expenditures	Gross Product	Personal Income	Job Years
Agriculture	-$31,771,445	-$8,478,580	-$5,726,137	-76
Mining	-$23,987,865	-$5,514,052	-$2,756,539	-13
Utilities	-$81,527,141	-$18,522,218	-$8,082,601	-29
Construction	-$27,377,622	-$14,420,769	-$11,883,611	-139
Manufacturing	-$131,670,803	-$37,398,893	-$20,364,549	-241
Wholesale Trade	-$48,282,999	-$32,647,724	-$18,824,968	-178
Retail Trade	-$252,369,949	-$189,725,199	-$110,364,761	-2,816
Transportation & Warehousing	-$50,709,922	-$34,278,521	-$22,670,590	-258
Information	-$32,422,070	-$20,037,649	-$8,554,716	-64
Financial Activities	-$163,436,211	-$36,019,603	-$14,110,584	-119
Business Services	-$37,081,078	-$21,772,759	-$17,760,990	-180
Health Services	-$596,203,267	-$410,708,160	-$347,257,555	-4,788
Other Services	-$101,681,707	-$52,644,940	-$42,683,241	-862
Total, All Industries	**-$1,578,522,080**	**-$882,169,066**	**-$631,040,843**	**-9,763**

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

Notes: Monetary values given in 2020 US dollars per year. A job-year is equivalent to one person working for one year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate. Based on a conservative estimate of the potential undercount derived from the planning model of the US Census Bureau and the resulting implications for more than 300 programs with funding levels tied to the Census findings.

The Impact of the Potential Loss of Federal Funding Arising from a 2020 Census Undercount on Business Activity in the Permian Basin

Results for **Housing Programs**: 2021-2030

Industry	Total Expenditures	Gross Product	Personal Income	Job Years
Agriculture	-$1,852,005	-$531,389	-$358,168	-5
Mining	-$1,908,657	-$490,660	-$253,284	-1
Utilities	-$4,946,705	-$1,112,610	-$485,513	-2
Construction	-$43,987,732	-$17,059,129	-$14,057,785	-165
Manufacturing	-$15,329,061	-$5,012,419	-$2,855,325	-36
Wholesale Trade	-$4,994,794	-$3,379,523	-$1,948,663	-18
Retail Trade	-$18,061,770	-$13,798,959	-$8,065,805	-201
Transportation & Warehousing	-$4,384,089	-$2,918,699	-$1,930,324	-22
Information	-$1,991,279	-$1,230,084	-$525,162	-4
Financial Activities	-$9,464,845	-$2,081,698	-$886,985	-8
Business Services	-$2,657,302	-$1,593,662	-$1,300,020	-13
Health Services	-$2,984,316	-$2,091,704	-$1,768,555	-24
Other Services	-$6,195,648	-$3,172,863	-$2,574,833	-52
Total, All Industries	**-$118,758,202**	**-$54,473,400**	**-$37,010,422**	**-551**

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

Notes: Monetary values given in 2020 US dollars per year. A job-year is equivalent to one person working for one year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate. Based on a conservative estimate of the potential undercount derived from the planning model of the US Census Bureau and the resulting implications for more than 300 programs with funding levels tied to the Census findings.

The Impact of the Potential Loss of Federal Funding Arising from a 2020 Census Undercount on Business Activity in the Permian Basin

Results for **Food and Nutrition Programs**: 2021-2030

Industry	Total Expenditures	Gross Product	Personal Income	Job Years
Agriculture	-$1,838,416	-$516,093	-$348,355	-5
Mining	-$1,397,892	-$312,478	-$154,015	-1
Utilities	-$4,589,419	-$1,048,232	-$457,421	-2
Construction	-$1,565,526	-$833,365	-$686,745	-8
Manufacturing	-$6,721,153	-$1,848,924	-$1,041,381	-13
Wholesale Trade	-$43,167,331	-$29,210,999	-$16,843,322	-160
Retail Trade	-$15,080,119	-$11,181,933	-$6,477,163	-169
Transportation & Warehousing	-$3,826,177	-$2,610,404	-$1,726,428	-20
Information	-$2,310,146	-$1,427,638	-$609,504	-5
Financial Activities	-$9,093,924	-$2,064,955	-$860,557	-7
Business Services	-$2,709,290	-$1,640,347	-$1,338,103	-14
Health Services	-$2,745,369	-$1,924,095	-$1,626,840	-22
Other Services	-$6,356,811	-$3,155,189	-$2,563,811	-52
Total, All Industries	**-$101,401,572**	**-$57,774,654**	**-$34,733,646**	**-476**

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

Notes: Monetary values given in 2020 US dollars per year. A job-year is equivalent to one person working for one year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate. Based on a conservative estimate of the potential undercount derived from the planning model of the US Census Bureau and the resulting implications for more than 300 programs with funding levels tied to the Census findings.

The Impact of the Potential Loss of Federal Funding Arising from a 2020 Census Undercount on Business Activity in the Permian Basin

Results for **Infrastructure Programs**: 2021-2030

Industry	Total Expenditures	Gross Product	Personal Income	Job Years
Agriculture	-$1,681,090	-$554,051	-$374,690	-5
Mining	-$1,869,422	-$520,706	-$274,238	-2
Utilities	-$4,018,817	-$906,392	-$395,525	-1
Construction	-$32,944,051	-$16,444,438	-$13,551,241	-159
Manufacturing	-$11,376,752	-$3,688,351	-$2,095,212	-27
Wholesale Trade	-$3,261,398	-$2,206,429	-$1,272,247	-12
Retail Trade	-$13,093,924	-$9,867,487	-$5,744,529	-146
Transportation & Warehousing	-$3,619,841	-$2,394,076	-$1,583,357	-18
Information	-$1,638,195	-$1,011,663	-$431,911	-3
Financial Activities	-$7,938,816	-$1,690,610	-$717,473	-6
Business Services	-$3,204,160	-$1,968,972	-$1,606,176	-16
Health Services	-$2,555,732	-$1,790,918	-$1,514,238	-21
Other Services	-$5,355,657	-$2,733,068	-$2,218,648	-45
Total, All Industries	**-$92,557,857**	**-$45,777,161**	**-$31,779,486**	**-461**

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

Notes: Monetary values given in 2020 US dollars per year. A job-year is equivalent to one person working for one year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate. Based on a conservative estimate of the potential undercount derived from the planning model of the US Census Bureau and the resulting implications for more than 300 programs with funding levels tied to the Census findings.

The Impact of the Potential Loss of Federal Funding Arising from a 2020 Census Undercount on Business Activity in the Permian Basin

Results for Education and Job Training Programs: 2021-2030

Industry	Total Expenditures	Gross Product	Personal Income	Job Years
Agriculture	-$1,460,170	-$420,533	-$284,135	-4
Mining	-$1,213,521	-$276,275	-$137,507	-1
Utilities	-$4,137,384	-$937,815	-$409,238	-1
Construction	-$1,926,289	-$1,039,316	-$856,461	-10
Manufacturing	-$5,790,704	-$1,616,271	-$907,893	-11
Wholesale Trade	-$2,207,832	-$1,493,908	-$861,401	-8
Retail Trade	-$11,768,432	-$8,833,922	-$5,136,317	-131
Transportation & Warehousing	-$2,784,832	-$1,866,623	-$1,234,518	-14
Information	-$1,770,003	-$1,092,456	-$466,404	-3
Financial Activities	-$8,204,361	-$1,966,271	-$717,761	-6
Business Services	-$1,896,480	-$1,147,454	-$936,029	-10
Health Services	-$2,276,393	-$1,595,722	-$1,349,198	-19
Other Services	-$31,299,156	-$18,000,529	-$15,461,816	-307
Total, All Industries	**-$76,735,556**	**-$40,287,097**	**-$28,758,678**	**-525**

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

Notes: Monetary values given in 2020 US dollars per year. A job-year is equivalent to one person working for one year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate. Based on a conservative estimate of the potential undercount derived from the planning model of the US Census Bureau and the resulting implications for more than 300 programs with funding levels tied to the Census findings.

The Impact of the Potential Loss of Federal Funding Arising from a 2020 Census Undercount on Business Activity in the Permian Basin

Results for Social and Protective Service Programs: 2021-2030

Industry	Total Expenditures	Gross Product	Personal Income	Job Years
Agriculture	-$723,661	-$189,437	-$127,980	-2
Mining	-$433,597	-$97,412	-$48,654	0
Utilities	-$1,598,290	-$363,555	-$158,646	-1
Construction	-$598,399	-$316,303	-$260,654	-3
Manufacturing	-$2,382,823	-$678,881	-$380,854	-5
Wholesale Trade	-$921,180	-$623,184	-$359,334	-3
Retail Trade	-$5,063,045	-$3,805,619	-$2,213,683	-56
Transportation & Warehousing	-$1,064,801	-$729,393	-$482,395	-5
Information	-$693,596	-$427,381	-$182,462	-1
Financial Activities	-$3,167,558	-$678,856	-$275,861	-2
Business Services	-$5,100,624	-$3,667,092	-$2,991,407	-30
Health Services	-$1,001,467	-$701,768	-$593,352	-8
Other Services	-$8,902,132	-$5,334,850	-$4,554,313	-90
Total, All Industries	**-$31,651,174**	**-$17,613,732**	**-$12,629,594**	**-208**

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

Notes: Monetary values given in 2020 US dollars per year. A job-year is equivalent to one person working for one year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate. Based on a conservative estimate of the potential undercount derived from the planning model of the US Census Bureau and the resulting implications for more than 300 programs with funding levels tied to the Census findings.

The Impact of the Potential Loss of Federal Funding Arising from a 2020 Census Undercount on Business Activity in the Permian Basin

Results for Miscellaneous Programs: 2021-2030

Industry	Total Expenditures	Gross Product	Personal Income	Job Years
Agriculture	-$1,419,065	-$446,328	-$300,087	-4
Mining	-$12,674,508	-$2,787,697	-$1,293,461	-1
Utilities	-$3,091,414	-$693,675	-$302,701	-4
Construction	-$2,276,367	-$1,157,103	-$953,525	-27
Manufacturing	-$5,197,413	-$1,464,064	-$850,496	-38
Wholesale Trade	-$2,347,041	-$1,587,644	-$915,449	-11
Retail Trade	-$6,940,770	-$5,190,405	-$3,014,427	-336
Transportation & Warehousing	-$1,850,489	-$1,204,446	-$796,578	-17
Information	-$1,013,997	-$624,983	-$266,825	-8
Financial Activities	-$6,673,240	-$2,138,855	-$704,605	-21
Business Services	-$5,630,493	-$3,753,135	-$3,061,597	-34
Health Services	-$1,495,811	-$1,043,881	-$882,611	-545
Other Services	-$3,304,789	-$1,669,870	-$1,329,287	-106
Total, All Industries	**-$53,915,398**	**-$23,762,086**	**-$14,671,648**	**-1,151**

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

Notes: Monetary values given in 2020 US dollars per year. A job-year is equivalent to one person working for one year. Components may not sum due to rounding. Retail Trade includes Restaurants, Financial Activities includes Real Estate. Based on a conservative estimate of the potential undercount derived from the planning model of the US Census Bureau and the resulting implications for more than 300 programs with funding levels tied to the Census findings. Miscellaneous programs include a variety of funding categories with relatively small allocations, such as several types of block grants, administrative funds, arts and cultural programs, and agricultural and environmental initiatives.

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