# *The Economic Impact of Homelessness in Midland*

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# Introduction

Despite rapid economic growth, high per capita incomes, and low unemployment, numerous people in Midland are currently homeless. Many of them have physical, mental, or substance abuse issues which simultaneously contribute to and are exacerbated by not having a home.

*In addition to the immeasurable human cost of homelessness, there are also measurable adverse economic consequences to local areas such as increased emergency room visits, crime and incarceration costs, and lost economic productivity.*

In addition to the immeasurable human cost of homelessness, there are also measurable adverse economic consequences to local areas such as increased emergency room visits, crime and incarceration costs, and lost economic productivity. In this analysis, The Perryman Group (TPG) estimates the economic and fiscal consequences of homelessness in the Midland area.

A January 2019 survey indicates that 159 people are currently homeless in Midland County. The Perryman Group estimated homelessness in the area based on a model using population and income levels and state and national data and found that the predicted number of homeless individuals for 2018 (the year most closely aligned with the time that the survey was conducted) is virtually identical to the survey results. The Perryman Group's model was then used to estimate the number of homeless persons at present using this model and the firm's US Multi-Regional Econometric Model, with the survey results utilized to extract and analyze various subgroups. It is important to note that the small size of the population necessarily means that there were limited numbers of responses in some groups. The Perryman Group thus also analyzed response patterns in relation to local demographics and income distribution and national and state data on various breakouts and

found the survey findings to be reasonable (though subject to some degree of survey error).

This data regarding the size of the homeless population formed the basis of The Perryman Group's assessment of the economic and fiscal impact of homelessness in Midland.

# The Economic Cost of Homelessness

As a starting point for this analysis, TPG defined the typical economic and fiscal costs of an individual in poverty in Midland County. 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, and other issues related to poverty. The system was fully localized to the Midland area to reflect the economic characteristics and composition of the area.

Information from extensive academic and policy research was implemented to calculate the incremental economic and social costs associated with homelessness over and above those typical of any person in poverty. For example, homeless persons tend to earn less and are more likely to have substance abuse issues than the typical individual in poverty. The research indicates that these effects are exacerbated by certain factors, such as being unsheltered. This process was used in conjunction with the survey results to determine the direct economic effects of the homeless population on the area. The total impact of the homeless population was then estimated using The Perryman Group's US Multi-Regional Impact Assessment System, which is briefly described on the following page, with additional explanation in Appendix A. Results were

*The current annual economic cost associated with homelessness includes an estimated $51.9 million in annual gross product and 508 jobs in Midland County and $47.5 million in gross product each year and 463 jobs in the City of Midland (including multiplier effects).*

localized to the City of Midland using extensive secondary data and techniques such as gravity modeling.

## Measuring Economic and Fiscal Impacts

Any economic stimulus, whether positive or negative, generates multiplier effects throughout the economy. In this instance, the economic and social costs of homelessness generate multiplier effects and dynamic responses rippling through the economy.

The Perryman Group's 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 hundreds 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 direct costs associated with poverty and homelessness. The models used in the current analysis reflect the specific industrial composition and characteristics of Midland County, with results localized to the City of Midland.

Total economic effects are quantified for key measures of business activity:

- **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 each 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.
- **Jobs** are ongoing effects or those measured for a particular year.

Reduced economic activity also reduces tax receipts to local governments through channels such as lower retail sales. Monetary values were quantified on a constant (2019) basis to eliminate the effects of inflation. See Appendix A for additional information regarding the methods and assumptions used in this analysis.

When multiplier effects are considered, the current annual economic cost of the homeless population includes an estimated **$88.2 million** in annual gross product and **862** jobs in Midland County and **$80.8 million** in gross product each year and **787** jobs in the City of Midland. However, some of these costs are not specific to the characteristic of being homeless but are more generally linked to poverty. Therefore, The Perryman Group isolated the portion of overall economic costs which are specifically associated with homelessness.

*These economic costs involve sizable losses to local governments which The Perryman Group estimates to be over $2.1 million per year for Midland County and nearly $2.0 million for the City of Midland.*

The current annual economic cost associated with homelessness includes an estimated **$51.9 million** in annual gross product and **508** jobs in Midland County and **$47.5 million** in gross product each year and **463** jobs in the City of Midland (including multiplier effects). These costs involve sizable losses to local governments which The Perryman Group estimates to be over **$2.1 million** per year for taxing entities in Midland County and nearly **$2.0 million** for the portion of those entities that are in the City of Midland. (Note that these costs reflect the aggregate reduction in available tax revenue associated with the types of economic harms measured in this study including outlays to deal with homelessness.)

| Annual Economic and Fiscal Costs of Homelessness | | | | | |
|---|---|---|---|---|---|
| | **Total Expenditures** (Millions of 2019 Dollars) | **Gross Product** (Millions of 2019 Dollars) | **Personal Income** (Millions of 2019 Dollars) | **Employment** (Jobs) | **Local Government** (Millions of 2019 Dollars) |
| Midland County | ($129.118 m) | ($51.888 m) | ($30.024 m) | (508) | ($2.147 m) |
| City of Midland | ($119.261 m) | ($47.531 m) | ($27.499 m) | (463) | ($1.952 m) |

Note: Direct effects based on studies of the cost of poverty (such as earnings losses, criminal activity and incarceration, incremental educational costs, incremental health care costs, and productivity losses associated with increased morbidity and mortality), studies of homelessness, and The Perryman Group's estimate of related multiplier effects. Additional explanation of methods and assumptions may be found elsewhere in this report and Appendix A.
Source: US Multi-Regional Impact Assessment System, The Perryman Group

The Perryman Group also examined the portion of these total effects associated with characteristics such as race/ethnicity and mental and physical issues. (Note that an individual could be reflected in multiple distributions of the total, such as both in the Non-Hispanic White subtotal and the Physical Disability subtotal, if appropriate.)

Several findings are particularly noteworthy. For example, **although those that are chronically homeless account for less than 35% of the local homeless population, they are responsible for more than 52% of the total costs.** In addition, **approximately 65% of the homeless population in the area has some history of substance abuse or mental health issues.** The following tables describe these and other results for Midland County and the City of Midland.

## Summary of Estimated Annual Economic and Fiscal Costs of Homelessness by Characteristic: Midland County

| | **Expenditures** (Millions of 2019 Dollars) | **Gross Product** (Millions of 2019 Dollars) | **Personal Income** (Millions of 2019 Dollars) | **Employment** (Jobs) | **Local Government** (Millions of 2019 Dollars) |
|---|---|---|---|---|---|
| **Total Estimated Cost of the Homeless Population (1)** | | | | | |
| | ($219.414 m) | ($88.175 m) | ($51.020 m) | (862) | ($3.649 m) |
| **Costs Associated with Homelessness (2)** | | | | | |
| | ($129.118 m) | ($51.888 m) | ($30.024 m) | (508) | ($2.147 m) |
| **Living Arrangement** | | | | | |
| Sheltered (3) | ($60.955 m) | ($24.496 m) | ($14.174 m) | (240) | ($1.014 m) |
| Unsheltered/Chronic (4) | ($68.163 m) | ($27.393 m) | ($15.850 m) | (268) | ($1.134 m) |
| **Race/Ethnicity (5)** | | | | | |
| Non-Hispanic White | ($27.533 m) | ($11.064 m) | ($6.402 m) | (108) | ($0.458 m) |
| Black | ($24.684 m) | ($9.920 m) | ($5.740 m) | (97) | ($0.411 m) |
| Hispanic | ($61.711 m) | ($24.799 m) | ($14.350 m) | (243) | ($1.026 m) |
| Other/ Unidentified | ($15.190 m) | ($6.104 m) | ($3.532 m) | (60) | ($0.253 m) |
| **Substance Abuse (6)** | | | | | |
| | ($52.821 m) | ($21.227 m) | ($12.282 m) | (208) | ($0.878 m) |
| **Disability (7)** | | | | | |
| Mental | ($49.495 m) | ($19.890 m) | ($11.509 m) | (195) | ($0.823 m) |
| Physical | ($21.520 m) | ($8.648 m) | ($5.004 m) | (85) | ($0.358 m) |
| Developmental | ($10.760 m) | ($4.324 m) | ($2.502 m) | (42) | ($0.179 m) |
| Chronic Health | ($33.013 m) | ($13.267 m) | ($7.677 m) | (130) | ($0.549 m) |

Notes: (1) Represents the total estimated economic and fiscal losses incurred by Midland County as a result of homeless individuals in the area, including effects that would likely occur irrespective of homeless status. (2) Represents the estimated economic and fiscal losses incurred as a result of homelessness in the area, excluding effects that would likely occur irrespective of homeless status. (3) Represents the portion of economic and fiscal losses incurred as a result of the homelessness in the area that stems from those living in shelters. (4) Represents the portion of economic and fiscal losses incurred as a result of the homelessness in the area that stems from those living in unsheltered environments who are chronically homeless. (5) Represents the portion of economic and fiscal losses incurred as a result of the homelessness in the area for major racial/ethnic groups. (6) Represents the portion of economic and fiscal losses incurred as a result of the homelessness in the area that stems from those who have a history of substance abuse. (7) Represents the portion of economic and fiscal losses incurred as a result of the homelessness in the area that stems from those who experience various major categories of disabilities.

## Summary of Estimated Annual Economic and Fiscal Costs of Homelessness by Characteristic: City of Midland

| | **Expenditures** (Millions of 2019 Dollars) | **Gross Product** (Millions of 2019 Dollars) | **Personal Income** (Millions of 2019 Dollars) | **Employment** (Jobs) | **Local Government** (Millions of 2019 Dollars) |
|---|---|---|---|---|---|
| **Total Estimated Cost of the Homeless Population (1)** | | | | | |
| | ($202.664 m) | ($80.770 m) | ($46.730 m) | (787) | ($3.317 m) |
| **Costs Associated with Homelessness (2)** | | | | | |
| | ($119.261 m) | ($47.531 m) | ($27.499 m) | (463) | ($1.952 m) |
| **Living Arrangement** | | | | | |
| Sheltered (3) | ($56.301 m) | ($22.438 m) | ($12.982 m) | (219) | ($0.921 m) |
| Unsheltered/Chronic (4) | ($62.960 m) | ($25.092 m) | ($14.517 m) | (245) | ($1.030 m) |
| **Race/Ethnicity (5)** | | | | | |
| Non-Hispanic White | ($25.431 m) | ($10.135 m) | ($5.864 m) | (99) | ($0.416 m) |
| Black | ($22.800 m) | ($9.087 m) | ($5.257 m) | (89) | ($0.373 m) |
| Hispanic | ($57.000 m) | ($22.717 m) | ($13.143 m) | (221) | ($0.933 m) |
| Other/ Unidentified | ($14.031 m) | ($5.592 m) | ($3.235 m) | (54) | ($0 230 m) |
| **Substance Abuse (6)** | | | | | |
| | ($48.789 m) | ($19.444 m) | ($11.250 m) | (189) | ($0.798 m) |
| **Disability (7)** | | | | | |
| Mental | ($45.717 m) | ($18.220 m) | ($10.541 m) | (178) | ($0.748 m) |
| Physical | ($19.877 m) | ($7.922 m) | ($4.583 m) | (77) | ($0.325 m) |
| Developmental | ($9.938 m) | ($3.961 m) | ($2.292 m) | (39) | ($0.163 m) |
| Chronic Health | ($30.493 m) | ($12.153 m) | ($7.031 m) | (118) | ($0.499 m) |

Notes: (1) Represents the total estimated economic and fiscal losses incurred by Midland County as a result of homeless individuals in the area, including effects that would likely occur irrespective of homeless status. (2) Represents the estimated economic and fiscal losses incurred as a result of homelessness in the area, excluding effects that would likely occur irrespective of homeless status. (3) Represents the portion of economic and fiscal losses incurred as a result of the homelessness in the area that stems from those living in shelters. (4) Represents the portion of economic and fiscal losses incurred as a result of the homelessness in the area that stems from those living in unsheltered environments who are chronically homeless. (5) Represents the portion of economic and fiscal losses incurred as a result of the homelessness in the area for major racial/ethnic groups. (6) Represents the portion of economic and fiscal losses incurred as a result of the homelessness in the area that stems from those who have a history of substance abuse. (7) Represents the portion of economic and fiscal losses incurred as a result of the homelessness in the area that stems from those who experience various major categories of disabilities.

# Conclusion

Given the relatively low poverty rate in Midland County and high overall income levels, a lower rate of homelessness would be expected in the Midland area. However, high housing costs for both rental and purchases work to increase homelessness. In fact, **The Perryman Group estimates that approximately 36% of local homelessness could be avoided through more affordable housing options in line with those in other areas.**

*There are compelling social and humanitarian reasons to reduce homelessness, including the positive effects on human health, wellbeing, and dignity. At the same time, there are significant economic and fiscal costs which are worthy of consideration when evaluating community priorities.*

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# Appendices

# Appendix A: Methods Used

## *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 more than three 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, Texas, and Texas 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. In this analysis, it was used to estimate the size and composition of the 2019 homeless population.

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."

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 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.

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.

## 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.

## *US Multi-Regional Impact Assessment System*

The basic modeling technique employed in the impact assessment portion of this study 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. This process was described within the report. The second major phase of the analysis is the simulation of the input-output system to measure overall economic effects of the direct costs of homelessness. The present study was conducted within the context of the US Multi-Regional Impact Assessment System (USMRIAS) which was developed and is maintained by The Perryman Group. This model has been used in hundreds of diverse applications across the country and has an excellent reputation for accuracy and credibility; it has also been peer reviewed on multiple occasions. The systems used in the current simulations reflect the unique industrial structure of Midland County, with results localized to the City of Midland through the use of secondary local data and techniques such as gravity modeling.

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) 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 were measured in constant 2019 dollars to eliminate the effects of inflation.

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.

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 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 aggregate used is **Jobs,** which reflects 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 2018 and $1 million in 2019, it is appropriate to say that $2 million was achieved in the 2018-19 period. If the same area has 100 people working in 2018 and 100 in 2019, it only has 100 Jobs.