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# The Potential Economic Benefits for Texas of a Free Trade Agreement between the United States and the European Union

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## Introduction and Overview

Import and export activity is an essential aspect of optimizing economic performance. By allowing each nation to focus resources on those goods and services where it has a competitive advantage and import other products, foreign trade helps improve business conditions and quality of life around the globe.

From the beginnings of such exchanges centuries ago, there have been tariffs, quotas, and other impediments to free trade. Over time, many of these have been eliminated through free trade agreements. It is a widely accepted economic principle that free trade is beneficial from both the import and the export side, and additional efforts to enhance exchange are worthy of consideration. While the world has become highly integrated and complex, with extensive intra-industry trade in addition to that between sectors, the basic principles remain in place.

The Perryman Group was recently asked to examine the potential impact of a transatlantic free trade agreement between the United States and the European Union on business activity in Texas. This analysis reveals that the state would likely see the addition of between approximately \$9 billion in economic output and more than 89,600 jobs from a US-EU free trade agreement, with additional potential gains stemming from productivity enhancements and efforts to eliminate non-tariff barriers to trade.

## Trade and Trade Agreements

The volume of trade between the United States and the European Union has risen markedly over the last decade. In 2002, US exports to the EU totaled \$1.5 billion, while imports from the EU were \$2.3 billion according to foreign trade data from the US Census Bureau. In 2012, US exports to the EU totaled \$265.1 billion, somewhat lower the peak of \$271.8 billion in 2008 (prior to the global recession). Imports from the EU reached a record high of \$380.8 billion in 2012. Top export products from the US to the EU in 2012 include chemicals, transportation equipment, and computer and electronic products.

Texas has significant trading relationships with many EU countries. Five of Texas' top 20 exporting countries are EU members (Netherlands, Belgium, United Kingdom, France, and Germany); in 2012, Texas exports to these countries totaled over \$24,516.6 million. The top export products from Texas to the EU include petroleum and coal products, chemicals, and computer and electronic products.

Five of the top 25 countries from which Texas imports are EU countries including Germany, United Kingdom, France, Italy, and Netherlands. Texas' imports from these countries in 2012 were \$19.9 billion.

### The Benefits of Free Trade Agreements

The notion that the comparative advantages of various regions could produce gains from trade dates back about two centuries to the British Classical economists, particularly Robert Torrens and David Ricardo. While the world has changed markedly since that time, this basic premise has been repeatedly demonstrated through myriad trade relationships over the years. Specifically with regard to an expanded agreement between the EU and the US, a 2009 report by ECORYS Nederland BV for the European Commission, Directorate-General for Trade<sup>1</sup> examined non-tariff measures in both the United States and the European Union impede free trade. Removing these barriers (defined in the study as non-price and non-quantity restrictions on trade such as customs procedures and laws or regulatory procedures) was found to result in

<sup>1</sup> "Non-Tariff measures in EU-US Trade and Investment-An Economic Analysis," Dr. Koen G. Berden, Prof. Dr. Joseph Francois, Mr. Martin Thelle, Mr. Paul Wymenga, and Ms. Saara Tamminen; ECORYS Nederland BV; December 2009.

potential gains in gross domestic product of up to 0.3% per year in the United States (0.7% in the EU). A study by the European Centre for International Political Economy<sup>2</sup> also found that, while tariffs between the EU and the US are relatively low, free trade could still result in sizable gains. These benefits were estimated to be up to a 1.33% increase in gross domestic product (on a dynamic basis) for the United States (0.47% for the EU).

While the methods used varied, it is notable that these and other studies have consistently found that free trade between the US and EU would lead to increased economic activity and income gains for both sides.

Benefits of the 13 US free trade agreements (with a total of 19 countries) are described by the US Department of State. The volume of trade with these nations has grown substantially in most cases, enhancing opportunities for businesses and choices for consumers.

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<sup>2</sup> "A Transatlantic Zero Agreement: Estimating the Gains from Transatlantic Free Trade in Goods," Fredrik Erixon and Matthias Bauer; European Centre for International Political Economy; 2010.

## Benefits of a US-EU Free Trade Agreement for the Texas Economy

Eliminating tariffs on goods traded between the United States and the European Union would lead to an expansion in international commerce. In addition, there are typically notable efficiencies gained when costs and barriers to trade are reduced.

The Perryman Group developed four scenarios reflecting progressively greater degrees of integration between the United States and the European Union. Within this framework, the likely effects for Texas were estimated based on consideration of factors such as trade flows, price responses, and historical and projected patterns in the competitiveness of Texas relative to other parts of the United States in attracting EU trade. **These benefits are spread across virtually all major industry sectors** (as described in the detailed sectoral results in the Appendices to this report). Although some sectors show negative effects (as expected) when the analysis is restricted to inter-industry patterns, most become positive when intra-industry patterns and overall welfare effects are examined. It should further be noted that all scenarios are likely to understate the actual realized benefits at maturity, as greater flexibility is likely to stimulate innovation and further opportunities to increase production and reduce costs,

The basic modeling technique employed in this study is known as dynamic general equilibrium analysis, which essentially makes use of a complex set of modeling resources, including both large scale impact assessment (dynamic input-output) and econometric systems. (The relevant processes and models are further described in the Appendices to this report.)

Effects are quantified for key measures of business activity:

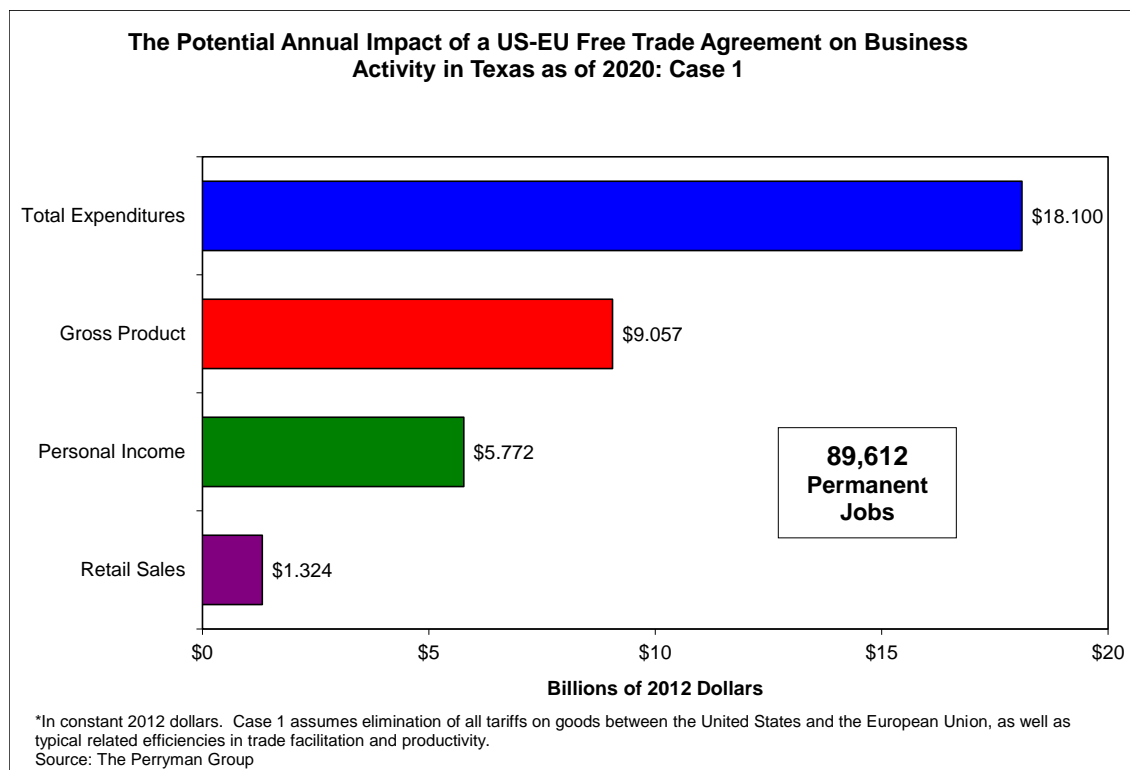
- Total expenditures (or total spending) measures the dollars changing hands as a result of the economic stimulus.
- Gross product (or output) is production of goods and services that will come about in each area as a result of the activity. This measure is parallel to the gross domestic product numbers 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.

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- Job gains are expressed as permanent jobs since the trade agreement represents an ongoing change in business conditions.

Impacts were estimated as of 2020 in order to allow time for the market to reach equilibrium and for industries to respond. After that time, the effects would likely increase with growth in trade volume and ongoing incentives for innovation. Results are presented in 2012 dollars to eliminate the effects of inflation; see the Appendices to this report for further information regarding assumptions and methods used.

## Scenario 1: Elimination of All Tariffs on US-EU Trade

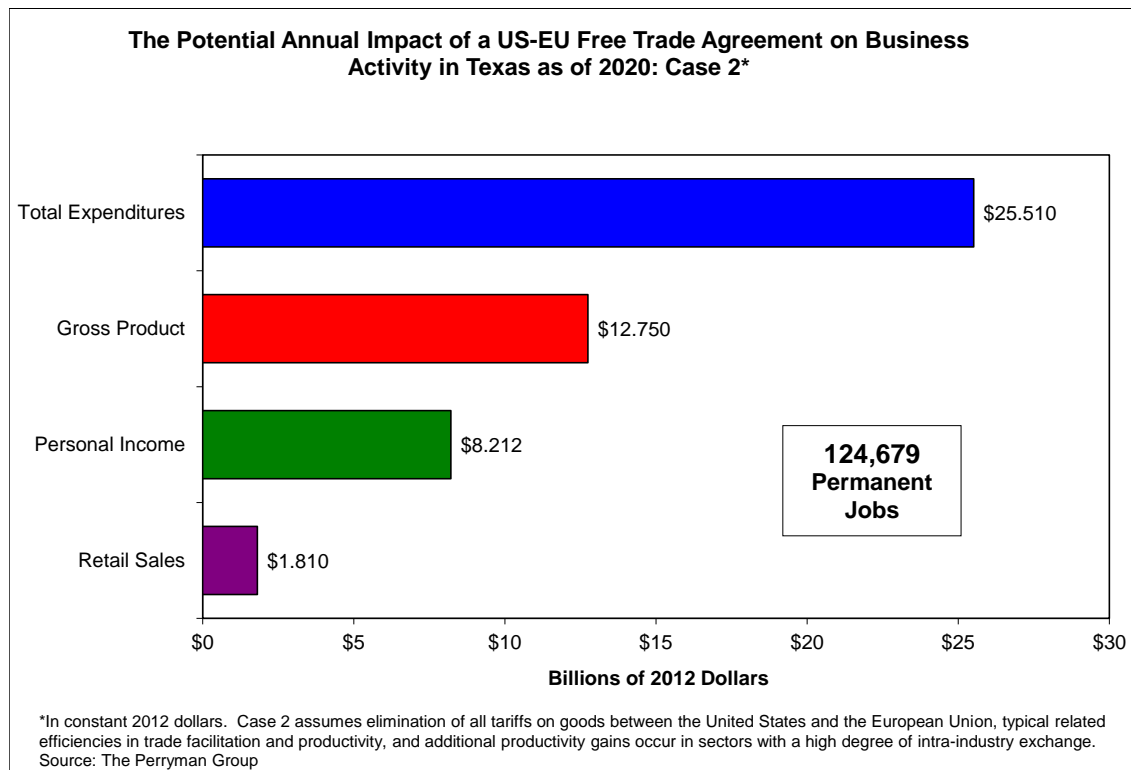
The first scenario examined assumes elimination of all tariffs on goods traded between the United States and the European Union as well as typical related efficiencies in trade facilitation and productivity. The Perryman Group estimated the gain in business activity in Texas under this set of assumptions to include an annual **\$18.1 billion in spending, \$9.1 billion in output (gross product), and \$5.8 billion in personal income, as well as 89,612 jobs**. The stimulus to production represents about 0.4% of expected baseline output. **Moreover, State and local fiscal revenues would expand by \$315.0 million and \$185.7 million per annum, respectively.**





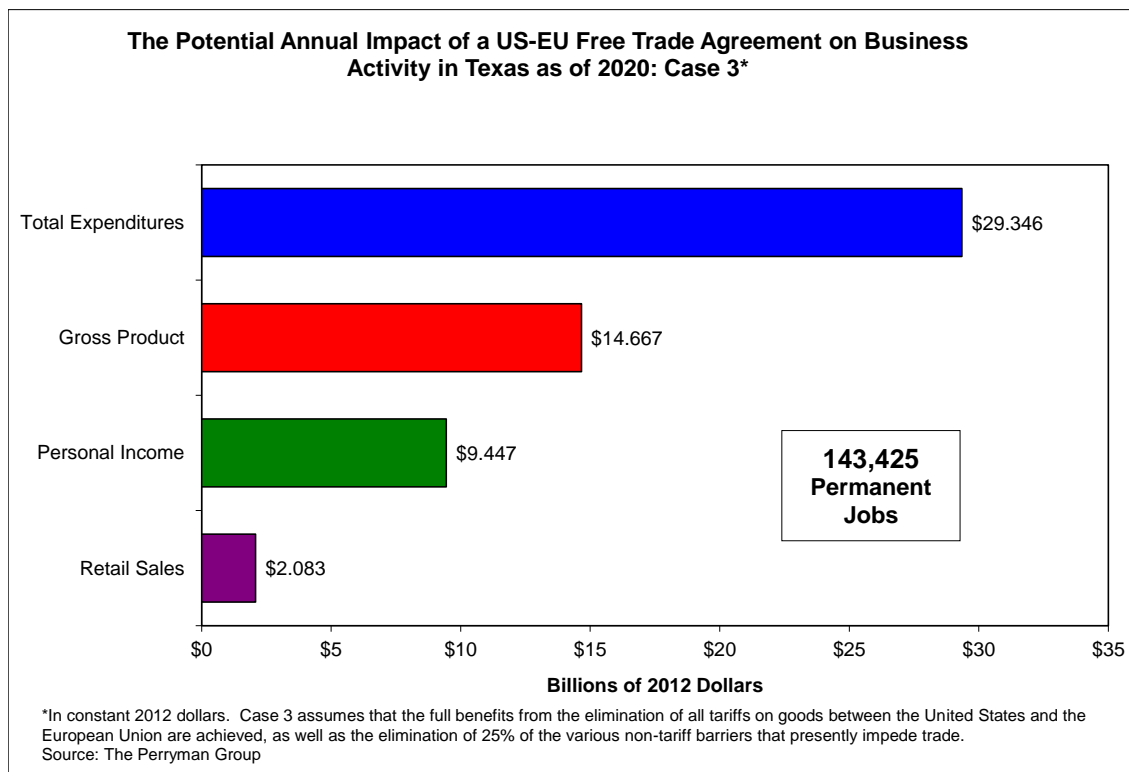
## Scenario 2: Elimination of All Tariffs on US-EU Trade and Productivity Gains

A second reasonable scenario, which is more in line with typical simulations, is that not only are all tariffs eliminated on US-EU trade (with typical related efficiencies in trade facilitation and productivity) but also additional productivity gains occur in sectors with a high degree of intra-industry exchange. For example, many types of scientific and technical instruments sectors are characterized by a high degree of intra-industry trade, as are a variety of categories of transportation equipment. In this scenario, the yearly benefits for Texas total an estimated **\$25.5 billion in expenditures, \$12.8 billion in gross state product (an increase of about 0.6% relative to baseline projections), \$8.2 billion in personal income, as well as 124,679 permanent jobs.** Annual State and local governmental revenues under these conditions are estimated at \$435.6 million and \$257.8 million.



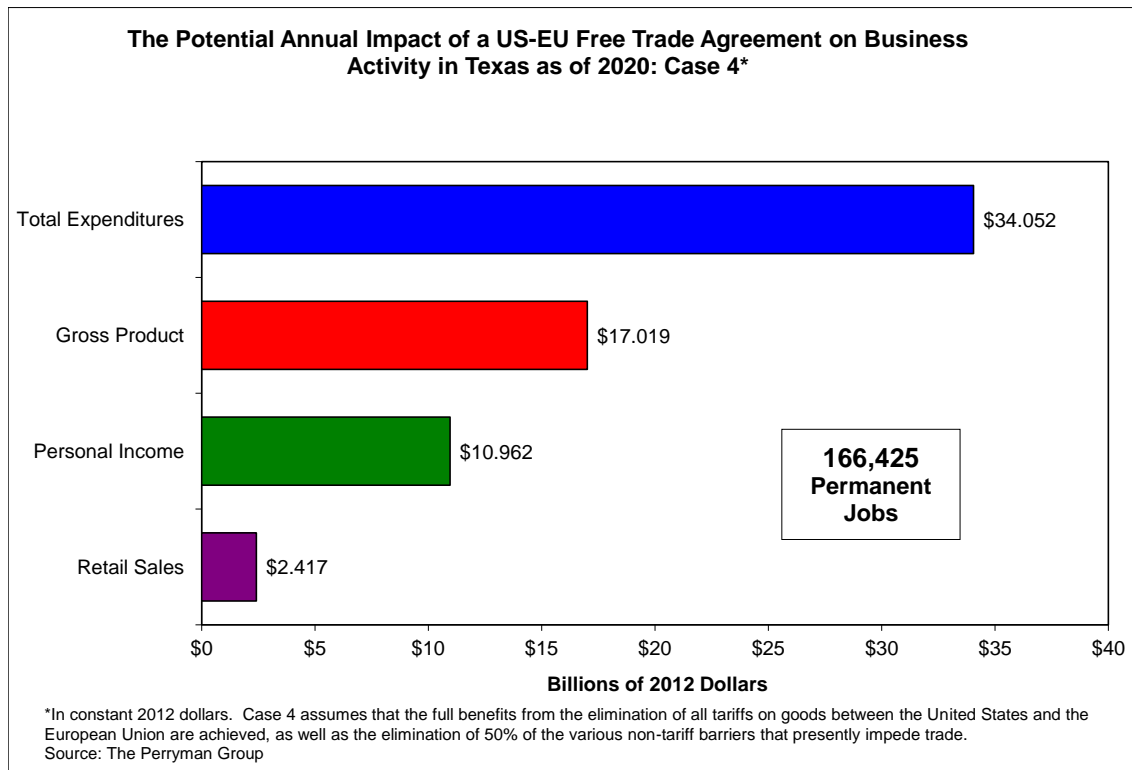
### Scenario 3: Full Benefits of Elimination of All Tariffs on US-EU Trade and 25% of Non-Tariff Barriers

The third case presumes the full benefits from the elimination of tariffs on US-EU trade, as well as dealing with 25% of the non-tariff barriers (such as excessive or inconsistent regulation or complex customs processing) that presently impede trade. It further assumes that these reductions in barriers will occur in a harmonized manner across multiple sectors, thus allowing synergies to be achieved. In this scenario, Texas’ benefits increase to **\$29.3 billion in yearly aggregate expenditures, \$14.7 billion in gross product each year (0.7% above projected totals), \$9.4 billion in personal income per annum, and 143,425 jobs. Governmental revenues expand by \$501.1 million (State) and \$296.5 million (local) on an annual basis in this scenario.**



## Scenario 4: Full Benefits of Elimination of All Tariffs on US-EU Trade and 50% of Non-Tariff Barriers

The fourth scenario assumes the full benefits from the elimination of tariffs on US-EU trade and a more successful effort to reduce non-tariff barriers. It must be recognized that full removal of non-tariff obstacles is not possible due to a variety of internal policy, precedents, contractual commitments, and other factors. In this case, where 50% of non-tariff barriers are eliminated in a harmonized manner, economic benefits for Texas include an estimated **\$34.1 billion in aggregate expenditures, \$17.0 billion in gross product (representing more than 0.8% of expected aggregate output at the time), and \$11.0 billion in personal income every year, as well as 166,425 jobs. The effects on yearly governmental revenues under these conditions expand to \$581.4 million for the State and \$344.1 million for various local taxing authorities.**



## Conclusion

A free trade agreement between the United States and the European Union has the potential to enhance the economic performance of all of the countries involved. Texas, with its large economy and high volume of export and import activity, would realize a significant portion of the gains.

The Perryman Group analyzed the potential impact of a US-EU free trade agreement and other efforts to remove barriers to trade. If all tariffs are removed on goods traded between the United States and the European Union, the potential **gains in business activity in Texas range from \$9.1 billion to \$17.0 billion in output (gross product) each year and 89,612 to 166,425 permanent jobs** (depending on assumptions regarding productivity gains and success in reducing non-tariff trade impediments).

Clearly, a Transatlantic free trade agreement between the United States and the European Union would be of notable benefit to the state and national economies.

## APPENDICES

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## About The Perryman Group

- The Perryman Group (TPG) is an economic research and analysis firm based in Waco, Texas. The firm has more than 30 years of experience in assessing the economic impact of corporate expansions, regulatory changes, real estate developments, public policy initiatives, and myriad other factors affecting business activity. TPG has conducted hundreds of impact analyses for local areas, regions, and states throughout the United States. Impact studies have been performed for hundreds of clients including many of the largest corporations in the world, governmental entities at all levels, educational institutions, major health care systems, utilities, and economic development organizations.
- Dr. M. Ray Perryman, founder and President of the firm, developed the US Multi-Regional Impact Assessment System (USMRIAS—used in this study) in the early 1980s and has consistently maintained, expanded, and updated it since that time. The model has been used in hundreds of diverse applications and has an excellent reputation for reliability.
- TPG has extensive experience in examining the economic effects of public policy. Moreover, the firm has completed numerous economic assessments related to international and regional commercial trade activity, including the pioneering analysis of the North American Free Trade Agreement; an assessment of offshore drilling patterns for the US Department of the Interior; several studies of major port investments; evaluations of the effects of pipelines, petroleum export facilities, and other projects to support export activity in several countries; and examinations of major highway expansions of global trade potential.

## Impact Analysis Methodology

- The basic modeling technique employed in this study is known as dynamic general equilibrium analysis. Dr. M. Ray Perryman, founder and president of The Perryman Group, developed the techniques required in this process (see, for example, M. Ray Perryman, “A Comprehensive Model of Multi-National Trade Patterns: Theory and an Application,” *The Journal of Systems Research*, 1993). This methodology essentially makes use of a complex set of modeling resources, including both large scale impact assessment (dynamic input-output) and econometric systems. The relevant processes and models are described in some degree of detail below.
- There are obviously myriad uncertainties associated with the projection of the impacts of changes in trade parameters on overall economic activity, and any effort to measure such effects is inherently fraught with difficulty. Nonetheless, as noted above, a reasonable and established approach can be implemented which systematically accounts for numerous factors and defines a plausible (and likely conservative) range of outcomes. In seeking to quantify the net benefits of expanded trade between the United States and the European Union on the Texas economy, a baseline forecast for business activity for 2020 was initially established. This period was selected to allow sufficient time for the responses to work through various sectors and generate stabilized effects. Monetary values are converted to 2012 dollars to adjust for the effects of inflation (in the subsequent analysis of various trade scenarios, the impacts on prices are incorporated into the relevant deflator indices). The differential between the baseline and the simulations under each alternative trade scenario provide a measure of the net gains from enhanced trade activity.
- The baseline forecast for 2020 is derived from the Texas Econometric Model, which was developed by The Perryman Group and has been continuously updated, expanded, and maintained for more than three decades. (The basic structure of this large-scale model is described in a subsequent section of this Appendix.) It provides detailed sectoral forecasts at the three-digit North American Industrial Classification System (NAICS) level for numerous variables reflecting significant dimensions of activity. Moreover, the Texas Econometric Model is fully integrated with the relevant geographic submodel of the US Multi-Regional Impact System (USMRIAS), a dynamic input-output system developed and maintained by the firm. Through the underlying joint determination process, industrial detail is obtained for more than 500 individual production categories.
- Four scenarios (described within the report) were developed reflecting progressively greater degrees of integration between the US and the EU. These were then modeled in a general equilibrium context within the context of the Texas model which permits consideration of (1)

inter-industry trade flows, (2) intra-industry integration, (3) price responses, (4) welfare effects that span the entire economy, (5) productivity stimulation, (6) trade efficiency, (7) historical and projected patterns in the competitiveness of Texas relative to the remainder of the US in attracting EU trade, (7) the anticipated industrial composition of Texas as it evolves over time in a dynamic context, and (8) supply chain and payroll implications of the expanded activity.

- Because a general equilibrium framework, by its very nature, provides a solution for the entire spectrum of changes occurring as a result of an external stimulus, it is not necessary or appropriate to estimate separate impacts within the context of the USMRIAS. This system is useful, however, in that reverse simulations may be used to solve measures beyond overall output changes, such as income, expenditures, and employment, in a manner than fully accounts for the underlying dynamics of the basic solution and changes in factor resource allocation and productivity over time.
- The USMRIAS has been used in hundreds of diverse applications across the country and has an excellent reputation for accuracy and credibility. The systems used in the current reverse simulations reflect the unique industrial structure and characteristics of the Texas economy as anticipated to present in 2020, with appropriate consideration of the dynamic process that occurs in the interim.
- 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 have been thoroughly tested for reasonableness and historical reliability.
- 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 *ACCRA 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 derived from the relevant reverse simulations were measured in constant 2012 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 Arkansas 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 fourth measure, **Retail Sales**, represents the component of Total Expenditures which occurs in retail outlets (general merchandise stores, automobile dealers and service stations, building materials stores, food stores, drugstores, restaurants, and so forth). Retail Sales is a commonly used measure of consumer activity.
- The final aggregates used are **Permanent Jobs and Person-Years of Employment**. The Person-Years of Employment measure reveals the full-time equivalent jobs generated by an activity. It should be noted that, unlike the dollar values described above, Permanent Jobs is a "stock" rather than a "flow." In other words, if an area produces \$1 million in output in 2010 and \$1 million in 2011, it is appropriate to say that \$2 million was achieved in the 2010-2011 period. If the same area has 100 people working in 2010 and 100 in 2011, it only has 100 Permanent 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 Person-Years (a person working for a year). This concept is distinct from Permanent Jobs, which anticipates that the relevant positions will be maintained on a continuing basis.

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## Texas Econometric Model Methodology

### *Overview*

- The Texas Econometric Model was developed by Dr. M. Ray Perryman, President and CEO of The Perryman Group (TPG) approximately 30 years ago has been consistently maintained 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 local, regional, and national 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 instance, the Texas Econometric Model was used establish the baseline levels of activity in 2020, as well as to capture the dynamic general equilibrium solutions for the trade simulations.
- 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 Texas Econometric 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.
- 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.

- The overall Texas 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 all major newspapers 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. As noted above, the impact system is used in the current application to reverse simulate various economic aggregates and to permit assessment at a much more disaggregated level of industrial detail.



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## Detailed Sectoral Results

**The Potential Annual Impact of Expanded International Commerce and Related Production Associated with the Establishment of a Transatlantic Free Trade Agreement Between the United States and the European Union on Business Activity in Texas (Case 1\*) as of 2020**  
**Detailed Industrial Category**

Category	Total Expenditures (2012 Dollars)	Gross Product (2012 Dollars)	Personal Income (2012 Dollars)	Employment (Permanent Jobs)
Agricultural Products & Services	\$244,708,342	\$97,805,189	\$49,497,228	567
Forestry & Fishery Products	\$14,064,550	\$1,624,875	\$418,777	18
Coal Mining	\$9,253,012	\$2,312,864	\$2,724,766	17
Crude Petroleum & Natural Gas	\$781,294,320	\$323,532,794	\$128,089,805	521
Miscellaneous Mining	\$17,402,997	\$8,157,681	\$6,323,678	61
New Construction	\$1,485,433,462	\$708,685,326	\$552,708,142	7,845
Maintenance & Repair Construction	\$682,937,236	\$471,079,707	\$367,398,026	5,214
Food Products & Tobacco	\$544,165,512	\$130,187,593	\$65,860,118	1,174
Textile Mill Products	(\$937,082)	(\$225,177)	(\$192,600)	-4
Apparel	(\$1,579,186)	(\$803,023)	(\$434,344)	-14
Paper & Allied Products	\$38,387,854	\$14,623,427	\$8,218,394	92
Printing & Publishing	\$124,288,709	\$74,390,475	\$43,162,830	623
Chemicals & Petroleum Refining	\$2,521,437,540	\$637,076,232	\$304,141,553	750
Rubber & Leather Products	\$147,269,195	\$65,481,769	\$42,719,795	493
Lumber Products & Furniture	\$117,626,580	\$43,361,044	\$33,289,982	604
Stone, Clay, & Glass Products	(\$18,777,144)	(\$9,879,156)	(\$5,773,460)	-93
Primary Metal	\$15,271,471	\$4,627,485	\$3,865,161	31
Fabricated Metal Products	\$30,495,686	\$14,576,983	\$9,613,743	155
Machinery, Except Electrical	\$678,462,207	\$242,946,675	\$193,302,048	1,162
Electric & Electronic Equipment	\$329,584,642	\$188,812,002	\$139,058,978	520
Motor Vehicles & Equipment	\$118,972,163	\$39,453,783	\$23,182,553	419
Transp. Equip., Exc. Motor Vehicles	\$662,139,968	\$346,051,870	\$222,555,400	3,396
Instruments & Related Products	\$60,338,593	\$19,029,765	\$17,390,892	140
Miscellaneous Manufacturing	\$66,600,772	\$18,637,792	\$21,933,807	137
Transportation	\$236,682,889	\$150,685,786	\$101,277,977	1,501
Communication	\$391,650,415	\$278,493,678	\$126,332,019	1,252
Electric, Gas, Water, Sanitary Services	\$1,169,470,362	\$244,744,702	\$113,598,311	463
Wholesale Trade	\$1,114,109,297	\$885,622,462	\$519,418,898	6,054
Retail Trade	\$927,062,380	\$816,894,618	\$492,913,538	13,810
Finance	\$564,965,512	\$287,520,619	\$203,326,114	1,360
Insurance	\$154,538,994	\$93,517,742	\$54,222,558	688
Real Estate	\$1,655,040,840	\$570,933,385	\$93,216,000	1,015
Hotels, Lodging Places, Amusements	\$282,353,961	\$146,314,397	\$99,591,985	2,497
Personal Services	\$114,810,210	\$79,399,700	\$61,621,997	993
Business Services	\$1,126,433,309	\$841,238,057	\$739,571,054	9,371
Eating & Drinking Places	\$396,854,668	\$259,209,512	\$143,770,784	8,438
Health Services	\$805,545,136	\$681,555,855	\$561,567,709	11,287
Miscellaneous Services	\$476,798,931	\$264,337,469	\$218,474,697	6,075
Households	\$15,091,947	\$15,091,947	\$14,317,085	977
<b>Total</b>	<b>\$18,100,250,250</b>	<b>\$9,057,107,902</b>	<b>\$5,772,275,998</b>	<b>89,612</b>

\*Assumes the elimination of all tariffs on goods between the United States and the European Union, as well as typical related efficiencies in trade facilitation and productivity.

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

**The Potential Annual Impact of Expanded International Commerce and Related Production Associated with the Establishment of a Transatlantic Free Trade Agreement Between The United States and the European Union on Business Activity in Texas (Case 2\*) as of 2020**  
**Detailed Industrial Category**

Category	Total Expenditures (2012 Dollars)	Gross Product (2012 Dollars)	Personal Income (2012 Dollars)	Employment (Permanent Jobs)
Agricultural Products & Services	\$244,970,181	\$99,196,570	\$50,797,538	629
Forestry & Fishery Products	\$12,109,836	\$1,491,676	\$387,264	17
Coal Mining	\$14,257,840	\$3,563,861	\$4,198,555	27
Crude Petroleum & Natural Gas	\$635,111,697	\$262,998,792	\$104,123,800	424
Miscellaneous Mining	\$26,816,042	\$12,570,060	\$9,744,070	94
New Construction	\$1,986,866,217	\$947,913,837	\$739,283,962	10,493
Maintenance & Repair Construction	\$913,474,051	\$630,100,492	\$491,419,336	6,975
Food Products & Tobacco	\$591,507,792	\$141,513,885	\$71,589,934	1,276
Textile Mill Products	\$7,975,844	\$1,916,564	\$1,639,286	35
Apparel	\$13,441,019	\$6,834,814	\$3,696,858	121
Paper & Allied Products	\$74,408,988	\$28,345,278	\$15,930,101	179
Printing & Publishing	\$184,171,426	\$110,232,056	\$63,958,826	924
Chemicals & Petroleum Refining	\$3,493,860,815	\$882,772,486	\$421,437,469	1,031
Rubber & Leather Products	\$211,337,045	\$93,984,319	\$61,195,617	715
Lumber Products & Furniture	\$123,777,961	\$45,628,646	\$35,030,910	636
Stone, Clay, & Glass Products	(\$44,576,355)	(\$23,452,808)	(\$13,706,013)	-221
Primary Metal	\$8,238,627	\$2,496,428	\$2,085,170	17
Fabricated Metal Products	\$243,024,304	\$116,165,977	\$76,613,237	1,238
Machinery, Except Electrical	\$1,497,043,452	\$536,067,780	\$426,525,697	2,559
Electric & Electronic Equipment	\$810,022,122	\$454,242,516	\$334,823,860	1,457
Motor Vehicles & Equipment	\$196,602,037	\$65,197,554	\$38,309,274	692
Transp. Equip., Exc. Motor Vehicles	\$915,096,300	\$478,253,543	\$307,577,904	4,693
Instruments & Related Products	\$85,222,696	\$26,877,787	\$24,563,031	195
Miscellaneous Manufacturing	\$94,067,446	\$26,324,161	\$30,979,479	194
Transportation	\$321,676,456	\$204,797,523	\$137,647,215	2,040
Communication	\$539,640,076	\$383,725,751	\$174,068,041	1,726
Electric, Gas, Water, Sanitary Services	\$1,654,924,748	\$346,339,743	\$160,753,672	655
Wholesale Trade	\$1,535,465,466	\$1,220,564,903	\$715,863,140	8,344
Retail Trade	\$1,277,677,399	\$1,125,844,187	\$679,333,452	19,033
Finance	\$815,087,577	\$414,812,018	\$293,342,843	1,963
Insurance	\$207,927,270	\$125,825,128	\$72,954,716	926
Real Estate	\$2,387,762,083	\$823,697,552	\$134,484,675	1,465
Hotels, Lodging Places, Amusements	\$380,698,262	\$196,790,750	\$134,092,115	3,356
Personal Services	\$154,112,140	\$106,579,873	\$82,716,493	1,332
Business Services	\$1,622,349,825	\$1,211,706,523	\$1,065,578,377	13,497
Eating & Drinking Places	\$532,706,301	\$347,942,336	\$192,986,523	11,327
Health Services	\$1,081,300,042	\$914,866,644	\$753,804,051	15,151
Miscellaneous Services	\$640,017,153	\$354,825,699	\$293,263,144	8,154
Households	\$20,258,235	\$20,258,235	\$19,218,122	1,311
<b>Total</b>	<b>\$25,510,430,416</b>	<b>\$12,749,813,138</b>	<b>\$8,212,311,744</b>	<b>124,679</b>

\*Assumes the elimination of all tariffs on goods between the United States and the European Union, as well as typical related efficiencies in trade facilitation and productivity. It further assumes that additional productivity gains occur in sectors with a high degree of intra-industry exchange.

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

**The Potential Annual Impact of Expanded International Commerce and Related Production Associated with the Establishment of a Transatlantic Free Trade Agreement Between the United States and the European Union on Business Activity in Texas (Case 3\*) as of 2020**  
**Detailed Industrial Category**

Category	Total Expenditures (2012 Dollars)	Gross Product (2012 Dollars)	Personal Income (2012 Dollars)	Employment (Permanent Jobs)
Agricultural Products & Services	\$281,802,939	\$114,111,379	\$58,435,257	724
Forestry & Fishery Products	\$13,930,624	\$1,715,958	\$445,492	20
Coal Mining	\$16,401,593	\$4,099,710	\$4,829,833	31
Crude Petroleum & Natural Gas	\$730,604,607	\$302,542,261	\$119,779,447	488
Miscellaneous Mining	\$30,847,997	\$14,460,045	\$11,209,150	108
New Construction	\$2,285,603,649	\$1,090,438,453	\$850,439,806	12,070
Maintenance & Repair Construction	\$1,050,820,436	\$724,839,937	\$565,307,225	8,023
Food Products & Tobacco	\$680,444,589	\$162,791,359	\$82,353,916	1,468
Textile Mill Products	\$9,175,061	\$2,204,731	\$1,885,763	40
Apparel	\$15,461,958	\$7,862,469	\$4,252,703	140
Paper & Allied Products	\$85,596,832	\$32,607,164	\$18,325,288	206
Printing & Publishing	\$211,862,722	\$126,806,117	\$73,575,425	1,063
Chemicals & Petroleum Refining	\$4,019,184,059	\$1,015,502,703	\$484,803,158	1,186
Rubber & Leather Products	\$243,112,856	\$108,115,433	\$70,396,751	823
Lumber Products & Furniture	\$142,388,731	\$52,489,191	\$40,298,021	731
Stone, Clay, & Glass Products	(\$51,278,681)	(\$26,979,081)	(\$15,766,796)	-255
Primary Metal	\$9,477,355	\$2,871,781	\$2,398,688	19
Fabricated Metal Products	\$279,564,488	\$133,632,239	\$88,132,504	1,424
Machinery, Except Electrical	\$1,722,133,049	\$616,668,834	\$490,656,432	2,943
Electric & Electronic Equipment	\$931,813,880	\$522,540,643	\$385,166,666	1,676
Motor Vehicles & Equipment	\$226,162,351	\$75,000,403	\$44,069,306	796
Transp. Equip., Exc. Motor Vehicles	\$1,052,686,600	\$550,161,875	\$353,824,114	5,399
Instruments & Related Products	\$98,036,447	\$30,919,026	\$28,256,232	225
Miscellaneous Manufacturing	\$108,211,059	\$30,282,159	\$35,637,432	223
Transportation	\$370,042,469	\$235,590,078	\$158,343,312	2,347
Communication	\$620,778,246	\$441,421,254	\$200,240,231	1,985
Electric, Gas, Water, Sanitary Services	\$1,903,752,759	\$398,414,032	\$184,923,966	753
Wholesale Trade	\$1,766,332,047	\$1,404,084,267	\$823,497,521	9,599
Retail Trade	\$1,469,783,974	\$1,295,121,714	\$781,475,373	21,895
Finance	\$937,640,956	\$477,181,531	\$337,448,726	2,258
Insurance	\$239,190,401	\$144,743,703	\$83,923,901	1,065
Real Estate	\$2,746,776,648	\$947,545,493	\$154,705,265	1,685
Hotels, Lodging Places, Amusements	\$437,938,563	\$226,379,437	\$154,253,681	3,861
Personal Services	\$177,283,838	\$122,604,806	\$95,153,421	1,533
Business Services	\$1,866,279,998	\$1,393,893,975	\$1,225,794,573	15,527
Eating & Drinking Places	\$612,801,937	\$400,257,584	\$222,003,222	13,030
Health Services	\$1,243,880,087	\$1,052,422,413	\$867,143,079	17,429
Miscellaneous Services	\$736,247,628	\$408,175,903	\$337,357,043	9,380
Households	\$23,304,184	\$23,304,184	\$22,107,684	1,509
<b>Total</b>	<b>\$29,346,078,935</b>	<b>\$14,666,825,163</b>	<b>\$9,447,082,811</b>	<b>143,425</b>

\*Assumes that the full benefits from the elimination of all tariffs on goods between the United States and the European Union are achieved, as well as the elimination of 25% of the various non-tariff barriers that presently impede trade.

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

**The Potential Annual Impact of Expanded International Commerce and Related Production Associated with the Establishment of a Transatlantic Free Trade Agreement Between the United States and the European Union on Business Activity in Texas (Case 4\*) as of 2020**  
**Detailed Industrial Category**

Category	Total Expenditures (2012 Dollars)	Gross Product (2012 Dollars)	Personal Income (2012 Dollars)	Employment (Permanent Jobs)
Agricultural Products & Services	\$326,992,710	\$132,410,219	\$67,805,904	840
Forestry & Fishery Products	\$16,164,531	\$1,991,128	\$516,931	23
Coal Mining	\$19,031,744	\$4,757,137	\$5,604,342	36
Crude Petroleum & Natural Gas	\$847,763,976	\$351,057,778	\$138,987,216	566
Miscellaneous Mining	\$35,794,766	\$16,778,850	\$13,006,643	125
New Construction	\$2,652,121,842	\$1,265,300,587	\$986,815,884	14,006
Maintenance & Repair Construction	\$1,219,329,446	\$841,074,886	\$655,959,593	9,310
Food Products & Tobacco	\$789,560,324	\$188,896,496	\$95,560,146	1,704
Textile Mill Products	\$10,646,368	\$2,558,281	\$2,188,162	47
Apparel	\$17,941,429	\$9,123,291	\$4,934,664	162
Paper & Allied Products	\$99,323,095	\$37,836,031	\$21,263,922	239
Printing & Publishing	\$245,836,916	\$147,140,679	\$85,373,941	1,233
Chemicals & Petroleum Refining	\$4,663,698,291	\$1,178,348,180	\$562,545,936	1,376
Rubber & Leather Products	\$282,098,305	\$125,452,767	\$81,685,537	955
Lumber Products & Furniture	\$165,222,113	\$60,906,330	\$46,760,190	849
Stone, Clay, & Glass Products	(\$59,501,704)	(\$31,305,432)	(\$18,295,151)	-295
Primary Metal	\$10,997,139	\$3,332,298	\$2,783,341	22
Fabricated Metal Products	\$324,395,302	\$155,061,434	\$102,265,385	1,652
Machinery, Except Electrical	\$1,998,293,394	\$715,557,523	\$569,337,838	3,415
Electric & Electronic Equipment	\$1,081,239,061	\$606,334,985	\$446,931,789	1,945
Motor Vehicles & Equipment	\$262,429,626	\$87,027,428	\$51,136,237	923
Transp. Equip., Exc. Motor Vehicles	\$1,221,494,867	\$638,385,543	\$410,563,162	6,265
Instruments & Related Products	\$113,757,520	\$35,877,185	\$32,787,387	261
Miscellaneous Manufacturing	\$125,563,728	\$35,138,190	\$41,352,232	259
Transportation	\$429,382,284	\$273,369,178	\$183,735,162	2,723
Communication	\$720,325,918	\$512,207,333	\$232,350,648	2,303
Electric, Gas, Water, Sanitary Services	\$2,209,037,545	\$462,303,496	\$214,578,275	874
Wholesale Trade	\$2,049,580,120	\$1,629,242,478	\$955,553,148	11,138
Retail Trade	\$1,705,477,756	\$1,502,806,748	\$906,792,350	25,406
Finance	\$1,088,000,564	\$553,702,109	\$391,561,825	2,620
Insurance	\$277,546,847	\$167,954,726	\$97,381,894	1,236
Real Estate	\$3,187,248,300	\$1,099,493,388	\$179,513,719	1,955
Hotels, Lodging Places, Amusements	\$508,166,159	\$262,681,524	\$178,989,719	4,480
Personal Services	\$205,712,981	\$142,265,648	\$110,412,173	1,779
Business Services	\$2,165,555,672	\$1,617,418,077	\$1,422,362,343	18,017
Eating & Drinking Places	\$711,070,531	\$464,442,679	\$257,603,541	15,120
Health Services	\$1,443,348,040	\$1,221,188,315	\$1,006,197,686	20,224
Miscellaneous Services	\$854,311,909	\$473,630,775	\$391,455,440	10,884
Households	\$27,041,230	\$27,041,230	\$25,652,861	1,751
<b>Total</b>	<b>\$34,052,000,646</b>	<b>\$17,018,789,496</b>	<b>\$10,962,012,018</b>	<b>166,425</b>

\*Assumes that the full benefits from the elimination of all tariffs on goods between the United States and the European Union are achieved, as well as the elimination of 50% of the various non-tariff barriers that presently impede trade.

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