Can Rural Counties Benefit from High-Speed Rail Investments: A Case Study of the Dallas–Houston Bullet Train Line

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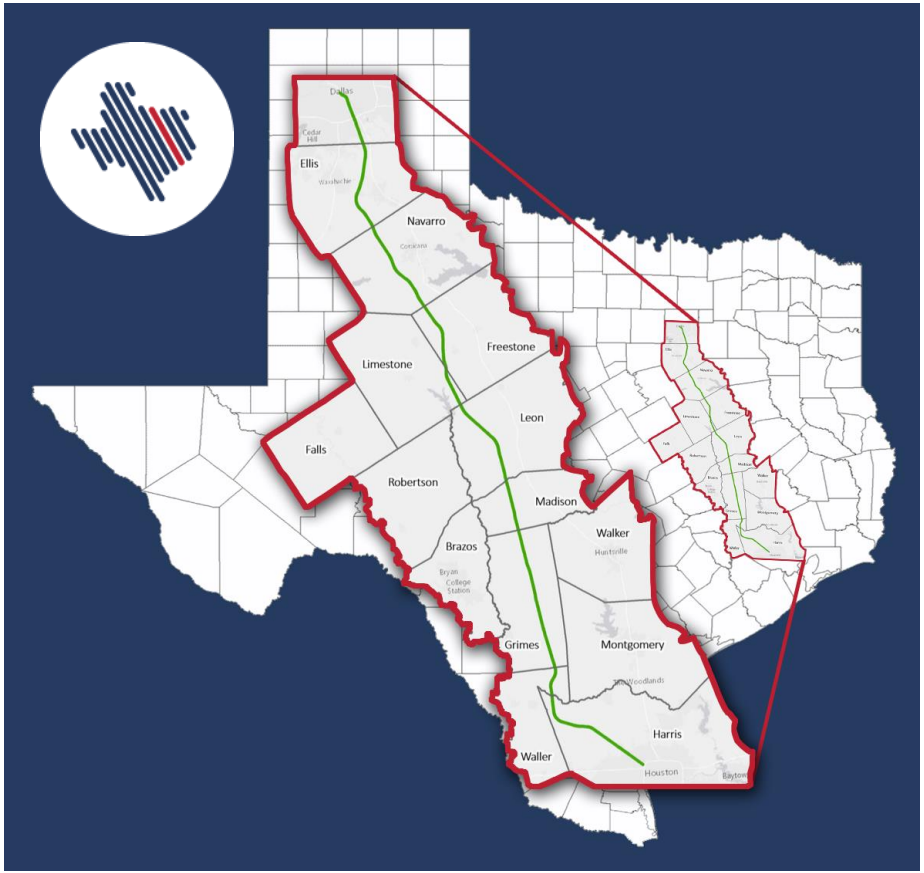
Content

- Introduction
  - Significance of HSR Economic Impacts on Rural Counties
  - DAL-HOU HSR Proposal in Texas Triangle
- Measuring Economic Impacts of HSR
  - Input-Output (IO) Model
  - Multi-Regional Input-Output (MRIO) Model
- Modeling Results
  - Input Scenarios for DAL-HOU HSR in Texas Triangle
  - Results of the three scenarios
- Conclusions and Limitations

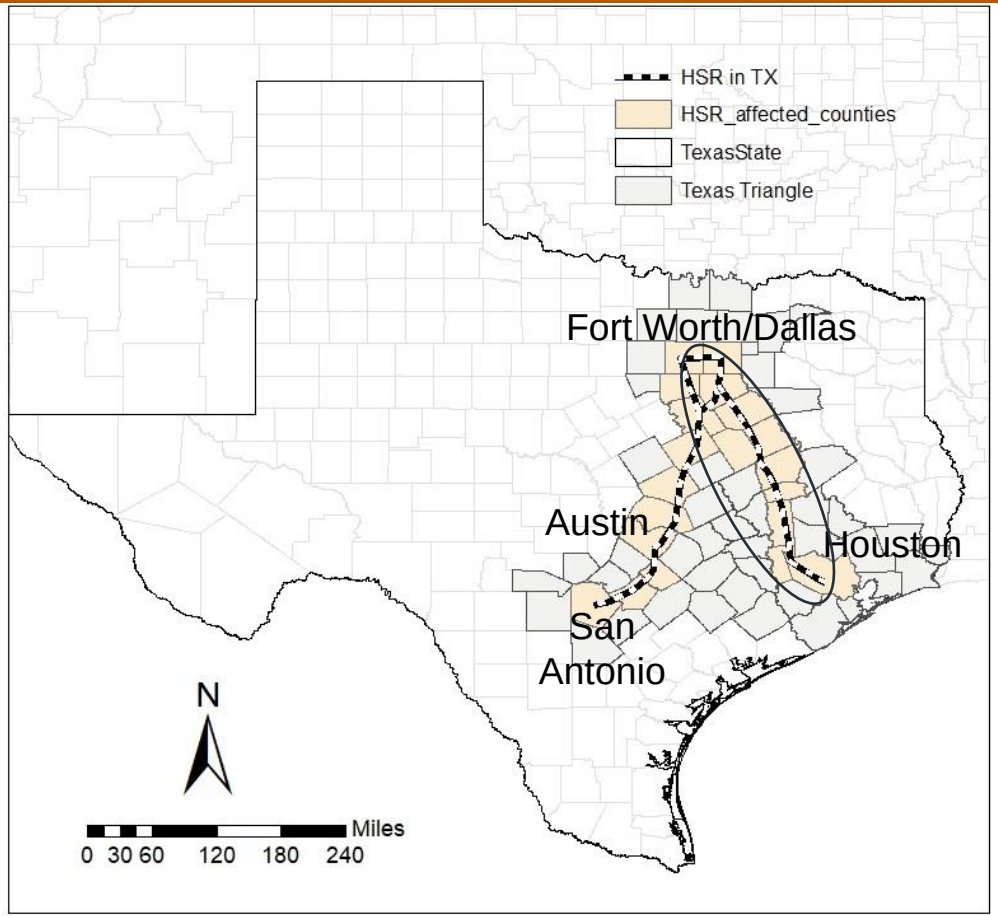
Introduction

- The construction of the HSR in the US is often objected to by rural landowners foreseeing little benefit from traversing traffic.
- This study contributes to the knowledge of the broad impacts of Dallas/Fort Worth – Houston (DAL-HOU) HSR with a focus on the rural counties in the Texas Triangle with a multi-regional input-output (MRIO) model based on the software IMPLAN.



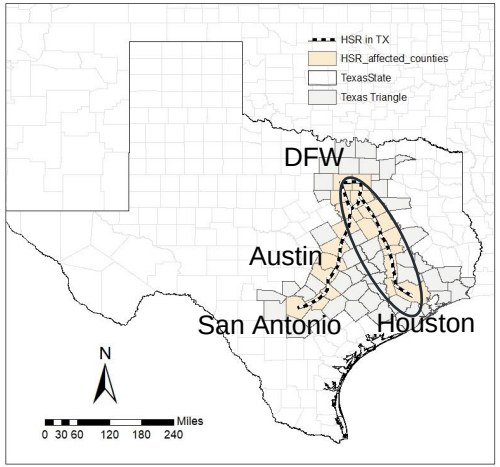
Introduction

- The result will show the direct, indirect and induced effects of the input by county along the HSR line and map out the incidence of value added by sectors in each county.
- With a focus on the rural counties, the study draws implications for both TCR and public agencies to develop strategies aiming at equitable distribution of HSR investments.

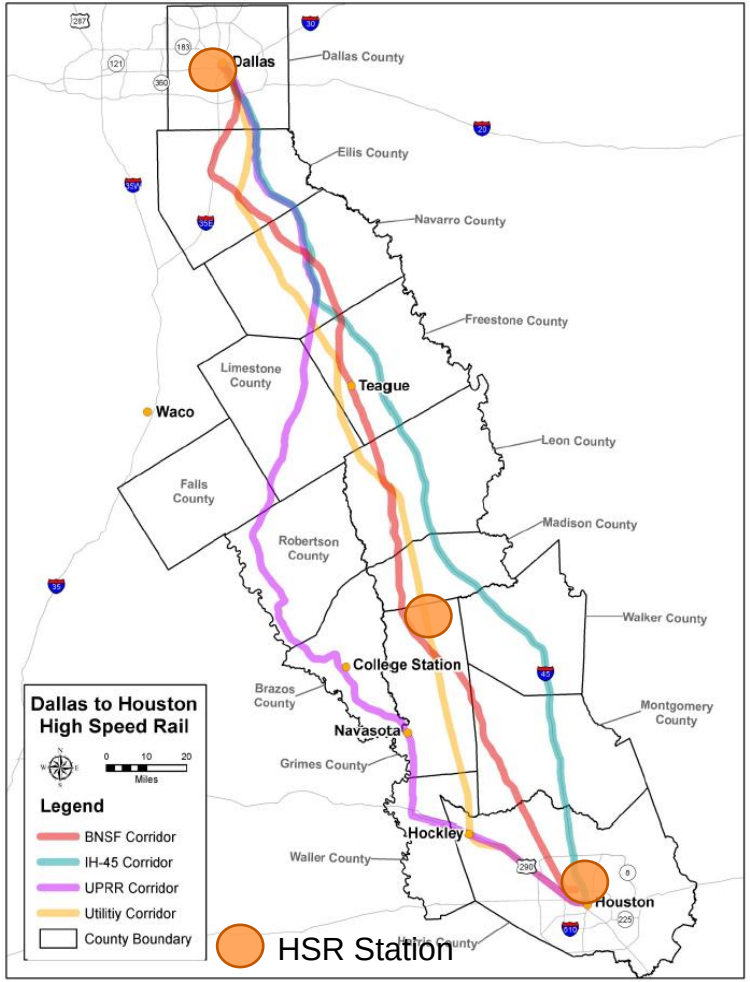


Introduction

- The failure of public investment in HSR results in alternative investment with private money. Texas Central Partners (TC), LLC, a private firm in Texas working on the (DAL-HOU) HSR provides a ray of hope for the feasibility of HSR in the US.



Source: FRA 2017

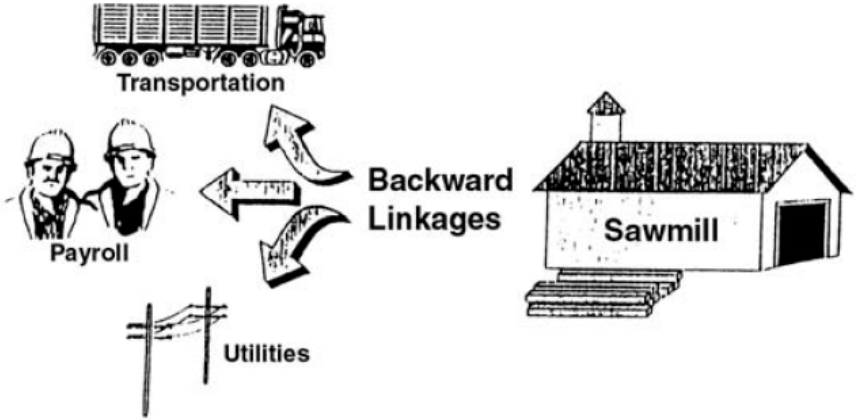


Methodology Selection: Measuring Economic Impacts for HSR

- Cost Benefit Analysis (CBA)
  - Compares the ratio of total cost and expected benefits of a project
  - Advantage: take time value into consideration
  - Disadvantage: lack of regional macroscopic economic impact
- Input-Output (IO) Model
  - Calculates output and value added by intermediate transactions from produce sectors to purchase sectors
  - Advantage: evaluate the regional economic impact
  - Disadvantage: cannot map the regional transaction within the study area
- Multi-Regional Input-Output (MRIO) Model
  - Calculates inter-regional transactions by sectors
  - Advantage: map out regional transactions by sectors

Input-Output Model

- **Direct effect**: those occurring to the firm that exports additional goods or services.
- **Indirect effect**: those occurring to the backward linked industries that supply the exporting firm.
- **Induced effects or consumption effects**: households spending some of the additional income in the local area



$$\text{Type I Multiplier} = \frac{\text{(Direct + Indirect Effects)}}{\text{Direct Effects}}$$

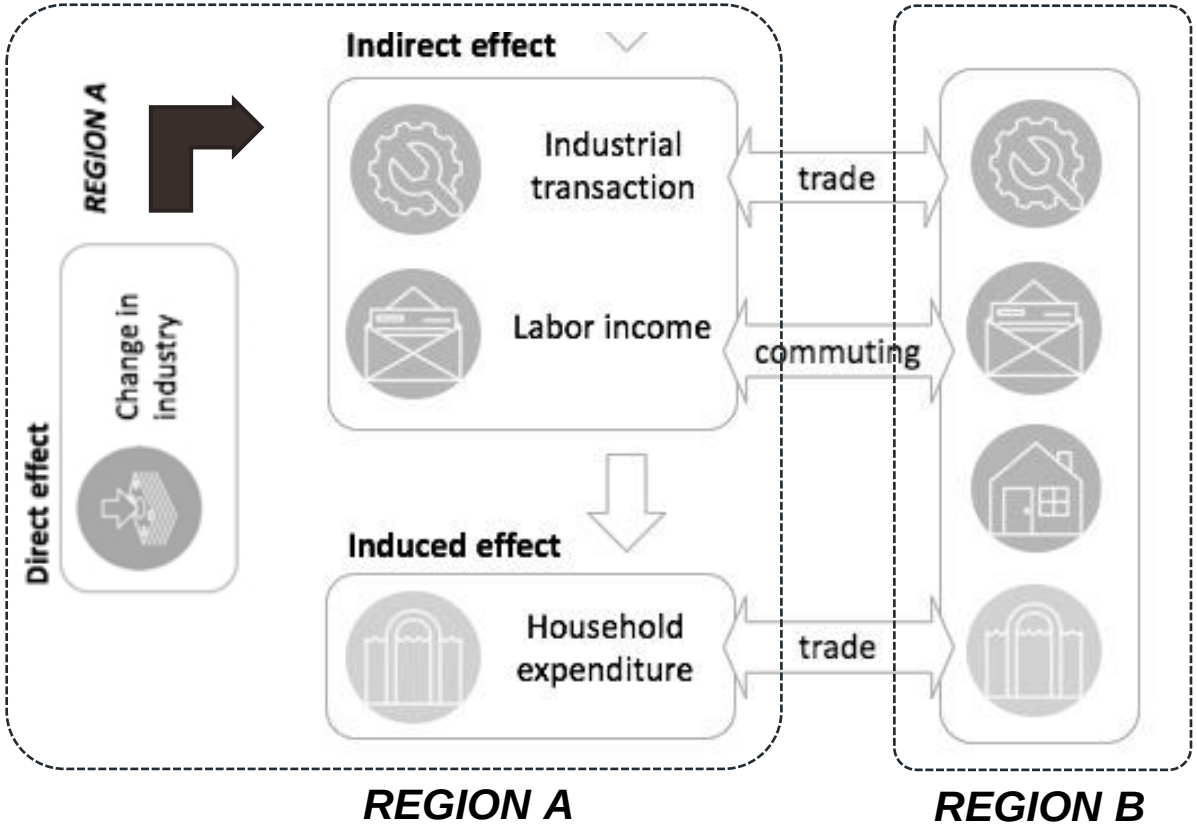
$$\text{Type II, III Multiplier} = \frac{\text{(Direct + Indirect + Induced Effects)}}{\text{Direct Effects}}$$

Input-Output Model

	Developed and Maintained Organizations	Indicators to regionalize national technical coefficients	Additional Packages
IMPLAN (IMpact analysis for PLANing)	Forest Service of the U.S. Department of Agriculture/ Minnesota IMPLAN Group (MIG, Inc)	Regional Purchase Coefficient (RPC) techniques	MRIO (Multi-Regional Input Output) analysis
REMI (Regional Economic Model Inc.)	Regional Economic Model Inc. Amherst, Massachusetts	Regional Purchase Coefficient (RPC) techniques	
RIMS II (Regional Input-output Model Simulation)	Bureau of Economic Analysis (BEA), US Department of Commerce	Location Quotient (LQ)	

Multi-Regional Input-Output Model

- Improve the regional specificity and limit aggregation bias
- Examine the interconnectedness of multiple regions
- Track leakages from a study region and determining the impacts created in other regions



Research design

Scenario #1 objective

Estimate the general value and employment added in Texas state with a longitudinal input

Preconstruction: 1yr
Construction: 5yr
Operation: 20yr
Input unit: state of Texas
Output unit: state of Texas

Scenario #2 objective

Measure the sectoral and spatial differences between metropolitans and rural areas

Preconstruction: 1yr
Construction: 5yr
Operation: 20yr
Input unit: MPOs involved
Output unit: MPOs and the rest of Texas Triangle

Scenario #3 objective

Evaluate the corridor spillover effect with county-level input

Preconstruction: 1yr
Construction: 5yr
Operation: 20yr
Input unit: 11 counties along the rail
Output unit: 11 counties along the rail

Longitudinal input estimation by sectors

		Industry Code in IMPLAN	NAICS code	Expenditure ($million)	Percentage	expenditure by fiscal year ($million)			
						2016-2017 (spent per year)	2018-2019 (spent per year)	2020-2021 (spent per year)	2021-2035 (spent per year)
Pre-construction period (consulting and management)	Environmental impact analysis	455	541620	330	2.20%	165	-	-	-
	Management consulting services	454	541611	600	4%	300	-	-	-
Construction	Right-of-way acquisition	440	531190	3,270	21.80%	-	1,635	-	-
	Manufacture of rolling stock	362	336510	675	4.50%	-	169	169	-
	Construction of stations	58		1,710	11.40%	-	428	428	-
	Construction of railway	54	336510	6,659	44.40%	-	-	3,330	-
Operations	Railway, terminals operation	409	488210	75	0.50%	-	-	-	5
	Maintenance of facilities	62/64	488210	1,680	11.20%	-	-	-	112
Total				15,000	100%	930	4,463	7,852	1,755

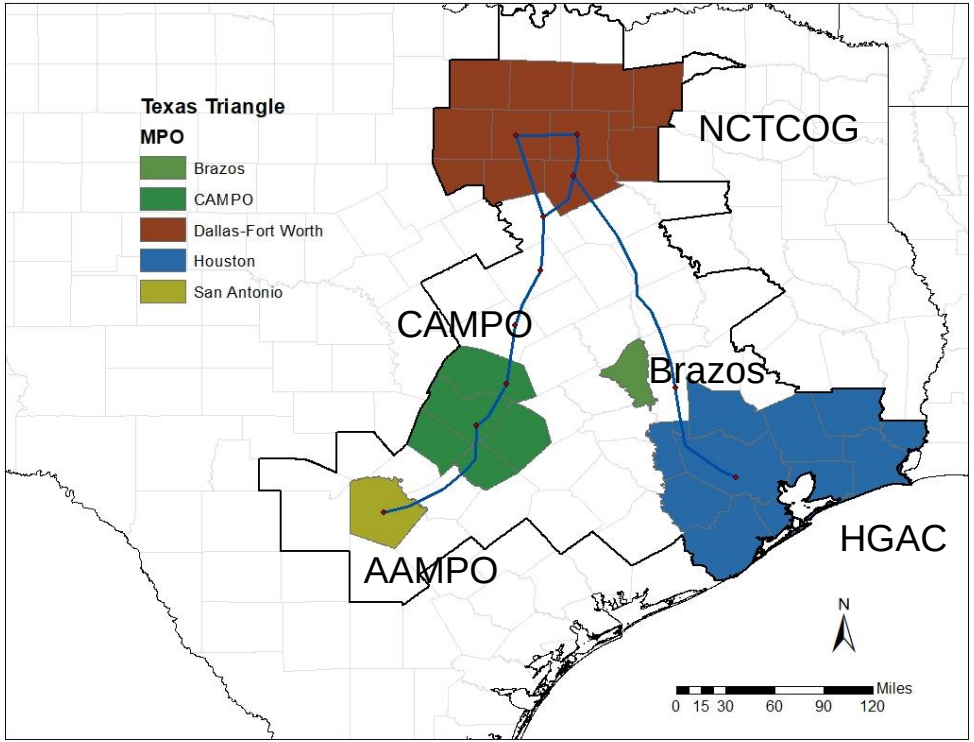
Scenario #1

Total Impact Summary				
Effect Type	Employment	Labor Income ($)	Total Value Added ($)	Output ($)
Direct Effect	82,480	5,369.92	8,007.68	16,339.67
Indirect Effect	41,760	2,940.46	4,756.96	8,839.79
Induced Effect	51,078	2,565.17	4,498.69	7,765.87
Total Effect	175,318	10,875.55	17,263.35	32,945.33

Top-ten Industries affected	
Description	Total Value Added ($)
Construction of new highways and streets	2,937.60
Real estate	2,809.04
Construction of other new non-residential structures	917.95
Maintenance, repair, and construction of highways, streets, bridges, and tunnels	751.30
Management consulting services	501.54
Railroad rolling stock manufacture	487.30
Wholesale trade	852.57
Full-service restaurants	105.26
Employment services	255.84
Environmental and other technical consulting services	257.85

Scenario #2

- In this scenario, the major input are expected to be proportionally distributed in Dallas/Fort Worth metropolitan (NCTCOG) and Houston metropolitan (HGAC) as two terminal stations and the output was measured within 66 counties in Texas Triangle.

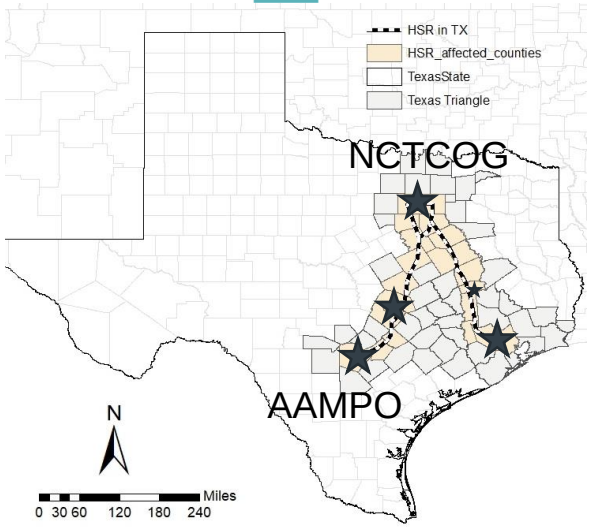


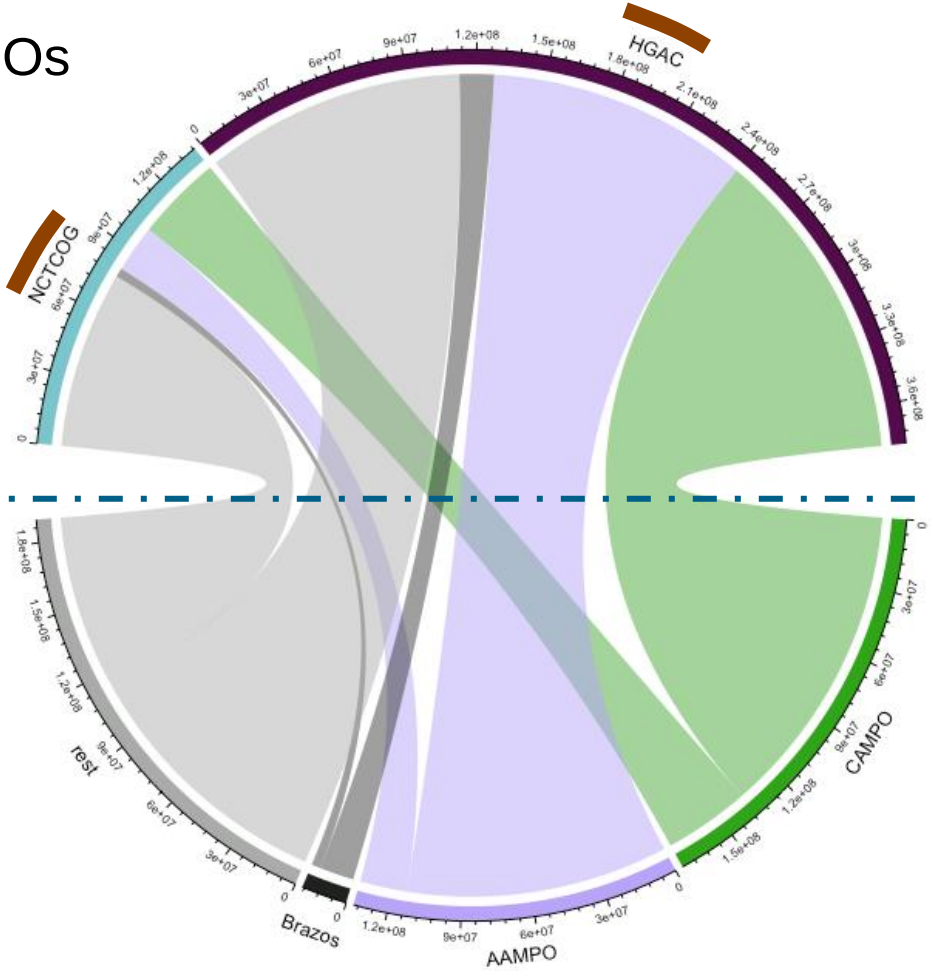
Result table for Scenario #2

Input		NCTCOG	HGAC	Top five indirectly and inductively affected industries (rank by output)				
		7,371.09	6,789.59					
Out-put	NCTCOG	14,101.07	6,391.54	Wholesale trade	Owner-occupied dwellings	Monetary authorities and depository credit intermediation	Employment services	Services to buildings
	HGAC	340.02	15,062.75	Wholesale trade	Owner-occupied dwellings	Petroleum refineries	Extraction of natural gas and crude petroleum	Employment services
	CAMPO	37.36	136.44	Semiconductor and related device manufacturing	Wholesale trade	Lighting fixture manufacturing	Other communications equipment manufacturing	Stone mining and quarrying
	AAMPO	20.48	113.36	Iron and steel mills and ferroalloy manufacturing	Fabricated structural metal manufacturing	Wholesale trade	Plate work manufacturing	Insurance carriers
	Brazos	3.92	14.90	Support activities for oil and gas operations	Iron, steel pipe and tube manufacturing from purchased steel	Commercial and industrial machinery and equipment rental and leasing	Other plastics product manufacturing	Extraction of natural gas and crude petroleum
	Other	76.80	112.61	Petroleum refineries	Fabricated structural metal manufacturing	Railroad rolling stock manufacturing	Stone mining and quarrying	Electric power generation - Fossil fuel
	Total	14,579.66	21,831.59					

Output leakages based on MPOs

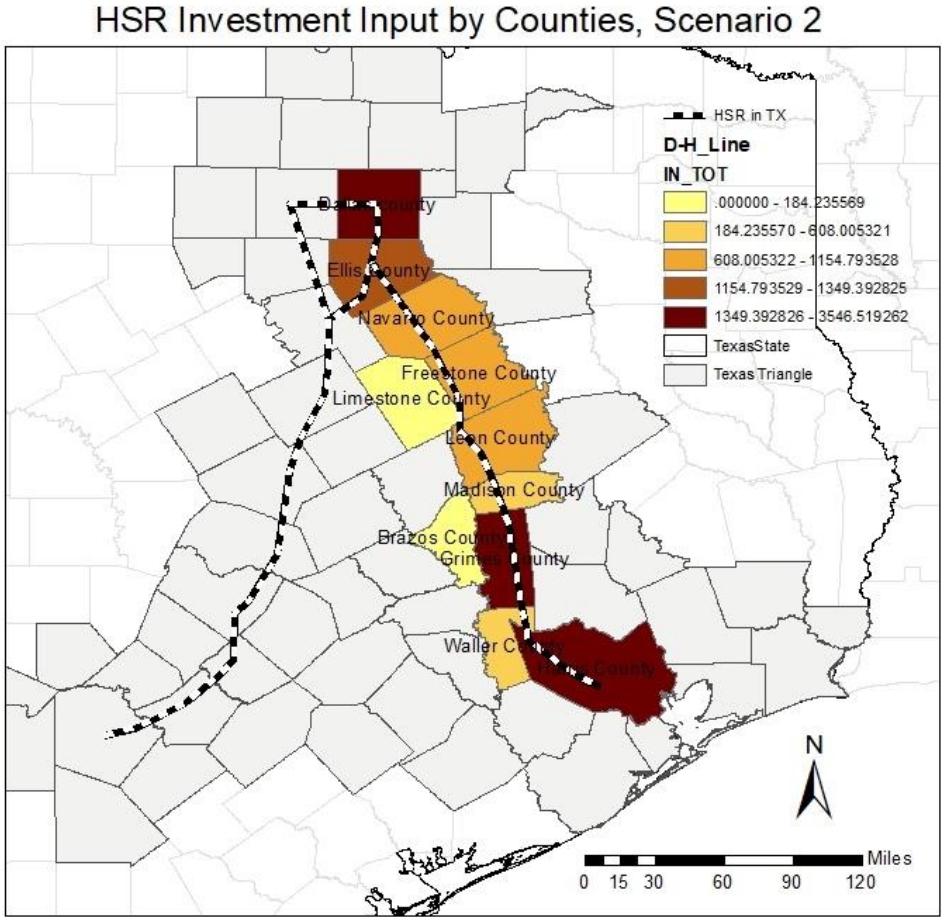
Total ouput received by CAMPO
Total ouput received by AAMPO
Total ouput received by Brazos
Total ouput received by rest counties
Total ouput generated by HGAC
Total Ouput generated by NCTCOG





Scenario #3

- In this scenario, the total investment on right-of-way acquisition and railroad construction are proportionally distributed in ten counties along the way, while the consultant and operation investment are evenly distributed in three anchor counties with stations.



County-level construction input estimation by sectors

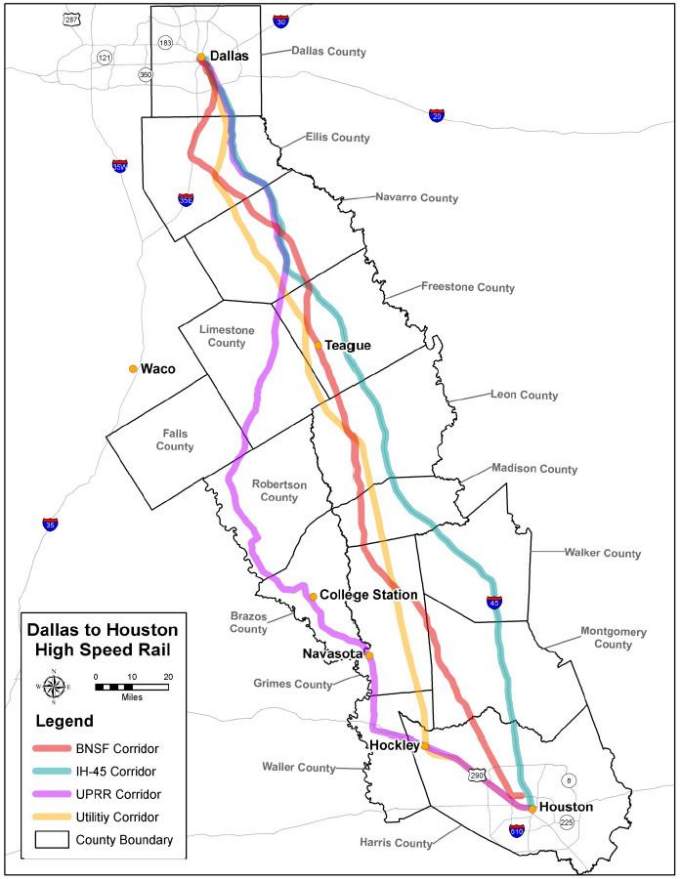
	Length (mile)	Percent	ROW acquisition	Track construction	Station construction	Total
Dallas county	27549	7.0%	230,441	469,339	570,000	1,604,280
Ellis County	53123	13.6%	444,362	905,031	-	1,349,393
Navarro County	45462	11.6%	380,279	774,514	-	1,154,794
Limestone County	7253	1.9%	60,670	123,566	-	184,236
Freestone County	43798	11.2%	366,360	746,165	-	1,112,526
Leon County	43745	11.2%	365,917	745,262	-	1,111,180
Madison County	23936	6.1%	200,219	407,786	-	608,005
Grimes County	67843	17.4%	567,491	1155,808	570,000	2,293,300
Brazos County		0%	0,000	0,000	-	0,000
Waller County	15620	3.996%	130,658	266,110	-	396,768
Harris County	62596	16.012%	523,602	1,066,418	570,000	2,494,519
Total	390925	100%	3,270,000	6,660,000	1,710,000	12,309,000

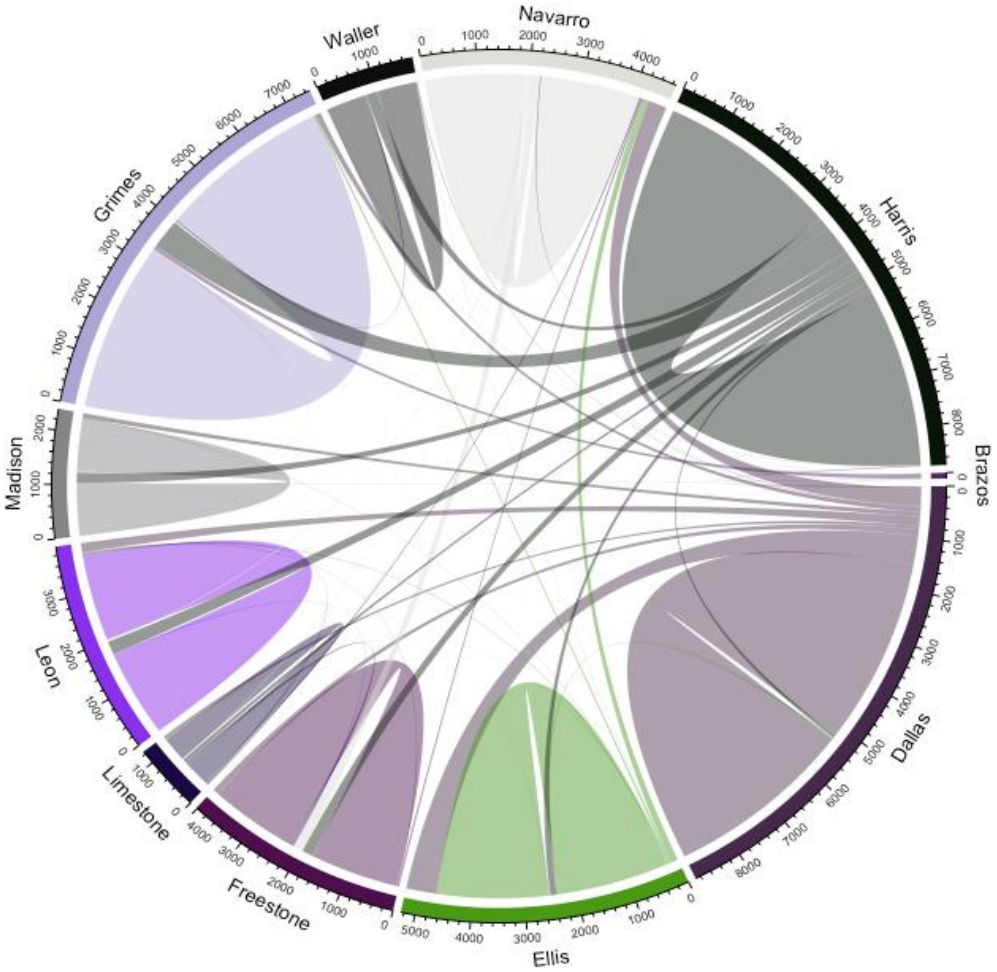
Result table for Scenario #3

High inter-connectivity

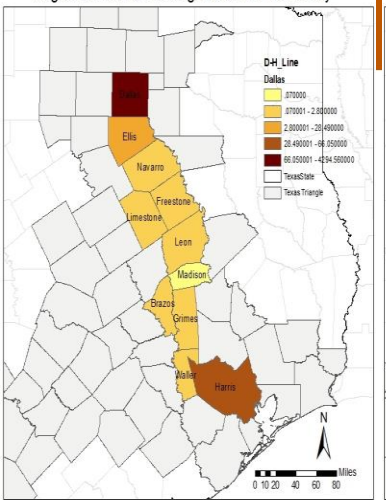
Low inter-connectivity

	Dallas	Ellis	Freestone	Leon	Madison	Grimes	Waller	Navarro	Harris	TOTAL
Dallas	$4294.56	$178.06	$117.46	$138.87	$48.93	$57.90	$1.90	$123.88	$20.91	$4982.47
Ellis	$28.49	$635.90	$4.56	$3.53	$3.60	$8.23	$0.13	$13.51	$2.76	$700.71
Freestone	$0.97	$2.20	$480.09	$10.21	$0.85	$1.06	$0.02	$21.34	$0.14	$516.88
Limestone	$1.09	$0.18	$19.09	$25.31	$0.83	$0.78	$0.01	$2.36	$0.43	$50.08
Leon	$1.51	$0.14	$12.31	$1028.46	$2.30	$2.44	$0.05	$0.43	$0.78	$1048.42
Madison	$0.07	$0.14	$0.78	$3.16	$783.11	$3.95	$0.03	$0.05	$0.07	$791.36
Grimes	$0.91	$18.00	$0.16	$16.28	$16.39	$2231.48	$0.55	$0.03	$1.02	$2284.82
Waller	$1.07	$0.03	$0.08	$0.27	$0.74	$16.49	$172.23	$0.05	$5.75	$196.71
Navarro	$2.8	$2.04	$56.96	$6.35	$1.13	$3.16	$0.03	$574.15	$0.63	$647.25
Harris	$66.05	$7.03	$28.97	$161.65	$118.45	$310.65	$36.48	$18.24	$3983.41	$4730.93
Brazos	$1.04	$0.08	$0.09	$1.43	$6.74	$58.20	$0.47	$0.13	$2.31	$70.49
Total	$4398.56	$843.80	$720.55	$1395.52	$983.07	$2694.34	$211.90	$754.17	$4018.21	$16020.12

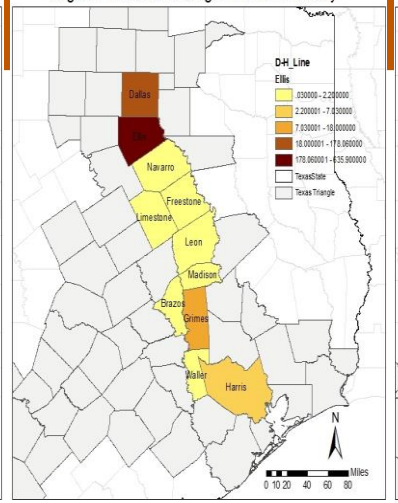

Dallas
Dallas County
Ellis County
Navarro County
Freestone County
Limestone County
Teague
Waco
Leon County
Falls County
Robertson County
Madison County
Walker County
College Station
Brazos County
Navasota
Montgomery County
Grimes County
Hockley
Waller County
Houston
Harris County
Dallas to Houston High Speed Rail
0 10 20
Miles
Legend
BNSF Corridor
IH-45 Corridor
UPRR Corridor
Utilitiy Corridor
County Boundary


Waller
Navarro
Grimes
Harris
Madison
Brazos
Leon
Dallas
Limestone
Freestone
Ellis

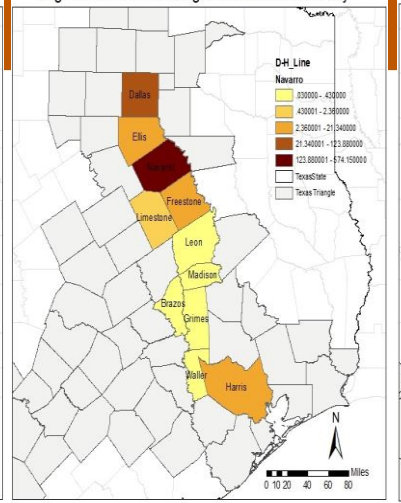
Regional Econmic Leakages from Dallas County



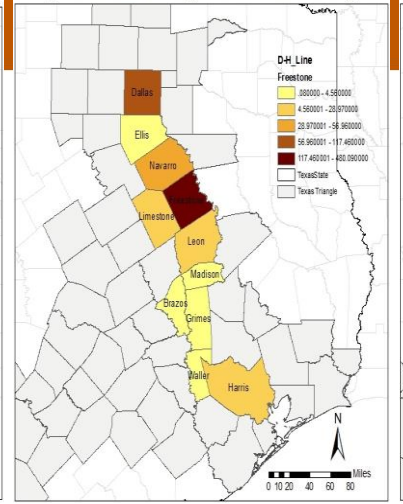
Regional Econmic Leakages from Ellis County



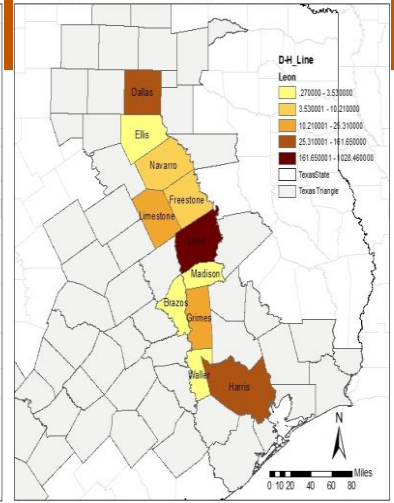
Regional Econmic Leakages from Navarro County



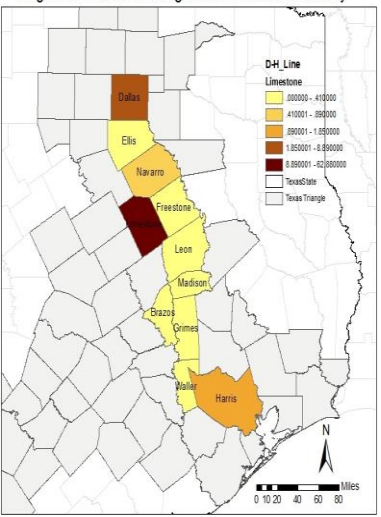
Regional Econmic Leakages from Freestone County



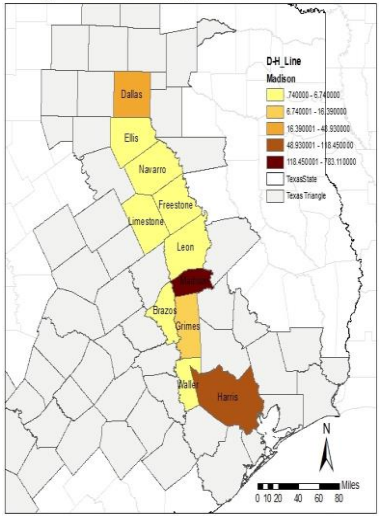
Regional Econmic Leakages from Leon County



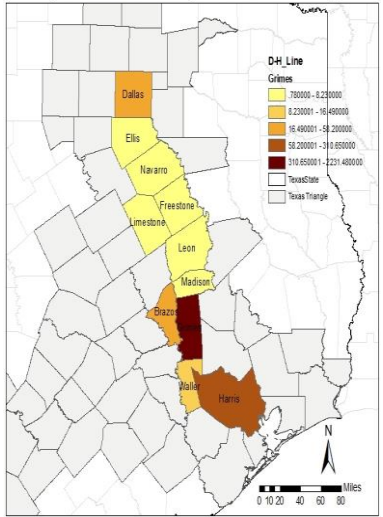
Regional Econmic Leakages from Limestone County



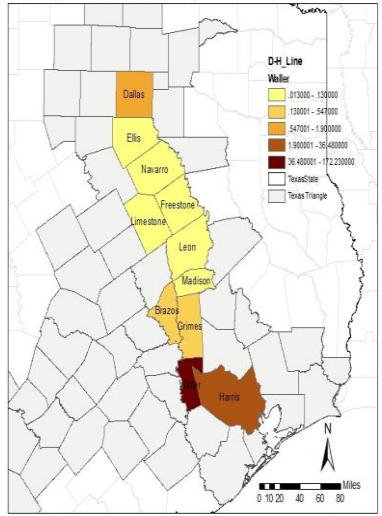
Regional Econmic Leakages from Madison County



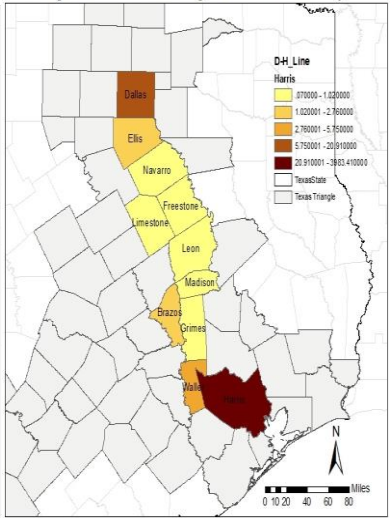
Regional Econmic Leakages from Grimes County



Regional Econmic Leakages from Waller County



Regional Econmic Leakages from Harris County



Conclusion – general output

- Investment in the DAL-HOU HSR will generate around $32.27 billion and 175,000 jobs in the state of Texas. With the majority of investment distributed to two metropolitan areas, the same input will generate $36.43 billion in the Texas Triangle megaregion. More specifically, $24.29 billion in the HSR corridor with input proportionally distributed to counties along the line based on the MRIO model with three scenarios. An anomalous finding that output in the Texas Triangle is greater than in the state of Texas could be caused by the duplicated overturn of input generated in multiple regions within the Texas Triangle.

Conclusion – sectoral spillover

- Intermediate demand is significant in parts of Texas where there is no direct input. First, for example, Ellis and Navarro counties, the suburbs and outskirts of the Dallas metropolitan area, share a large output spillover with the industrial linkages with manufacturing as the most affected sector followed by farming and mining.

- Second, consumption demands, such as wholesale trade, retail, and full-services restaurants in IMPLAN sectors, are also significantly affected as an induced effect of HSR investment. For example, in scenario 2, with significant input in the Dallas and Houston metropolitan areas, retail, full-service restaurants, and employment services all appear in top-ten affected sectors in Austin and San Antonio metropolitan areas.

Limitations

- The Regional Purchase Coefficient (RPC) are based on the existing active sectors in a county, while HSR may generate new activities for non-existing sectors. Thus, no indirect and induced impacts are generated in these counties. E.g., rural counties along D/H HSR lines does not have railway and rolling stock manufacturing for there is no railroad through these counties.

- In terms of private investment, there are some nuances not captured in the model but still worth discussing. The assumption in the model is that all purchases are within the state of Texas as long as the industry exists in the county. However, the reality might be different after price biding. As a private company, TC may purchase major products like locomotives and maglevs overseas, not locally, to minimize the cost for investors. If the HSR line is being built by public agencies, they would be legally obliged to purchase from local, or at least from US suppliers.

Thanks for your attention