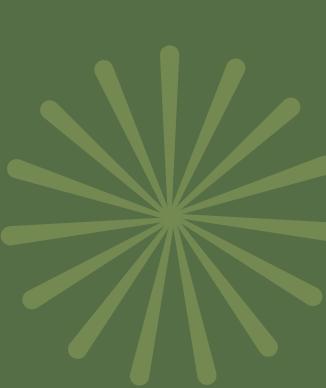


Understanding Drivers of U.S. Agricultural Productivity: A Data-Driven Analysis (1948–2021)

By George-Michael Kondoun





Introduction: Background

Dataset: *national_ag_prod.csv*

- U.S. agricultural productivity has grown despite reductions in labor and land.
- Productivity = efficiency: More output from fewer inputs.
- Total Factor Productivity (TFP) = growth in output minus growth in all inputs.
- Focus: Identify which inputs—Capital, Labor, or Intermediate—drive productivity growth.



HYPOTHESIS:

“Intermediate inputs are more strongly correlated with TFP and Total Output than Capital or Labor inputs.”

Reason: Intermediate inputs have steadily grown and evolved with technology.

Motivation and Research Goal



Why this matters:

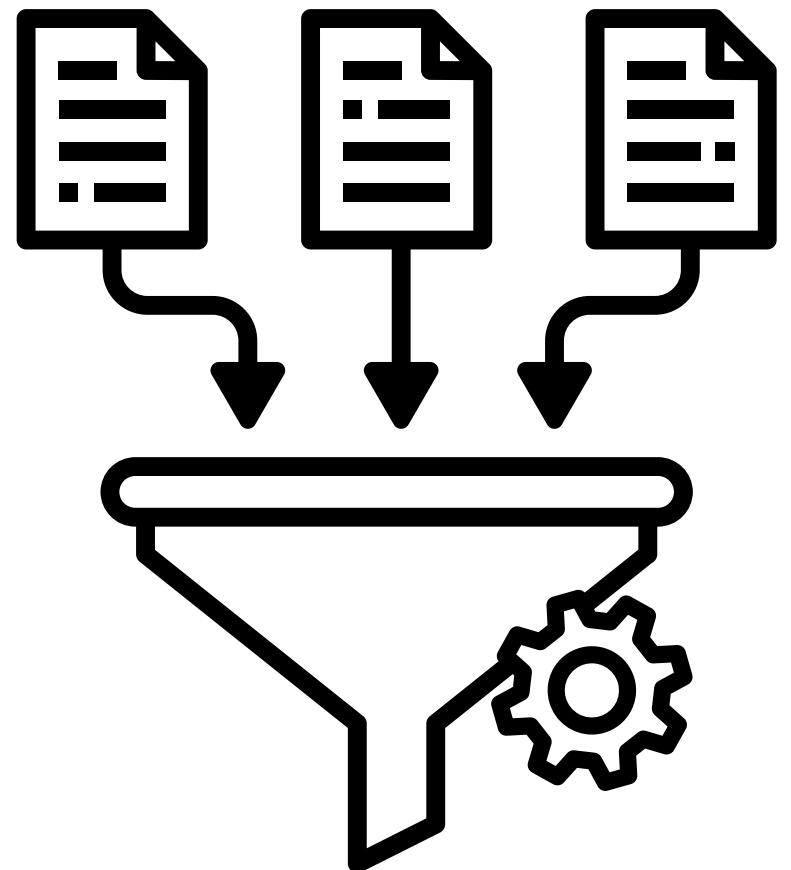
Input allocation influences cost-efficiency, policy, and sustainability.

Goal:

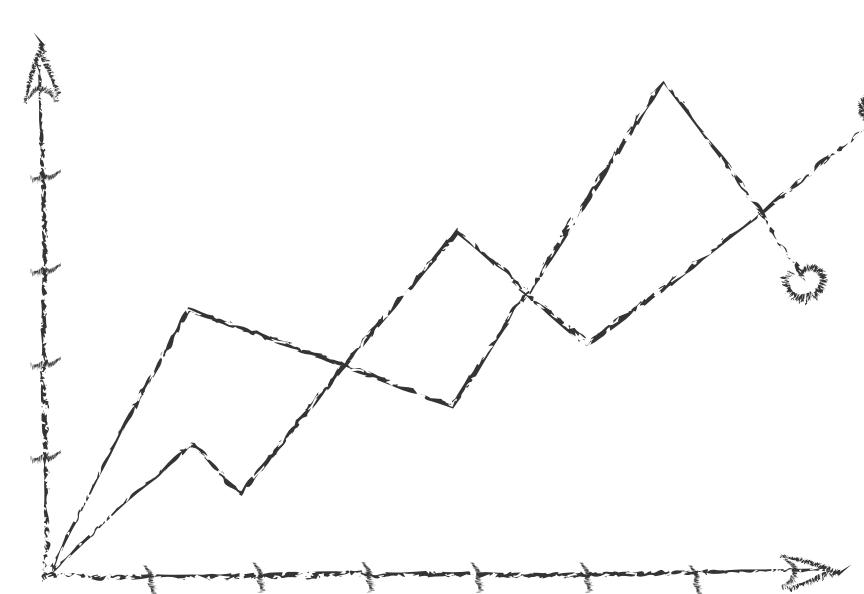
Determine which input category (and subcomponent) has the strongest correlation with:

- Total Agricultural Output
- Total Factor Productivity (TFP)

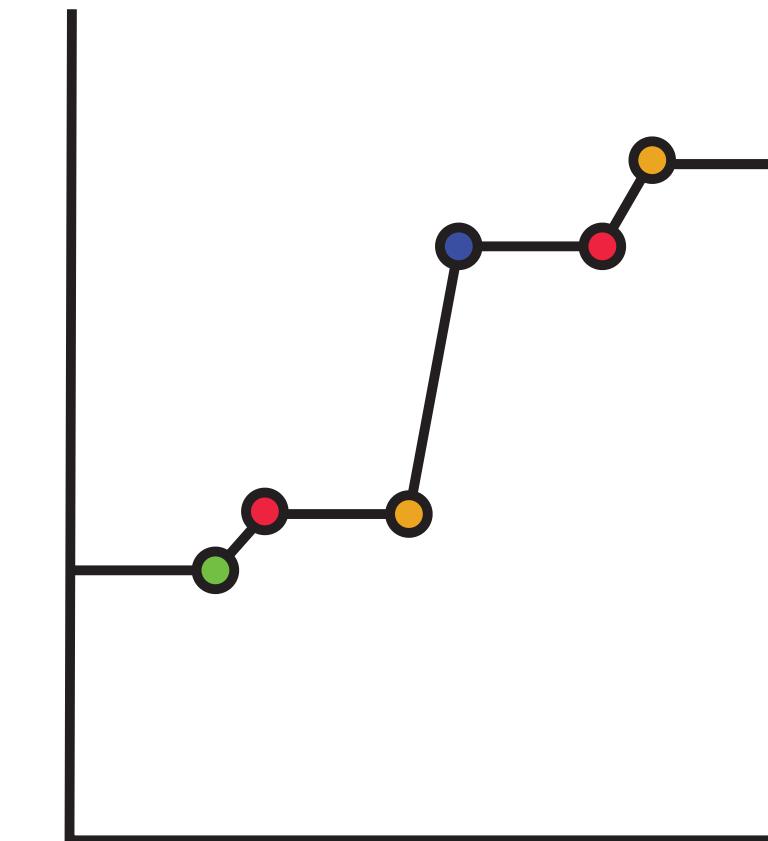
Methodology



Refining Dataset



Pearson correlation for
relationship strength.



CAGR for trends
analysis.

Refining Dataset

national_ag_prod.csv

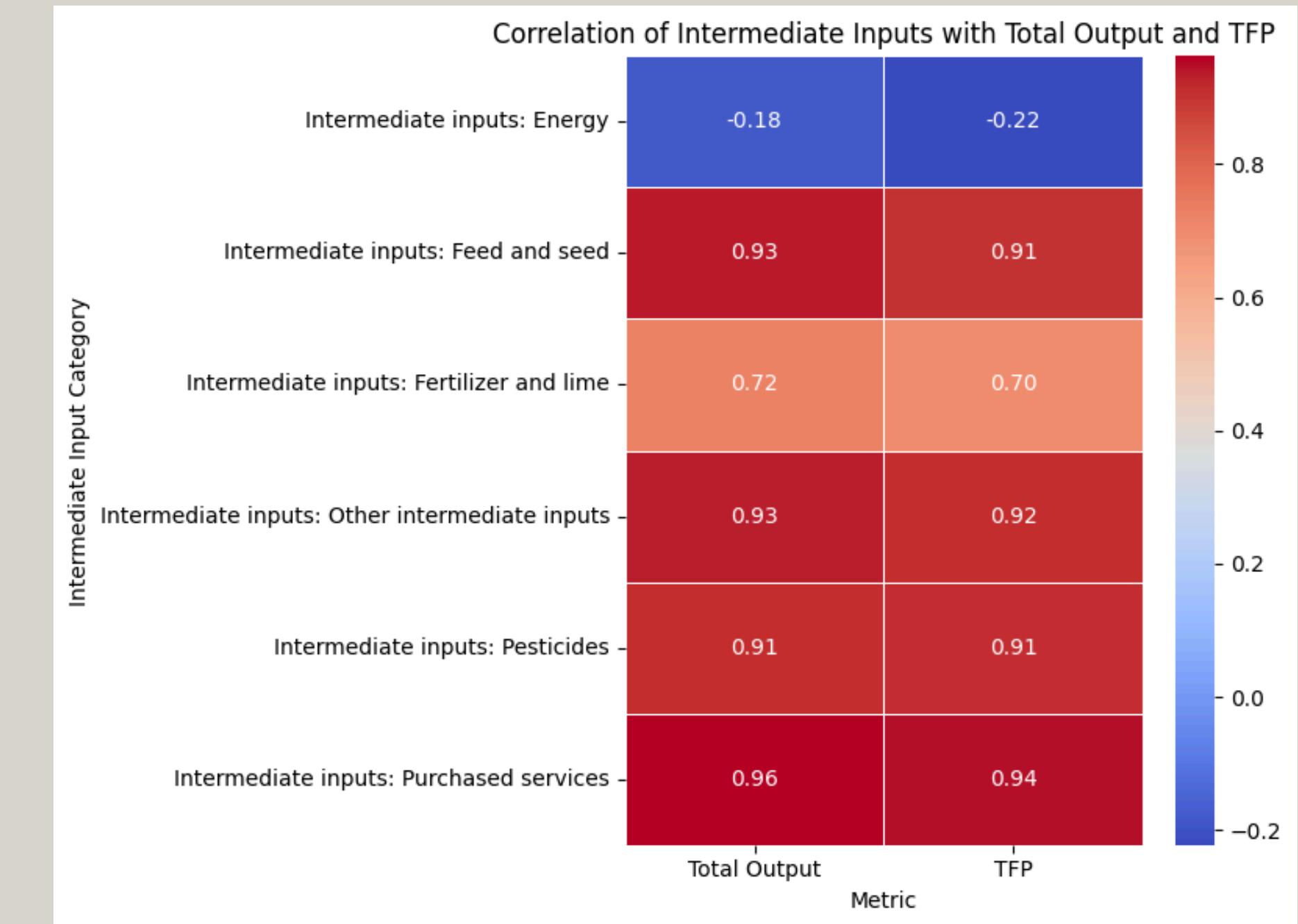
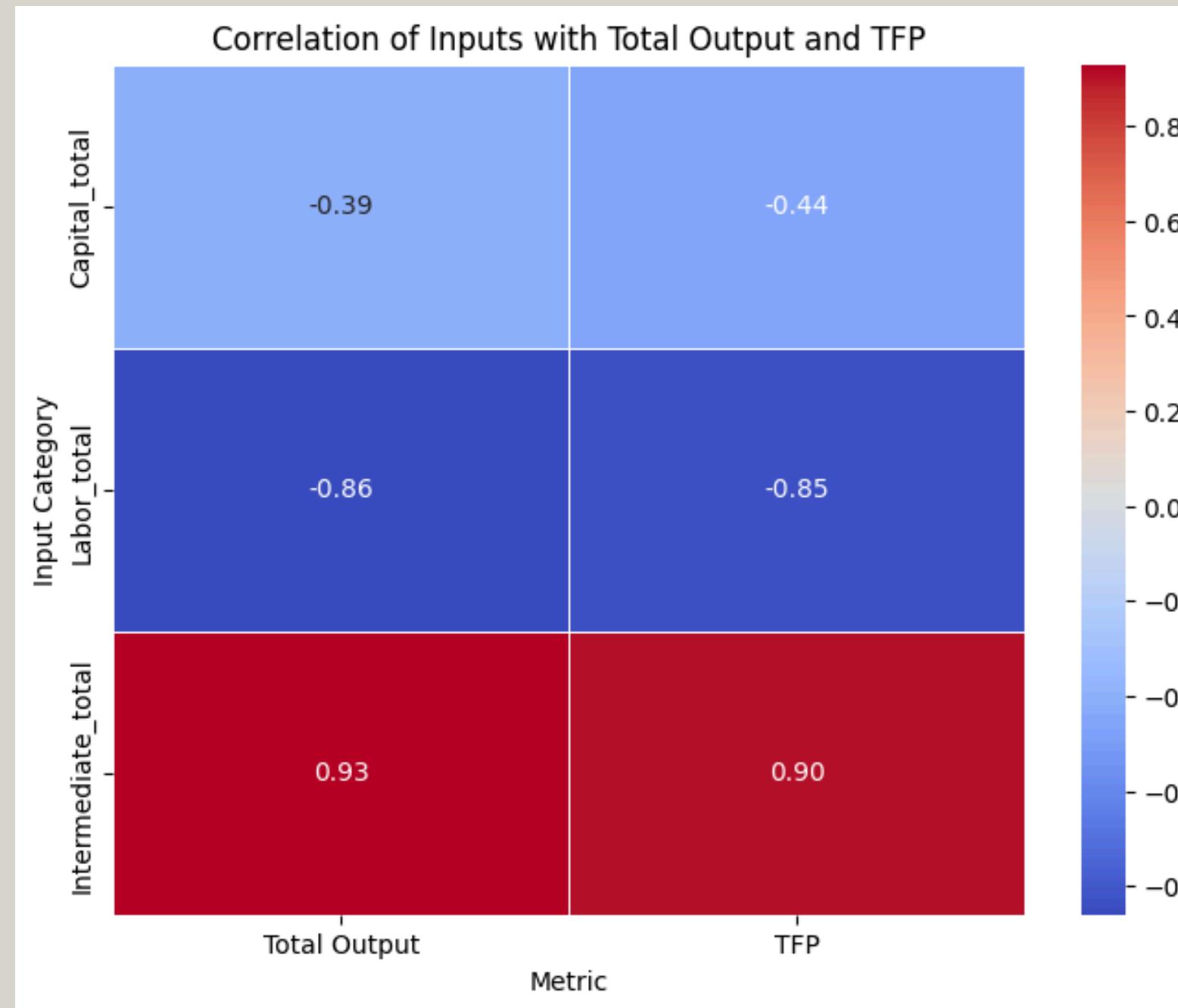
Raw Dataset

		Year	Attribute	Value
	0	1948	Total agricultural output	0.351754
	1	1948	Livestock and products output: Total	0.435704
	2	1948	Livestock and products output: Meat animals	0.562957
	3	1948	Livestock and products output: Dairy	0.449532
	4	1948	Livestock and products output: Poultry and eggs	0.129304
...	
	2215	2021	Intermediate inputs: Fertilizer and lime	0.617971
	2216	2021	Intermediate inputs: Pesticides	1.059324
	2217	2021	Intermediate inputs: Purchased services	0.962515
	2218	2021	Intermediate inputs: Other intermediate inputs	0.872286
	2219	2021	Total factor productivity (TFP)	1.095913

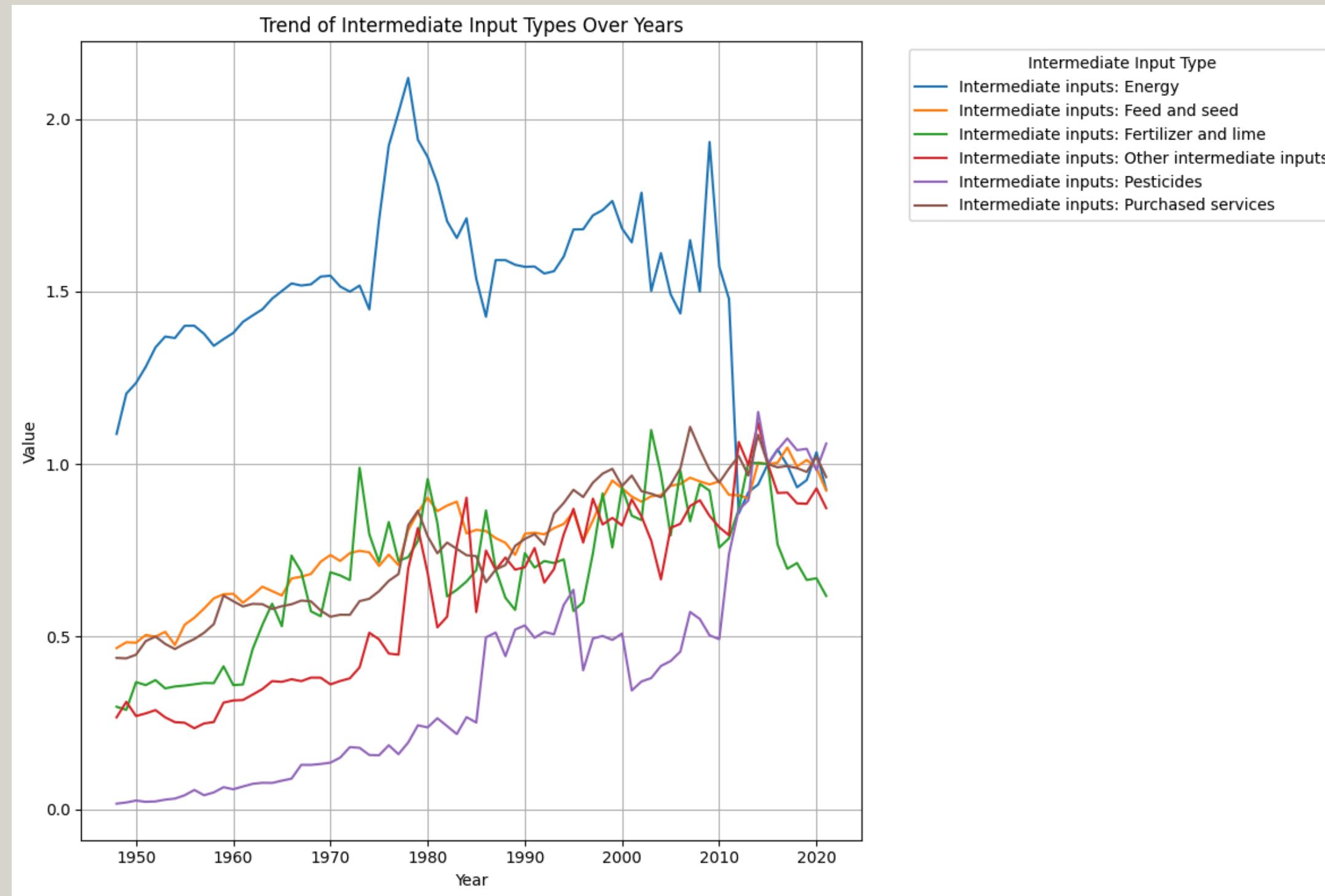
Refined Dataset

Year	Total Output	TFP	Capital_total	Labor_total	Intermediate_to	Capital inputs:	Capital inputs:	Capital inputs:	Capital inputs:	Labor inputs:	Labor inputs:	Intermediate							
0	1948	0.351754	0.370021	4.552634	11.544211	3.003762	0.467549	0.692027	1.370307	0.886676	2.999098	4.570501	1.087467	0.46688	0.296793	0.266192	0.016234	0.438363	
1	1949	0.346347	0.359459	4.757477	11.211547	3.189764	0.55174	0.748731	1.374993	0.925152	2.786415	4.546308	1.203892	0.483664	0.287811	0.311152	0.019592	0.437155	
2	1950	0.337995	0.348898	4.895516	10.873225	3.283744	0.636628	0.738851	1.378231	0.955876	2.904928	4.236456	1.234957	0.482371	0.368172	0.270106	0.025088	0.447737	
3	1951	0.353022	0.35882	5.040546	10.459782	3.408417	0.710513	0.756921	1.37963	0.983986	2.804684	4.066649	1.28179	0.504764	0.359695	0.277572	0.021484	0.487089	
4	1952	0.364475	0.369611	5.184406	10.225426	3.500789	0.772343	0.795399	1.37881	1.009756	2.740418	3.976753	1.338066	0.500052	0.37418	0.287195	0.022599	0.500222	

Correlation Analysis



CAGR for trends analysis.



While "Intermediate inputs: Purchased services" had a positive CAGR of 1.08%, it was not the highest.

Pesticides had the highest CAGR at 5.89%, and Other intermediate inputs followed at 1.64%.

The line plot supports this: Purchased services shows steady growth over time, while Pesticides rises more sharply in later years—resulting in a higher CAGR but weaker correlation.



Conclusion

Growth alone doesn't explain the strong correlation between Purchased Services and both Total Output and TFP.

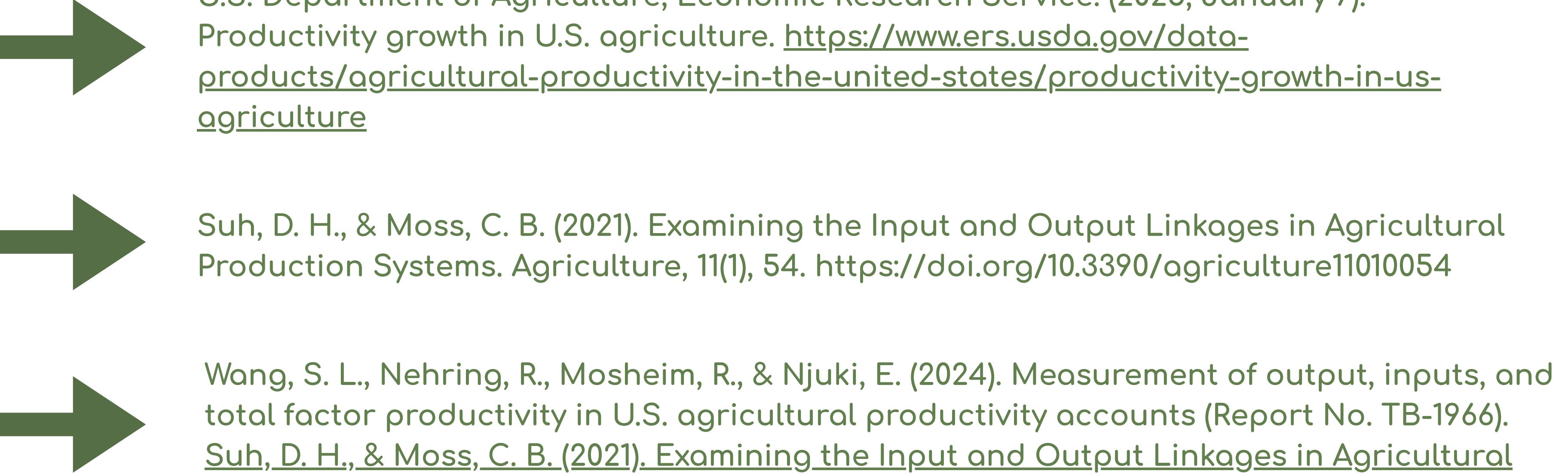
- Their impact is likely due to:
 - Consistent year-to-year use
 - Functional importance in core farm operations (e.g., equipment maintenance, contract labor)
 - Interactions with other inputs, enhancing overall efficiency and productivity

Next Steps

To build on this research, future work could explore:

- Regional or state-level trends for more targeted insights
- Efficiency modeling (e.g., TFP per dollar) for cost-benefit analysis

References

- 
- U.S. Department of Agriculture, Economic Research Service. (2025, January 7). Productivity growth in U.S. agriculture. <https://www.ers.usda.gov/data-products/agricultural-productivity-in-the-united-states/productivity-growth-in-us-agriculture>
- Suh, D. H., & Moss, C. B. (2021). Examining the Input and Output Linkages in Agricultural Production Systems. *Agriculture*, 11(1), 54. <https://doi.org/10.3390/agriculture11010054>
- Wang, S. L., Nehring, R., Mosheim, R., & Njuki, E. (2024). Measurement of output, inputs, and total factor productivity in U.S. agricultural productivity accounts (Report No. TB-1966). [Suh, D. H., & Moss, C. B. \(2021\). Examining the Input and Output Linkages in Agricultural Production Systems. Agriculture, 11\(1\), 54. https://doi.org/10.3390/agriculture11010054](#)



Language: Python

Level: Intermediate

Main data set: Agriculture and Food Security

Specific csv file(s): national_ag_prod.csv

QUESTION: Between the aggregate input and output which had a stronger influence on the TFP overtime?

HYPOTHESIS: Intermediate Input has the strongest influence on TFP?

SOURCES (3): (this is also your homework to post on UpSquad) Use APA style.

Source 1: Kalb, L. G., Stapp, E. K., Ballard, E. D., Holingue, C., Keefer, A., & Riley, A. (2019). Trends in psychiatric emergency department visits among youth and young adults in the US. Pediatrics, 143(4).

Source 2

Source 3