ESTIMATING ELASTICITIES FOR TRADABLE SERVICES IN POLICY SIMULATIONS

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Abstract

We provide new estimates of the Armington elasticities of substitution for several services sectors. Our approach relies on methods that utilize the theoretical relationship between the elasticity and profit margins in a monopolistic competition framework as described in Gervais and Jensen (2019) and Ahmad and Riker (2019). We find that the median elasticity of substitution is 5.65 at the NAICS 3-digit level and 5.42 at the more aggregated GTAP sector level. Finally, we illustrate the importance that these services trade elasticities can have on model outcomes in GTAP by simulating a hypothetical and stylized agreement that liberalizes services trade between the US and the UK.

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1 Introduction

The elasticity of substitution, or the trade elasticity, is often a key parameter in Armington trade models as it captures how consumers shift between domestic and imported varieties of a product after a change in relative prices that may arise as a result of policy actions such as an increase in tariffs. The chosen value for the elasticity of substitution can significantly impact the estimated welfare gains or losses arising from changes in trade policy in CGE simulations (McDaniel and Balistreri, 2003). Given its importance, recent works have made considerable progress in providing analysts and researchers with updated estimates on the elasticities of substitution for traded goods (Fontagné, Guimbard and Orefice, 2022). However, less information is currently available on the elasticities of substitution for the services sectors.

Several factors have made it difficult to pin down empirically-grounded estimates of elasticities of substitution for the services sectors including: common methods used to estimate elasticities of substitution for traded goods requires data inputs that are not available with traded services; trade data for disaggregated services is often absent for most countries; and some services are not traded across borders. From a policy perspective though, the lack of reliable estimates on trade elasticities for services sectors is especially disconcerting as recent trade agreements have focused more on non-tariff measures that affect the ability of firms to trade services across borders.[1]

This paper contributes to the literature by providing new estimates on the elasticities of substitution for several disaggregated U.S. services sectors. Our estimation approach relies on the theoretical relationship that exists between the elasticity and profit margins in a monopolistic competition model of trade as illustrated in Gervais and Jensen (2019)

[1]For example, the U.S. and partners have started negotiations on the Indo-Pacific Economic Framework for Prosperity (IPEF) which includes a range of non-tariff measures such as cross-border data flows and data localization standards, clean energy standards, and anti-money laundering and anti-bribery standards.

and Ahmad and Riker (2019). First, we estimate elasticities at the NAICS 3-digit level using industry output and gross operating surplus data from the U.S. Bureau of Economic Analysis (BEA). We then concord the 3-digit NAICS codes to GTAP sectors and re-estimate services elasticities at the GTAP sector level. The median elasticity of substitution is 5.65 at the NAICS 3-digit level and 5.42 at the more aggregated GTAP sector level. For the core tradable services sectors that are often targeted in FTAs, the mean elasticity is 5.01, similar to other average services estimates in the literature. Finally, to illustrate the impact that the services elasticities can have on model outcomes, we simulate the implementation of a hypothetical and stylized US-UK agreement that liberalizes services trade using the GTAP modeling framework.

2 Literature Review

Only a small number of studies have directly estimated trade elasticities for services sectors. Most of these studies rely on the monopolistic competition model of trade which postulates that a firm's revenues and profits are linked with the elasticity of substitution in its sector. Section 3 provides a brief overview of this mark-up approach for estimating trade elasticities.

Using the mark-up approach on firm-level data from Statistics Finland and the UK Office of National Statistics, Rouzet et al. (2017) calculate their elasticities as the median ratio of sales to operating profits among all firms in a given sector. The median estimate from Rouzet et al. (2017) is 2.30, ranging from 1.6 (banking) to 5.4 (distribution services). They note that the estimates are lower than what is usually found for estimates of σ for goods sectors, likely because of the higher aggregation level and the lower substitutability of services compared to goods.

Christen et al. (2019) use Austrian firm-level financial data from the Bureau van Dijk

AMADEUS database. Compared to the other studies, they have the most number of disaggregated services sector after our paper and Gervais and Jensen (2019). The median estimate for these sectors is 3.55 and estimates range from 1.33 (real estate activities) to 4.36 (computer and IT).

Blank et al. (2022) rely on the Deutsche Bundesbank for balance sheet information to estimate the elasticity of substitution with the mark-up method. Rather than taking the median ratio across all firms as their estimate, as in Rouzet et al. (2017), Blank et al. (2022) instead add up all firms' sales and divide it by the sum of operating profits in each services sector. This matches the approach taken in this paper since we are restricted to industry-level data from the BEA. The median services elasticity in Blank et al. (2022) is 4.86, ranging from 3.27 (other services, including financial services and insurance) to 6.00 (construction).

Gervais and Jensen (2019) rely on the mark-up method to estimate elasticities with U.S. data for both manufacturing and services sectors. Utilizing data from the U.S. Bureau of Economic Analysis, they estimate the trade elasticities with industry data on profit margins for firms operating in the United States. They find that the elasticity for manufacturing industries using this approach is in line with other estimates provided in the literature. For services scectors, they report a median elasticity estimate of 5.98, with a much larger range seen in services sectors than found in manufacturing sectors. Our paper extends their work by using more recent BEA data (2013-2022) for our estimates and by concording the NAICS data to GTAP sectors to get the trade elasticity estimates for our GTAP simulations.

In contrast to these above studies, Nakano and Nishimura (2024) estimate their elasticities for services sectors using variation in exchange rates rather than firm-level markups. Nakano and Nishimura (2024) estimates are among the lowest in the studies compared, centering around 1, with some sectors' elasticities less than one.

3 Methodology and Data

Following Gervais and Jensen (2019) and Ahmad and Riker (2019), our estimates of the elasticity of substitution for the services sectors are based on the relationship that exist between the elasticity of substitution and profit margins in a monopolistic competition model of trade. In the model, consumers are assumed to have constant elasticity of substitution (CES) preferences with an elasticity parameter σ_s that describes the level of substitutability, or tradability, across the different varieties of the service offered by firms (domestic and foreign) in a given sector.[2] Services industries s are segmented and behave under a monopolistic competition framework where there are a continuum of homogeneous firms, each producing a unique variety of the service provided. Each firm has a constant marginal cost and sell their service at a marked up price above their marginal cost. Given these assumptions, it is easy to show that each firm's profits π_i will be determined by the following rule:

$$\pi_i = \left(\frac{R_i}{\sigma_s}\right) - F_i \tag{1}$$

where R_i are the revenues generated by the firm and F_i are the firm's fixed costs. Rearranging terms and aggregating by all firms in a sector, the elasticity of substitution is given as:

$$\sigma_s = \frac{Revenues_s}{Gross\_Operating\_Profits_s} \tag{2}$$

Here we define $Gross\_Operating\_Profits_s$ in sector s as $\pi_s + F_s$. Following Gervais and Jensen (2019), we estimate the elasticity of substitution for each services industry using data on industry output and gross operating surplus from the Bureau of Economic Analysis (BEA) input-output tables.[3] This data is organized at the NAICS 3-digit level and includes

[2]The elasticity of substitution parameter should be a positive number greater than one in a model with CES demand.

[3]The BEA data series used was "Composition of Gross Output by Industry".

roughly 40 services sectors.

We use annual industry data from the BEA for the time period 2003-2022. Due to data constraints, we will focus on industry-level data from the BEA rather than firm-level data to estimate trade elasticities for the U.S. services sectors. An advantage of the industry-level data is that it allows us to estimate trade elasticities at the NAICS 3-digit level, resulting in much more disaggregate estimates than what is commonly found in the literature. These NAICS sectors can also be concorded to the GTAP sectors, enabling us to directly estimate the services trade elasticities for our policy simulation in Section 5.

For each services NAICS sector, the elasticities of substitution were calculated by dividing its industry output with its gross operating surplus on an annual basis. Our preferred measure of the elasticity for a NAICS sector was the median of the yearly estimates over the ten year periods (2003 to 2012 and 2013 to 2022).[4]

A similar approach was taken to estimate the elasticities by GTAP sector once a concordance between the services NAICS codes and GTAP codes had been established.[5] A custom concordance was constructed by first assigning GTAP codes to ISIC codes using the GTAP-ISIC concordance from the GTAP website.[6] Then, ISIC codes were concorded to NAICS 6-digit codes using a custom ISIC-NAICS concordance. Finally, the 6-digit NAICS codes were aggregated up to the 3-digit level and GTAP elasticities estimated.[7]

[4]A median was chosen to not be overly affected by outlier observations, as was the case during the height of the COVID-19 pandemic.

[5]See appendix table 11 for NAICS-GTAP services concordance.

[6]The GTAP-ISIC concordance can be found here: `https://www.gtap.agecon.purdue.edu/databases/contribute/concordinfo.asp`

[7]Using this method, there are some instances where a 6-digit NAICS component must be reallocated to a different 3-digit NAICS category. For example, NAICS 525 (Funds, Trusts and Other Financial Vehicles) is concorded to GTAP sector OFI (Other Financial Intermediation). However, a component of NAICS 525, NAICS 525110 (Pension Funds), should be reallocated to GTAP sector INS (Insurance). In the elasticity estimates provided in this paper, 6-digit NAICS components were not reallocated to different 3-digit NAICS groupings; the 3-digit NAICS code was mapped to the GTAP sector for which a majority of the 6-digit components were mapped. In future versions of this paper, the 6-digit NAICS components will be reallocated.

4 Elasticity Estimates

Table 1 summarizes estimates by broad 2-digit NAICS grouping and illustrates that there is significant heterogeneity by sector. Most of the individual estimates in Table 1 are comparable to what was reported in Gervais and Jensen (2019). We find that the core services sectors that are commonly targeted in FTAs such as wholesale and retail trade, information, finance and insurance, and professional services, have estimates in the middle of the distribution. We note that real estate has the lowest estimated elasticity of 1.98, indicating that foreign firms face significant barriers to entry in this sector. At the other end, services that are traded through the movement of people across borders such as education and health care have higher elasticity estimates of 13.78.[8] Lastly, the elasticities of substitution at the more disaggregated NAICS 3-digit sector level are reported in appendix tables 9. Again, we find considerable heterogeneity across sectors with the median elasticity of substitution at the 3-digit NAICS level estimated at 5.65 and a standard deviation of 5.60. Given the diversity and size of the U.S. service sectors, this is not a surprising result.

A feature of the BEA data is that we can compare the elasticity estimates over the most recent 10 years, with elasticity estimates from the 10 year period prior. To facilitate these comparisons and examine if services tradability has changed over time, Table 9 provides elasticity estimates using data from the latest ten years (2013–2022) with the prior ten years (2003-2012). The industries with the largest decreases in trade elasticity estimates are air transportation (NAICS 481), nursing and residential care facilities (NAICS 623) and general merchandise stores (NAICS 452). Industries with the largest increases in elasticity estimates are warehousing and storage (NAICS 493), social assistance (NAICS 624), and securities, commodity contracts, and investments (NAICS 523). However, for most sectors, the elasticities appear to be relatively stable over time.

[8]Since these sectors are also not typically targeted by FTA provisions, we will be excluding them from the GTAP simulations in Section 5.

Table 1: Summary of Elasticity Estimates by NAICS Group

NAICS	Description	Mean σ	Median σ	Std. Dev.
23	Construction	5.42	5.42	-
42	Wholesale trade	4.79	4.79	-
44-45	Retail trade	7.49	6.00	3.85
48-49	Transportation	6.50	5.22	5.08
51	Information	3.04	3.06	0.21
52	Finance and insurance	8.27	5.45	7.72
53	Real estate and leasing	1.98	1.98	0.42
54	Professional services	5.08	5.08	-
55	Management of companies	15.87	15.87	-
56	Administrative services	6.61	6.88	0.74
61-62	Education and health care	13.78	10.71	7.90
71-72	Recreation and food service	6.31	6.29	2.83
81	Other personal services	7.11	7.11	-

Note: The summary statistics reported in this table are calculated across all three-digit NAICS codes within each NAICS group. The mean σ is the mean elasticity estimate across the three-digit NAICS codes within the group. For NAICS groups with only one three-digit code, there is no standard deviation.

Estimated elasticities for GTAP services sectors are shown in table 10, and we continue to find significant heterogeneity across the different GTAP sectors. The median elasticity of substitution at the GTAP sector level is 5.42 and the standard deviation is 3.84. Note that in the standard GTAP model, the elasticity of substitution are assumed to be 3.8 for all services sectors. However, as seen in 10, the estimated elasticities for services sectors can vary considerably from the default GTAP values when estimated. In the next section, the impact of the new services trade elasticities on model outcomes is illustrated by simulating the implementation of a hypothetical and stylized US-UK free trade agreement using the GTAP model.

Table 2 compares our elasticity estimates at the NAICS 3-digit level and GTAP sector level with the studies described in section 2. We see that our median estimates are of a similar magnitude to the estimates found in Gervais and Jensen (2019) and Blank et al.

(2022). Other studies such as Rouzet et al. (2017) and Nakano and Nishimura (2024), however, have smaller median estimates. The more disaggregated services in our sample (40 NAICS sectors) as well as estimating it at the industry level, rather than at the firm level, could have contributed to our estimates being slightly higher than these studies.

5 US-UK Services FTA Simulation

Modern trade agreements have increasingly focused on non-tariff measures that affect the ability of firms to trade services across borders, making it even more important to have precise estimates of services elasticities when running policy simulations to determine the overall effects of an agreement. This section illustrates the importance of the elasticity of substitution of services sectors in GTAP by simulating a hypothetical services FTA between the United States and United Kingdom. Using GTAP Model 7 and GTAP database version 11 (2017), the policy experiment assumes a reduction in trade barriers in services sectors between the U.S. and the UK as a result of the trade agreement. The simulation is run twice, once with the default GTAP elasticities in place and again with the new markup-method elasticity estimates, and outcomes are compared across simulations.

Table 3 lists the reduction in trade barriers, as ad valorem equivalent (AVE), for the core GTAP services sectors as a result of a U.S.-UK agreement on services trade liberalization.[9] The AVEs are based on estimates from a structural gravity model used in the U.S. International Trade Commission's 2021 report on the Economic Impact of Trade Agreements Implemented under Trade Authorities Procedures (U.S. International Trade Commission, 2021). The estimates from the gravity model in that study were designed to capture the incremental impact of a trade agreement with services provisions on cross-border trade in services at the

[9]In practice, services provisions in trade agreements are likely to affect both a firm's fixed costs as well as its variable costs. However, we follow the standard GTAP modeling assumptions here and treat the removal of trade barriers as a reduction in AVEs in the policy simulation.

Table 2: Comparison of Services Trade Elasticity Estimates in the Literature

Paper	Data	Countries	Sector classification	No. of sectors	Median estimate
Rouzet et al. (2017)	UK Annual Business Survey and Finnish Financial Statements Panel	UK and Finland	OECD STRI	15	2.30
Gervais and Jensen (2019)	U.S. Bureau of Economic Analysis Input-Output Tables	United States	3-digit NAICS	40*	5.98
Christen et al. (2019)	Balance sheet data from the Bureau van Dijk AMADEUS database	Austria	2-digit NACE	22	3.55
Blank et al. (2022)	Transaction and firm-level information from Deutsche Bundesbank for German firms	Germany	Author grouping	5	4.86
Nakano and Nishimura (2024)	Japan Trade Statistics	Japan	WTO	8	1.04
Ahmad and Schreiber (2024)	U.S. Bureau of Economic Analysis Input-Output Tables	United States	3-digit NAICS	40	5.65
			GTAP	15	5.42

Note: All of the studies included in this table use the mark-up method to estimate the elasticity of substitution parameters, except for Nakano and Nishimura (2024) who use variation in exchange rates.
* Gervais and Jensen (2019) only reports summary statistics, they do not report the full set of elasticity estimates. They use the same BEA data as this paper and the number of services sectors is roughly 40.

GTAP sector level. The analysis measures an average effect of all trade agreements (U.S. and non-U.S.) with services provisions, assuming that countries have the same average effect on barriers to services trade. The core tradable services sectors were restricted to the following GTAP sectors: information and communication (ins), construction (cns), insurance (ins), other business services (obs), other financial intermediation (ofi), and wholesale and retail trade (trd). These core services sectors were considered to be the most tradable and the most impacted by FTA provisions. Other GTAP services sectors that are not typically a focus of FTAs such as travel, air transport, health and education services, and other governmental service were not impacted by the policy shocks.

Table 3: Gravity Estimates of the Average Impact of an FTA with Services Provisions on Trade Barriers

GTAP Sector	Description	AVE	Default EOS	New EOS
cmn	Information and Communication	-18.37	3.80	2.92
ins	Insurance	-3.94	3.80	4.13
obs	Other Business Services	-11.69	3.80	4.13
ofi	Other Financial Intermediation	-9.63	3.80	5.30
trd	Wholesale and Retail Trade	-5.98	3.80	5.19

Note: These AVE gravity estimates are from the U.S. International Trade Commission's 2021 report on the Economic Impact of Trade Agreements Implemented under Trade Authorities Procedures. (USITC, 2021)

The 2021 ITC report had found a statistically significant reduction in trade barriers for most of the core GTAP services sectors, including cmn, ins, obs, ofi, and trd. Only the construction sector was not found to have a statistically significant effect of agreements on trade, likely because a commercial presence abroad is typically needed to provide these services in foreign markets and the data on cross-border services trade do not include such sales. The AVE estimates in table 3 illustrate that the effect of a trade agreement is likely to be heterogeneous by service sector. The information and communication sector faced a much larger barrier to cross-border trade, and thus benefits more from an FTA compared to

the insurance sector and the retail trade sector.

The policy simulations were conducted using the GTAP database version 11 (2017) and GTAP model 7 with 65 sectors, 12 aggregated regions, and 5 factors of production. We rely on the standard GTAP model that assumes firms operate under perfect competition.[10] The AVE estimates described above were inserted into GTAP as a shock to AMS, the import-augmenting technology change variable. AMS reduces the effective price of services imports, capturing efficiency-enhancing measures from the U.S.-UK services FTA, such as reduced regulations on e-commerce and digital transactions.

The elasticity of substitution parameters for services sectors were changed to a non-nested structure to be comparable to the new markup estimates. The simulations were run first with the default elasticities, and again with the markup elasticities. No changes were made to goods sectors, only the core services sectors with statistically significant AVE estimates were shocked. Comparing elasticity estimates listed in table 3, the new elasticities increased for all sectors except for cmn where the new markup elasticity is lower than the default GTAP elasticity. Because of this, we expect to see larger changes in US-UK trade with the new markup elasticities for all sectors except cmn, where we expect to see a smaller change in exports. Sectors ofi and trd see the largest increase in the elasticity of substitution, so we should see the most effect from liberalization in these two sectors.

To better understand the simulation results, we first run a one-way liberalization where the UK is the liberalizing country. Economic effects at the sector level and macro level are shown in tables 4 and 5. Unsurprisingly, the effect of a services liberalization on U.S. exports to liberalizing UK become larger with the new elasticity estimates for all sectors except cmn, with ofi and trd experiencing the largest increase. On the macro side, the new

[10] A future extension to this paper would be to use a monopolistic competition CGE model instead so that the underlying assumptions in the parameter estimation match the assumptions in the simulation model. The estimated price-cost margins from the markup method could be used in the CGE model so that data sources are consistent.

elasticity estimates lead to larger positive welfare effects for the U.S. who benefits from a liberalization with their trading partner and smaller welfare effects for the UK, due to a bigger terms of trade effect.

Table 4: One-Way Services Liberalization: Change in US and UK Exports

		Default EOS		**New EOS**	
GTAP Sector	Description	US $\rightarrow UK$	UK $\rightarrow US$	US $\rightarrow UK$	UK $\rightarrow US$
cmn	Information and Communication	49.77	1.09	33.71	1.01
ins	Insurance	9.93	1.08	10.88	1.42
obs	Other Business Services	31.09	0.91	42.40	1.44
ofi	Other Financial Intermediation	24.88	1.08	38.14	1.84
trd	Wholesale and Retail Trade	15.84	0.89	23.51	1.53

Table 5: One-Way Services Liberalization: Macro Effects

	Default EOS		**New EOS**	
Variable	US	UK	US	UK
QGDP (% change)	0.0007	0.0771	0.0008	0.0738
PGDP (% change)	0.0528	-0.2248	0.0648	-0.2770
EV ($ mil)	1,586.93	840.41	1,931.58	448.11

Next, the two-way services liberalization is shown in tables 6 and 7. Comparing results across default and new EOS columns, we continue to see the same trend that sectors with bigger elasticities have larger percent changes in trade flows and sectors with smaller elasticities have smaller changes in trade flows. Because there are two policy changes–a reduction in barriers to services trade at the UK border and at the U.S. border–it is difficult to isolate the impacts on macro variables such as GDP and equivalent variation. The impact of heterogeneous elasticities on macro outcomes depends on the size of trade flows subject to the change in elasticity and the ability to shift production factors. We see only small changes in table 7 across the simulations with default and new services elasticities.

Table 6: Two-Way Services Liberalization: Change in US and UK Exports

GTAP Sector	Description	Default EOS US $\rightarrow UK$	Default EOS UK $\rightarrow US$	New EOS US $\rightarrow UK$	New EOS UK $\rightarrow US$
cmn	Information and Communication	51.63	50.69	35.39	34.62
ins	Insurance	11.69	10.30	13.04	11.53
obs	Other Business Services	32.73	31.69	44.71	43.41
ofi	Other Financial Intermediation	26.47	26.07	40.68	40.17
trd	Wholesale and Retail Trade	17.46	16.00	26.02	24.06

Table 7: Two-Way Services Liberalization: Macro Effects

Variable	Default EOS US	Default EOS UK	New EOS US	New EOS UK
QGDP (% change)	0.0112	0.1010	0.0112	0.1017
PGDP (% change)	-0.0023	0.1868	-0.0034	0.1853
EV ($ mil)	2,338.57	3,940.34	2,299.49	3,946.85

Sensitivity analysis using elasticity confidence intervals

As described earlier, we used the median of the yearly elasticity estimates from 2013–22 as the markup elasticities reported in table 9 and 10. In this case, it is natural to question whether there is significant variation in the elasticity estimates across years that a median estimate may not capture. To test whether yearly variation in markups would have an impact on our simulation results, we run the one-way liberalization simulation again with a 95% confidence interval on the elasticity of substitution estimates instead of using the median estimate.[11] The confidence interval is calculated using the standard deviation across the yearly elasticity estimates for each sector. Table 8 reports median, mean, standard deviation, and 95% confidence interval values for the core services sectors. The 95% confidence intervals reported in the table are narrow, indicating little variation over time. Simulation results with the low and high ends of the 95% confidence intervals are graphed in figure 1.

[11] We assume that the elasticities are not correlated, so the confidence intervals are calculated separately.

6 Conclusion

This paper presents a set of elasticity of substitution estimates at both the NAICS 3-digit level and GTAP sector level, estimated using the markup method arising from a monopolistic competition model of trade. The median estimate is 5.65 at the NAICS 3-digit level and 5.42 at the more aggregated GTAP sector level. The estimates show considerable heterogeneity across sectors, differing from the standard GTAP assumption of services sectors having the same value. In a hypothetical simulation of a new U.S.-UK services agreement, we show that trade elasticities for services sectors can significantly impact trade flows and macroeconomic outcomes.

Future extensions to this paper include estimating the elasticity of substitution for services sectors in other economies, including the EU, to compare tradability across countries. Additionally, a CGE model with a monopolistic competition framework could be used in place of this perfect competition model to better align with the assumptions used to estimate the trade elasticity. A CGE model with increasing returns to scale would also be able to account for the effects of trade provisions on the fixed costs of supplying services across borders.

Table 8: Elasticity Confidence Intervals

GTAP	Median	Mean	SD	CI: low	CI: high
CMN	2.91	2.94	0.04	2.85	3.04
INS	4.13	4.31	0.20	3.85	4.78
OBS	4.83	4.87	0.08	4.69	5.05
OFI	5.30	5.28	0.07	5.12	5.43
TRD	5.19	5.18	0.11	4.93	5.43

Figure 1: Change in U.S. exports to UK, 95% confidence interval

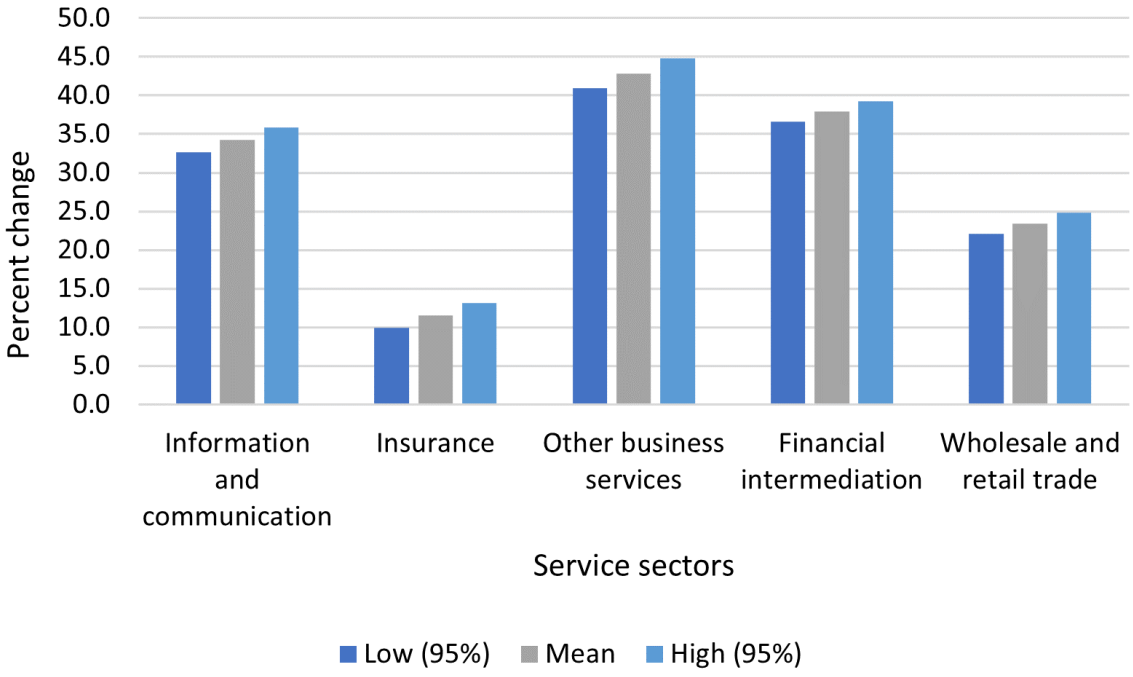

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Table 9: NAICS Elasticity Estimates

NAICS	Description	EOS (2003–12)	EOS (2013–22)
230	Construction	5.730	5.418
420	Wholesale trade	4.921	4.787
441	Motor vehicle and parts dealers	7.056	5.208
445	Food and beverage stores	6.208	6.793
452	General merchandise stores	15.267	13.123
4A0	Other retail	5.796	4.827
481	Air transportation	9.630	5.534
482	Rail transportation	4.555	3.662
483	Water transportation	6.036	7.264
484	Truck transportation	6.129	4.904
485	Transit and ground passenger transportation	3.418	3.625
486	Pipeline transportation	3.777	1.892
487	Other transportation and support activities	6.352	6.822
493	Warehousing and storage	6.737	18.288
511	Publishing industries, except internet	3.097	2.931
512	Motion picture and sound recording industries	2.875	3.180
513	Broadcasting and telecommunications	3.183	2.800
514	Data processing and other information services	2.694	3.261
521	Federal Reserve banks, credit intermediation	3.429	2.631
523	Securities, commodity contracts, and investments	14.795	19.569
524	Insurance carriers and related activities	4.165	4.128
525	Funds, trusts, and other financial vehicles	5.582	6.761
531	Real estate	1.669	1.684
532	Rental services and lessors of intangible assets	2.271	2.272
541	Professional, scientific, and technical services	4.759	5.083
550	Management of companies and enterprises	14.669	15.865
560	Administrative and waste management services	5.986	6.879
561	Administrative and support services	6.017	7.178
562	Waste management and remediation services	5.274	5.772
610	Educational services	8.269	8.150
620	Health care and social assistance	9.802	9.689
621	Ambulatory health care services	7.137	6.872
622	Hospitals	13.094	11.731
623	Nursing and residential care facilities	32.650	27.414
624	Social assistance	10.266	18.839
711	Performing arts and related activities	3.747	3.279
713	Amusements, gambling, and recreation industries	7.480	7.916
721	Accommodation	5.200	4.661
722	Food services and drinking places	9.006	9.388
810	Other services, except government	6.666	7.106

Table 10: GTAP Elasticity Estimates

GTAP	Description	EOS (2003–12)	EOS (2013–22)
afs	Accommodation, food and service activities	7.756	7.371
atp	Air transport	9.630	5.534
cmn*	Information and communication	3.096	2.914
cns*	Construction	5.730	5.418
edu	Education	8.269	8.150
hht	Human health and social work	9.802	9.691
ins*	Insurance (formerly isr)	4.165	4.128
obs*	Other business services nec	4.450	4.827
ofi*	Other financial intermediation	6.343	5.299
otp	Land transport and transport via pipelines	5.353	4.696
ros	Recreation and other services	5.862	5.843
rsa	Real estate activities	1.669	1.684
trd*	Wholesale and retail trade; repair of motor vehicles	5.752	5.194
whs	Warehousing and support activities	6.737	18.28
wtp	Water transport	6.036	7.264

*Core tradable service.

Table 11: GTAP-NAICS Services Concordance

GTAP	Description	NAICS
afs	Accommodation, food and service activities	721, 722
atp	Air transport	481
cmn*	Information and communication	51
cns*	Construction	23
edu	Education	61
hht	Human health and social work	621, 622, 623, 624
ins*	Insurance	524
obs*	Other business services	532, 533, 541, 561
ofi*	Other financial intermediation	521, 522, 523, 525, 55
otp	Land transport and transport via pipelines	482, 484, 485, 486, 487
ros	Recreation and other services	711, 713, 81
rsa	Real estate activities	531
trd*	Wholesale and retail trade	42, 44, 45
whs	Warehousing and support activities	493
wtp	Water transport	483

*Core tradable service.