Exploring Aggregation Bias in General Equilibrium Models: A Comparison of Elasticity Aggregation Formulas Using Real-World Data

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Abstract

The elasticity of substitution between inputs for an aggregated sector may not align with the simple weighted average of disaggregated sectors. The discrepancy may result in an aggregation bias in computable general equilibrium analyses. In this study, we explore this potential gap between the simplified weighted average of disaggregate elasticities and the elasticity derived mathematically within a general equilibrium framework. We also investigate the impacts of alternative aggregation formulas for elasticities, using the real-world economic dataset (GTAP 10 DB), to provide insight into the aggregation bias of CGE model simulations.

In a simplified general equilibrium model with a two-sector, two-factor economy, we found significant differences between aggregated elasticities calculated using simplified weighted averages and those derived from exact general equilibrium methods—sometimes the discrepancy was more than threefold.

However, more practical simulations using the GTAP Database showed that the variances in elasticities and the impacts of exogenous shocks using the two different elasticity formulas were not significantly different. This may be due to the specific economic structures currently reflected in the GTAP Database. While this finding suggests that aggregation bias from using non-exact elasticity formulas may not always be a critical issue, it does not rule out the possibility of significant deviations in equilibrium impacts under different conditions. Further research is necessary to confirm the utility of the simplified average formula and to determine the need for more sophisticated aggregation formulas.

1. Introduction

In the modeling exercises such as CGE model simulations, sectors and regions are often aggregated into smaller numbers to reduce computational burden and a simplified weighted sum of original elasticities of substitutions is applied to represent the substitution elasticity for the aggregated sector or region. In theory, the elasticity of substitution between inputs for aggregated sectors, however, is affected by not only the elasticity of substitution in the original sectors, but also other behavioral parameters such as elasticity of substitution between sector outputs by consumers. (Jones, 1965) This paper reviews the literature on the aggregation of elasticities and provides the simulation results of alternative aggregation formulas under the CGE model to derive methodological implications for aggregation choices.

2. Literature Review

Computable General Equilibrium (CGE) models are widely applied to simulate the economy-wide effects of transformations in production recipes (Gerlagh & Kuik, 2014; Wiebe & Lutz, 2016) as well as policy interventions, such as carbon tax (Caron et al., 2018; Kirchner et al., 2019). In order to produce sensible results to inform policy makers, these models need to be parametrized using empirical data that represents the production structure appropriately. The use of inappropriate estimates or arbitrary values of those parameters has resulted in skepticism in the usefulness of these models, especially from an econometric perspective (McKitrick, 1998; Antimiani et al., 2015).

Studies in modelling production functions to estimate elasticities have been conducted on a diverse level of industrial sectors and regions. Numerous studies modelled production functions specifically for manufacturing sectors at different levels of sector aggregation to study substitutability of capital and energy using CES functions (Kemfert, 1998; Okagawa & Ban, 2008; van der Werf, 2008).

Jones (1965) provides an analytic formula for the elasticity of substitution between factors for a simple general equilibrium model with two factors, land (T) and labor (L), and two commodities, manufactured good (M) and food (F), and a single consumer. According to Jones (1965), the elasticity of substitution between factors (labor and land) of the aggregated economy is the weighted average not only of the elasticities of substitution between factors for individual sectors, but also of elasticities of substitution between commodities for final demand. When there are two factors, labor ('L') and land ('T'), and two commodities manufacturing ('M') and food ('F'), the elasticity of substitution between factors for the aggregate economy is derived by Jones (1965) as follows:

$$\sigma = Q_M \sigma_M + Q_F \sigma_F + Q_D \sigma_D$$

$$Q_M = a_{LM} \left(\frac{a_{TM} M}{T}\right) + a_{TM} \left(\frac{a_{LM} M}{L}\right)$$

$$Q_F = a_{LF} \left(\frac{a_{TF} F}{T}\right) + a_{TF} \left(\frac{a_{LF} F}{L}\right)$$

$$Q_D = \left(\frac{a_{LM} M}{L} - \frac{a_{TM} M}{T}\right)(a_{LM} - a_{LF})$$

Where M and F are the amounts of outputs for manufacturing and food sector, L and T are the amounts of factor supplies for labor and land, and a_{fj} is the factor input coefficient which is the quantity of factor *f* required to produce a unit of commodity *j*. When there are no intermediate inputs, the sum of the factor input coefficients over all the factors is one for each sector. ($\sum_f a_{fj} = 1, \forall j$)

The above formula indicates that the general equilibrium (GE) elasticities for the aggregated economy, σ, is not just a weighted average of the elasticities of disaggregated sectors but reflect the elasticity of substitution between commodities on the demand side, as well as elasticities on the supply side. This implies that the simple weighted average of supply side elasticities might lead to a distortion of production technologies and may misrepresent the structure of the aggregated economies.

The conventional way of simplified weighted average ($\tilde{\sigma}$) of the disaggregate elasticities uses as weights the share of factor cost shares of disaggregate sectors as follows:

$$\tilde{\sigma} = \widetilde{Q_M} \sigma_M + \widetilde{Q_F} \sigma_F$$

$$\widetilde{Q_M} = \frac{(a_{LM} + a_{TM}) M}{L + T}$$

$$\widetilde{Q_F} = \frac{(a_{LF} + a_{TF}) F}{L + T}$$

The gap between the two may be significant, particularly if Q_D is big.

3. Aggregation of Elasticities for a simple example

The table 1 shows the exemplary cases of a simple two-sector economy where we can apply the aggregated elasticity formula of Jones (1965). The cases are constructed so than we can observe the varying differences between the simplified weighted averages of elasticities ($\tilde{\sigma}$) and the GE elasticities of aggregate economy (σ), according to the different combinations of the input data levels, such as factor shares and market shares.

Table 1. Elasticities of aggregate economy with different aggregation formulas

Scenario	A	B	C	D	E	F	G	H	I
a_{LM}	0.5	0.9	0.1	0.9	0.9	0.9	0.9	0.9	0.9
a_{TM}	0.5	0.1	0.9	0.1	0.1	0.1	0.1	0.1	0.1
a_{LF}	0.5	0.1	0.9	0.1	0.1	0.1	0.1	0.1	0.1
a_{TF}	0.5	0.9	0.1	0.9	0.9	0.9	0.9	0.9	0.9
M	5	5	5	9	5	9	1	5	5
F	5	5	5	1	5	1	9	5	5
L	5	5	5	8.2	5	8.2	1.8	5	5
T	5	5	5	1.8	5	1.8	8.2	5	5
σ_M	0.5	0.5	0.5	0.5	0	0.5	0.5	0.1	1
σ_F	0.1	0.1	0.1	0.5	0	0.1	0.1	0.5	5
σ_D	1	1	1	0.5	1	1	1	1	1
$\widetilde{Q_M}$	0.50	0.50	0.50	0.90	0.50	0.90	0.10	0.50	0.50
$\widetilde{Q_F}$	0.50	0.50	0.50	0.10	0.50	0.10	0.90	0.50	0.50
$\tilde{\sigma}$	0.30	0.30	0.30	0.50	0.00	0.46	0.14	0.30	3.00
Q_M	0.50	0.18	0.18	0.55	0.18	0.55	0.06	0.18	0.18
Q_F	0.50	0.18	0.18	0.06	0.18	0.06	0.55	0.18	0.18
Q_D	0.00	0.64	0.64	0.39	0.64	0.39	0.39	0.64	0.64
σ	0.30	0.75	0.75	0.50	0.64	0.67	0.48	0.75	1.72
%change	0.0%	149.3%	149.3%	0.0%	NA	45.8%	239.7%	149.3%	-42.7%

Note) The shaded cells are the exogenous parameters (assumptions for the scenarios) and all the other cells are determined by input output relationships or weighted average formulas. '%change' indicates the % difference of σ from $\tilde{\sigma}$.

The first four rows are factor input coefficients, and the next two rows are outputs, followed by two factor supplies and three disaggregate elasticities (two for supply side (σ_M and σ_F) and one for demand side (σ_D)). $\widetilde{Q_M}$ and $\widetilde{Q_M}$ are the weights for simple averaging of elasticities, which gives $\tilde{\sigma}$ and Q_M, Q_F and Q_D are the GE weights, yielding GE elasticity, σ.

Case A of Table 1 is a benchmark case with same factor input structure for the two sectors with identical amounts of outputs. The disaggregate elasticities of substitution are assumed to be 0.5 and 0.1 for sector M and F and 1.0 for demand side. The benchmark case has the same substitution elasticity for the aggregate economy for both the simplified weighted average formula and the GE elasticity formula by Jones (1965). But for the other variations of parameter values, the gap between the two different elasticity formula may become quite large, some cases showing that the GE elasticities being more than three times higher than the simple average formula.

4. Analysis of the impacts of different elasticity formula on simulation results

Baqaee and Farhi (2018) provide a generalized formula for the GE elasticities applicable for many sectors and factors, as well as intermediate demands and complex structure of nested technologies. Following the notation of Baqaee and Farhi (2018), the model has a set of producers N, and a set of factors F, with N+F for the union of these two sets. With some abuse of notation, N and F are also denote the cardinalities of these sets. Each good i is produced with a nested CES production function. Y_i is the total output of i, x_{ij} is the use of input j, and L_{if} is the use of factor f. Final demand is a CES function. C_i represents the use of good i in final demand and Y is real output.

The input-output matrix is defined by (1+N+F)×(1+N+F) matrix Ω whose ij-th element is equal to i-th expenditures on inputs from j as a share of its total revenues,

$$\Omega_{ij} \equiv \frac{p_j x_{ij}}{p_i y_i}$$

The Leontief inverse matrix is defined as

$$\Psi \equiv (I - \Omega)^{-1}$$

Input-output covariance operator is defined as follows:

$$\mathrm{Cov}_{\Omega^{(k)}}\left(\Psi_{(j)}, \Psi_{(i)}\right) = \sum_{l \in N+F} \Omega_{kl}\Psi_{lj}\Psi_{li} - \left(\sum_{l \in N+F} \Omega_{kl}\Psi_{lj}\right)\left(\sum_{l \in N+F} \Omega_{kl}\Psi_{li}\right),$$

where $\Omega^{(k)}$ corresponds to the k th row of $\Omega, \Psi_{(j)}$ to j th column of Ψ, and $\Psi_{(i)}$ to the i th column of Ψ. In words, this is the covariance between the j th column of Ψ and the i th column of Ψ using the k th row of Ω as the distribution.

According to Proposition 8 of Baqaee and Farhi (2018), the elasticity of substitution between factors in the aggregate production function are given by

$$1 - \frac{1}{\sigma_{fg}^{F}} = \left(I_{(g)} - I_{(f)}\right)' (I - \Gamma)^{-1} \delta_{(g)}$$

where Γ is the $F \times F$ factor share propagation matrix defined by

$$\Gamma_{hh'} = - \sum_{k \in 1+N} (\theta_k - 1) \lambda_k \mathrm{Cov}_{\Omega^{(k)}} \left(\Psi_{(h')}, \Psi_{(h)} / \Lambda_h \right),$$

δ is the $F \times F$ factor share impulse matrix defined by

$$\delta_{hh'} = \sum_{k \in 1+N} (\theta_k - 1) \lambda_k \mathrm{Cov}_{\Omega^{(k)}} \left(\Psi_{(h')}, \Psi_{(h)} / \Lambda_h \right)$$

$\delta_{(g)}$ is its g th column, I is the $F \times F$ identity matrix, and $I_{(f)}$ and $I_{(g)}$ are its f th and gth columns.

The impact of alternative aggregation formulas of elasticities on CGE modeling has been investigated with GTAP 10 Power DB. Since the GTAP DB has a huge amount of detailed transaction data for the global economy, we simplified it with the high level of aggregation for regions and factors as far as the minimum level of disaggregation is sustained so that we can test the aggregation of elasticities further on the disaggregated data set. We merged all the regions into a single global region and aggregated the original 76 sectors into 5 and 8 factors into 2. The five aggregated sectors are AGR, MNU, FOD, INF, SER and the matching table between 76 original sectors and the aggregated sectors are provided in the appendix. Land and natural resources are aggregated into capital and the five categories of labors are taken into on single labor.

The three categories of final demands for household, government and investment are integrated into a single household final demand and all the taxes are shifted to labor cost.

We introduced new fictitious producers which linearly transform factors into aggregate factors for each sector to accommodate nested CES structures in a single input-output matrix framework with all the individual sectors having a simple CES functions with single elasticity.

Table 2. Aggregated single region input output table of GTAP 10 Power DB

	AGR	MNU	FOD	INF	SER	Consumption	SUM
AGR	669.9	4,546.4	1,791.4	387.3	115.2	1,734.5	9,244.6
MNU	1,107.7	22,586.2	660.8	7,228.6	4,252.5	14,185.0	50,020.9
FOD	352.6	203.9	1,513.8	665.9	410.0	4,383.7	7,530.0
INF	706.0	4,622.0	918.9	5,077.4	3,576.4	21,072.7	35,973.5
SER	528.6	3,407.8	469.2	4,856.9	10,599.3	32,886.0	52,747.7
Labor	1,953.1	8,665.7	1,154.0	10,895.2	19,685.5		42,353.7
Capital	3,926.8	5,988.7	1,021.9	6,862.2	14,108.8		31,908.3
SUM	9,244.6	50,020.9	7,530.0	35,973.5	52,747.7	74,261.9	
Elasticity	0.22	1.26	1.12	1.60	1.26	1.00	

For the evaluation of elasticity aggregation on CGE model results, we construct a simple nested CES structure that the output of each sector is a Leontief aggregate of intermediate input bundle and value-added bundle, and the intermediate input bundle is a Leontief aggregate of individual inputs and the value-added bundle is a CES aggregate of labor and capital.

We enumerate all the cases of aggregation of sectors to investigate the impacts of alternative aggregation formulas for substitution elasticities. The number of all the possible aggregation of *n* sectors is the sum of Stirling numbers of the second kind S(n,k) for all k less than or equal to *n*.[1] S(n,k) is the number of cases for possible groupings of n elements into *k* subsets and for n=5, S(5,k) is equal to 1, 15, 25, 10 and 1 for k=1,2,3,4 and 5. The total number of partitions of the 5-sector economy is the sum of S(5,k) for all k, which is 52.

Figure 1. shows the result of simulations for 52 partitions for 3 scenarios, baseline, simple average and GE elasticity. Baseline scenario is the equilibrium at base year GTAP data with

[1] The Sterling numbers can be calculated by $S(n,k) = \frac{1}{k!}\sum_{i=0}^{k}(-1)^i \binom{k}{i} (k-i)^n$. (Ronald et. al., 1988)

no policy or environmental shock and thus reproduces the input data as an equilibrium. Therefore, the equilibria of baseline scenarios are all the same to each other except the sector partitions (aggregations) are different. To evaluate the impact of alternative formulas for aggregate elasticity, we assumed a hypothetical change of factor endowments: 10% increase of capital and 10% reduction of labor. To see the different impacts of elasticity aggregation, we constructed two more scenarios for the same change of factor endowments: 'simple average' ('Simple') for simplified weighted average of disaggregate elasticity of substitution and 'GE elasticity' ('GE') for aggregate elasticity according to Baqaee and Farhi (2018).

Figure 1 shows the equilibrium results for the 52 cases of sectoral aggregations for the three scenarios. The first label is the aggregation title and second label is the number of aggregated sectors. Each of the five numbers of the aggregation title indicates the ordinality of the sector which the original sector is aggregated into. For example, 11555 means that the first and the second sector is aggregated to the first sector and the last three sectors are to the last (fifth) sector so that the five original sectors are aggregated into two subgroups. The ordinality of sectors follows the order in Table 3. The label for the number of aggregation goes from 0 to 4 and 0 indicates the original sector aggregation with 5 sectors and 1 indicates single sector aggregation and similarly for 2 to 4.

Figure 1 shows the comparison between the simple averaging and GE elasticity formula. It indicates that the GE elasticities may be higher or lower than the simple average elasticities: GE elasticities could be higher than the simple average by 6~7 % or lower by 2% depending on how the sectors are aggregated.

Figure 1. Elasticity of substitution under GE elasticity formula (% change from Simple Average)

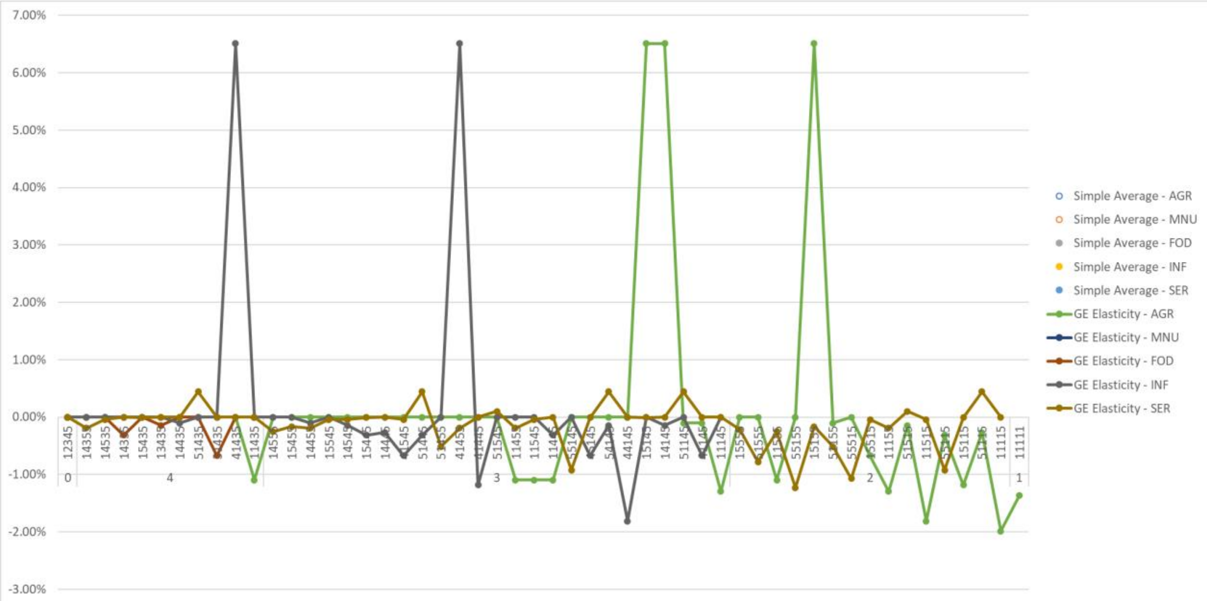
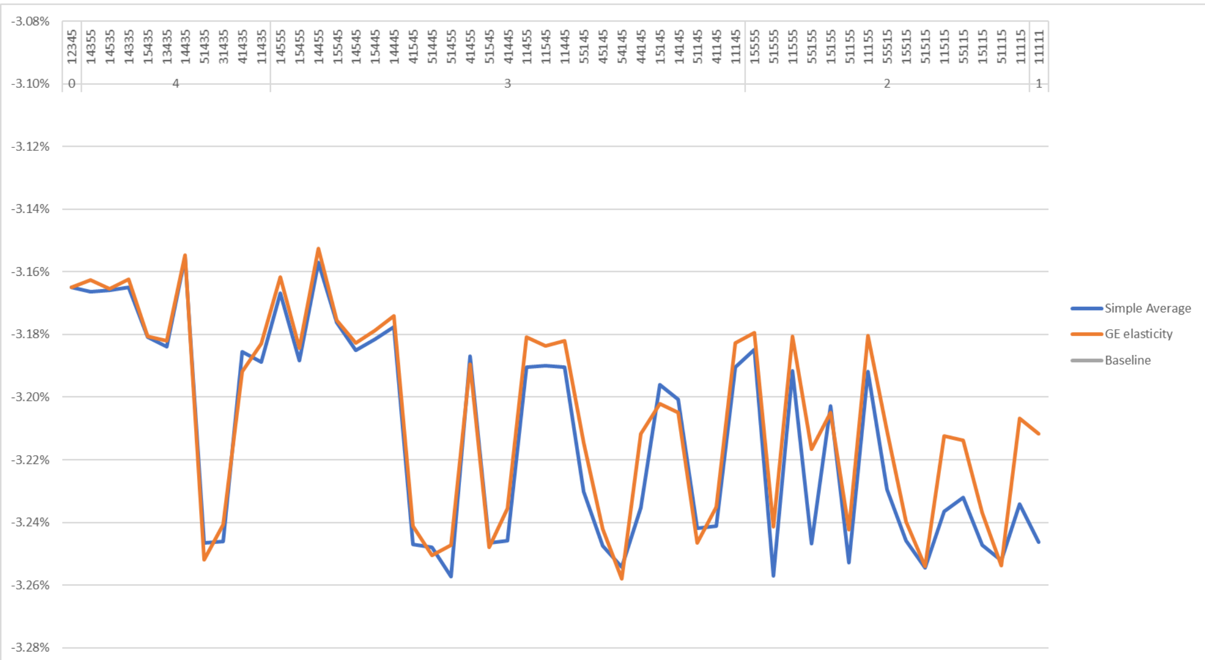


Figure 2 shows the results for the impacts on real GDP indicator, which is the same as the real consumption in this simple economy example, under the hypothetical change of factor endowments (10% increase of capital and 10% reduction of labor) in the % changes from baselines.

Figure 2. Real GDP impacts by scenarios and sector aggregations (% change from Baseline)



The first result is for 5-sector aggregation ('12345'), which is the original disaggregated economy, and show the same results for both 'Simple' and 'GE' at -3.165% change from the baseline. We can observe that the aggregation of sectors results in deviation from the original disaggregated case, the degree of which varies by aggregation scenarios. There is no clear tendency identifiable between the simple average and the GE aggregation in terms of the deviation from the original disaggregated case but for the group of 2-subgroup or single partitions, the 16 rightmost cases in Figure 3, the GE aggregation performs quite better than the simple average scheme, that is significantly closer to the result in the original disaggregated case (the leftmost '12345'), for some cases like '11111', '11115', '55115', '11515'.

5. Concluding Remarks

This study investigates the aggregation of elasticities for general equilibrium models, particularly for the computable general equilibrium analysis with a variety of sectoral aggregations. In a simplified general equilibrium model with a two-sector, two-factor economy, we found significant differences between aggregated elasticities calculated using simplified weighted averages and those derived from exact general equilibrium methods—sometimes the discrepancy was more than threefold.

However, more practical simulations using the GTAP Database showed that the variances in elasticities and the impacts of exogenous shocks using the two different elasticity formulas were not significantly different. This may be due to the specific economic structures currently reflected in the GTAP Database. While this finding suggests that aggregation bias from using non-exact elasticity formulas may not always be a critical issue, it does not rule out the possibility of significant deviations in equilibrium impacts under different conditions.

This analysis should serve as a foundation for further research into improving elasticity aggregation schemes for computable general equilibrium modeling. We highlighted various instances where different elasticity formulas diverged, identifying some extreme cases that could cause significant distortions in general equilibrium analyses. Our experiments with simple aggregation exercises in the GTAP Database indicated that discrepancies in general equilibrium impacts might be minor, even when using the simplified weighted averaging of elasticities. Nevertheless, we acknowledge that our understanding of the factors that exacerbate distortions from aggregations in computable general equilibrium analyses is limited, and it is unclear which aggregation formula should be applied under various conditions. Further research is necessary to confirm the utility of the simplified average formula and to determine the need for more sophisticated aggregation formulas.

Appendix

Table A1: Aggregation of original GTAP sectors into 5 sectors for simulation analysis

Sector	Explanation	Intermediate input	Labor	Capital	Final demand	Elasticity	Aggregated sector	aggregate elasticity
Pdr	"Paddy rice"	94.2	101.6	115.2	52.8	0.25	AGR	0.22
wht	"Wheat"	87.1	60.1	62.0	50.9	0.25		
Gro	"Cereal grains nec"	121.6	113.1	102.1	117.4	0.25		
v_f	"Vegetables - fruit - nuts"	218.0	303.7	257.0	512.0	0.25		
Osd	"Oil seeds"	98.6	86.5	101.0	72.5	0.25		
c_b	"Sugar cane - sugar beet"	32.4	23.9	33.4	12.3	0.25		
pfb	"Plant-based fibers"	34.5	24.2	33.5	26.9	0.25		
ocr	"Crops nec"	117.5	73.7	86.4	89.1	0.25		
ctl	"Bo horses"	198.4	90.5	94.3	65.9	0.25		
oap	"Animal products nec"	383.5	142.0	138.9	247.4	0.25		
rmk	"Raw milk"	167.6	80.8	103.0	118.6	0.25		
wol	"Wool - silk-worm cocoons"	33.2	-7.0	29.7	28.8	0.25		
frs	"Forestry"	127.2	97.5	122.6	71.4	0.20		
fsh	"Fishing"	151.7	82.1	158.0	178.5	0.20		
coa	"Coal"	222.1	97.3	217.3	8.9	0.20		
oil	"Oil"	555.5	312.9	1,589.2	0.1	0.20		
gas	"Gas"	178.1	63.9	345.6	36.0	0.20		

oxt	"Other extraction (fmr. Minerals nec)"	543.7	206.1	337.6	35.1	0.20		
cmt	"Meat: cattel sheep goat horse"	523.6	112.8	72.1	458.4	1.12	FOD	1.12
omt	"Meat products"	468.4	89.0	57.6	422.3	1.12		
vol	"Vegetable oils and fats"	402.1	58.2	60.0	184.7	1.12		
mil	"Dairy products"	610.8	99.9	86.2	511.2	1.12		
pcr	"Processed rice"	358.1	43.4	56.4	323.9	1.12		
sgr	"Sugar"	155.6	31.6	32.1	89.0	1.12		
ofd	"Food products nec"	2,042.5	486.5	398.5	1,602.5	1.12		
b_t	"Beverages and tobacco products"	789.2	236.4	259.0	791.9	1.12		
tex	"Textiles"	1,166.4	279.6	174.5	336.3	1.26	MNU	1.26
wap	"Wearing apparel"	770.9	217.6	110.0	827.6	1.26		
lea	"Leather products"	383.6	104.5	56.7	319.2	1.26		
lum	"Wood products"	657.7	244.5	104.4	206.7	1.26		
ppp	"Paper products - publishing"	1,135.8	406.0	248.4	144.3	1.26		
p_c	"Petroleum - coal products"	3,600.2	209.6	164.5	774.2	1.26		
chm	"Chemical products"	3,227.8	584.6	571.8	659.6	1.26		
bph	"Basic pharmaceuticals"	728.8	184.5	300.1	348.6	1.26		
rpp	"Rubber and plastic products"	1,371.8	479.5	234.0	227.2	1.26		
nmm	"Mineral products nec"	1,273.7	397.4	288.9	106.7	1.26		
i_s	"Ferrous metals"	2,405.5	380.9	343.7	34.7	1.26		
nfm	"Metals nec"	1,546.5	252.6	244.6	59.6	1.26		
fmp	"Metal products"	1,768.7	589.9	272.3	388.2	1.26		
ele	"Computer electronic and optical prod"	3,339.0	690.6	440.9	1,445.7	1.26		
eeq	"Electrical equipment"	1,614.1	392.0	228.8	781.4	1.26		
ome	"Machinery and equipment nec"	2,704.9	887.5	466.7	2,237.4	1.26		
mvh	"Motor vehicles and parts"	3,163.8	575.1	364.2	2,278.1	1.26		
otn	"Transport equipment nec"	880.1	295.8	119.6	744.7	1.26		
omf	"Manufactures nec"	1,152.9	433.2	225.7	907.7	1.26		
TnD	"TnD"	382.8	208.3	137.9	188.9	1.26		

NuclearBL	"NuEB"	71.4	32.9	85.6	56.8	1.26		
CoalBL	"CoEB"	509.3	93.6	127.9	172.3	1.26		
GasBL	"GaEB"	281.7	59.0	32.2	110.2	1.26		
WindBL	"WiEB"	25.8	12.0	44.1	23.1	1.26		
HydroBL	"HyEB"	49.0	25.2	117.0	55.8	1.26		
OilBL	"OiEB"	59.0	2.7	1.0	26.2	1.26		
OtherBL	"OtEB"	32.3	9.7	24.0	17.9	1.26		
GasP	"GaEP"	132.5	25.2	9.7	46.4	1.26		
HydroP	"HyEP"	11.4	6.1	39.4	9.6	1.26		
OilP	"OiEP"	189.0	27.1	7.4	63.7	1.26		
SolarP	"SoEP"	9.0	2.5	18.5	7.8	1.26		
gdt	"Gas manufacture - distribution"	129.4	61.8	97.8	81.3	1.26		
wtr	"Water"	613.9	471.9	286.5	504.1	1.26		
cns	"Construction"	7,151.8	3,334.7	1,533.8	9,542.3	1.40	INF	1.6
trd	"Trade"	4,448.7	4,170.7	3,296.7	5,761.9	1.68		
afs	"Accomodation and food service"	2,085.8	1,415.0	631.6	3,316.7	1.68		
otp	"Transport nec"	2,552.8	1,298.1	769.7	1,593.9	1.68		
wtp	"Water transport"	556.2	150.7	145.4	209.8	1.68		
atp	"Air transport"	716.8	232.2	105.1	380.1	1.68		
whs	"Warehousing and support activities"	694.6	303.2	379.8	253.6	1.68		
cmn	"Communication"	2,745.4	1,510.0	1,449.0	2,412.8	1.26	SER	1.26
ofi	"Financial services nec"	1,783.5	2,055.6	1,143.8	1,640.1	1.26		
ins	"Insurance"	930.2	614.3	312.8	1,064.3	1.26		
rsa	"Real estate activities"	1,199.0	806.6	1,423.4	1,660.7	1.26		
obs	"Business services nec"	3,981.3	3,559.1	2,201.3	1,479.2	1.26		
ros	"Recreational and other services"	1,986.1	1,285.9	804.0	2,838.5	1.26		
osg	"Public admin and defence"	1,998.7	2,615.4	1,275.1	5,645.9	1.26		
edu	"Education"	987.4	2,757.4	624.9	3,832.8	1.26		
hht	"Human health and social work"	2,665.1	3,891.9	799.6	7,032.8	1.26		
dwe	"Dwellings"	684.4	581.7	4,074.9	5,278.8	1.26		