

Decomposing Gross Export

Hyok Jung Kim

September 26, 2014



Outline

Motivation

KWW(2014)

Idea

Computation
Problems

WWZ(2013)

Idea

Computation
Comparison with KWW(2014)

Conclusion

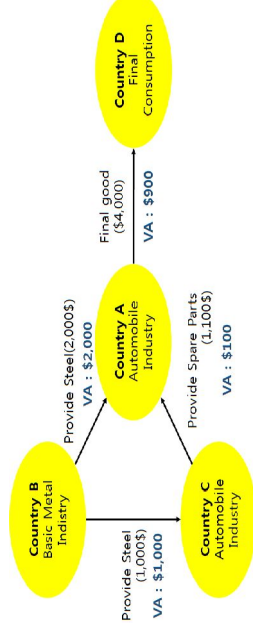
Koopman, Wang, and Wei. (2014). Tracing Value-Added and Double Counting in Gross Exports, *American Economic Review*, 104(2): 459-494
Wang, Wei, and Zhu. (2013). Quantifying International Production Sharing at the Bilateral and Sector Levels, *NBER Working Paper No. 19677*

Problems with Previous Official Trade Statistics

- ▶ Official statistics data provided in gross terms
- ▶ Fragmentation in production process involves double counting in gross exports
 - ▶ Grossman & Rossi-Hansberg(2008)
- ▶ Intermediate and final goods compiled together
- ▶ Unable to characterize source of value-added

Need framework that captures source of value-added and type of goods in gross exports

Big Picture



- ▶ Decomposition
 - ▶ Country A's VA : \$ 900
 - ▶ Country B's VA : \$ 3,000
 - ▶ Direct Export : \$ 2,000
 - ▶ Third Country Export : \$ 1,000
 - ▶ Country C's VA : \$ 100
 - ▶ Gross Exports : \$ 4,000
- ▶ How can we decompose gross exports in value-added components?

Literature Review

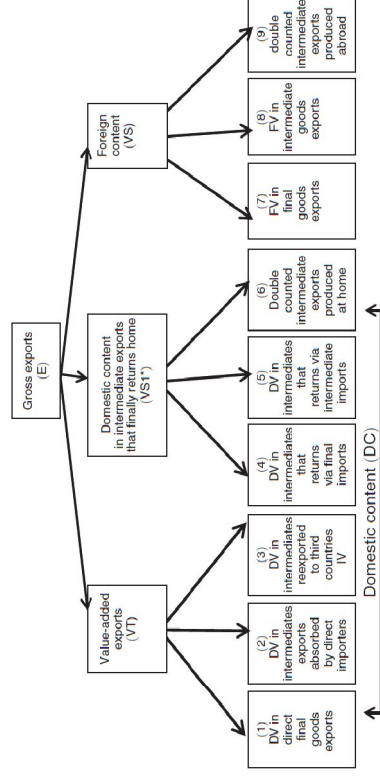
- ▶ Many attempts to decompose gross exports using ICIO
- ▶ Johnson & Noguera(2012)
 - ▶ Filter out value-added content from gross exports
- ▶ Koopman, Wang & Wei(2014)
 - ▶ Furthermore decomposing Johnson & Noguera(2012)
 - ▶ Used both GTAP based IO table, and WIOD
 - ▶ Some difficulties when dealing sectoral and bilateral level data
- ▶ Wang, Wei & Zhu(2014)
 - ▶ Furthermore decomposing Koopman, Wang & Wei(2014)
 - ▶ Overcome some difficulty in Koopman, Wang & Wei(2014)

Strategy

- ▶ Like Johnson & Noguera(2012), extract value-added content from gross trade
- ▶ Other part of gross trade are double counted terms
 - ▶ Some terms are finally return back to domestic country
 - ▶ Some terms represents contribution of foreign countries
- ▶ We can decompose gross exports of country s as,

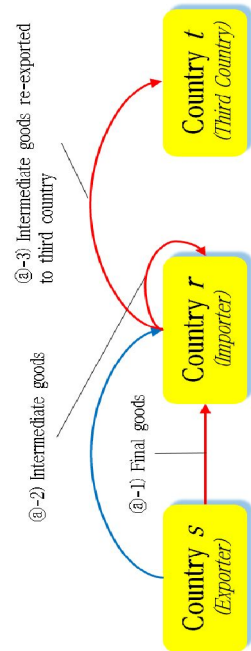
$$E_s = \underbrace{VT_s}_{\text{Value-added}} + \underbrace{DOM_s}_{\text{Returned value-added}} + \underbrace{FOR_s}_{\text{Foreign value-added}}$$

KWW



Source: Figure from Koopman, Wang and Wei(2014)

VA Exports



Various Indexes

1. VAX
 - ▶ Share of value-added exports to gross exports
 - ▶ Originally by Johnson & Noguera(2012)
2. VS
 - ▶ Share of foreign value-added exports to gross exports
 - ▶ Originally by Hummels, Ishii & Yi(2001), “the use of imported inputs in producing goods that are exported”
3. DC share
 - ▶ Share of $VT_s + DOM_s$ to gross exports
4. Double count share
 - ▶ Share of purely double counted terms to gross exports
5. Share of vertical trade
 - ▶ Extent of participation in the GVC
 - ▶ Combination of VS and VS1

Inconsistency in Value-Added Trade

- ▶ Every problems stems out when observing case of sectoral and bilateral level
- ▶ In bilateral level, the value-added exports becomes larger than gross exports in some cases
- ▶ Subtle differences in forward linkage measure and backward linkage measure
- ▶ Shortcomings in VAX ratio itself
 - ▶ Originally in Johnson & Noguera(2012), VAX ratio is computed as forward linkage measure
 - ▶ Forward linkage measure omits value-added contribution of other sectors
 - ▶ Backward linkage measure omits value-added contribution to other sectors' gross exports
- ▶ Value added export itself is not summed up by three components in forward linkage measure

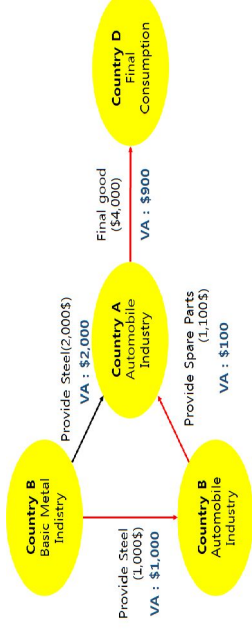
Inconsistency in Gross Exports - 1

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	AE	AH
1	country	industry	year	Value-added exports				Domestic Value-added				Foreign Value-added				Gross Exports	Gross Exports	Gross Exports
				Gross Exports	Direct Exports	Indirect Exports	Intermediate Exports	Gross Exports	Direct Exports	Indirect Exports	Intermediate Exports	Gross Exports	Direct Exports	Indirect Exports	Intermediate Exports			
2																		
3																		
4	AUS	C	1995	7013059	1023901	4385765	5161017	1684331	4571177	1133927	6154661	1134589	3531100	6384109	3632313	110751	-25-12	
5	AUT	C	1995	94909784	5227833	5227833	9324384	2397729	1728633	1103825	1169482	1336378	6492582	1137577	6608554	341931	1105-12	
6	BEL	C	1995	28537421	1751037	7222461	2178394	2100521	5459417	8383101	1395341	5423824	2835570	2655364	30753024	594189	125-12	
7	BGR	C	1995	3504305	2822006	15571406	2228645	0048526	005274	0335768	2330265	1437905	509322	4703565	5133139	166315	138-13	
8	BRA	C	1995	4103574	1892173	3947726	884674	1035556	3730119	03354704	7935105	1034779	233623	6521743	3023278	36327	345-12	
9	CAN	C	1995	6334853	1454945	5884538	4702546	312547	1673381	1562721	3326704	4851653	8522476	7654475	10484273	20349	105-12	
10	CHN	C	1995	678366	1383315	6947411	1067073	3934892	4672502	2527203	7770542	3333886	1773924	1512328	1564664	13884	-25-11	
1	CYP	C	1995	2643585	1673489	2508595	4822239	0000235	0018387	0006794	238283	2463485	1383877	1383061	1089566	336662	124-13	
2	CZE	C	1995	7484118	3343078	4837215	7553247	2649135	23667567	13951702	7133245	8931755	3308347	8540143	3538511	138051	732-13	
3	DEU	C	1995	5048656	3227435	2424251	6012374	15351573	9038378	2633208	1773465	7133345	402150	6361053	4084021	384636	537-12	
4	DNK	C	1995	2424527	2461794	1090228	1384682	4343318	1737707	1330228	6808819	1756834	6722223	371472	6043825	210333	305-13	

Inconsistency in Gross Exports - 2

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1						Value-added exports	Domestic VA returns home	Foreign VA returned to foreign country								
2	export country	sector	year	import country	Gross Export	Direct final exports	Intermediate exports to third countries	Final exports to third countries	Intermediate exports produced at home	Final exports produced abroad	Value-added exports	Domestic VA returns home	Foreign VA returned to foreign country	Value-added exports	Domestic VA returns home	Foreign VA returned to foreign country
3					(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
99	KOR	C1	1995	AUS	0.6017895	15192866	15657834	13725527	0.0443398	0.7979709	0.1559014	13.694492	14452542	3.8513183	35.78847	4.00181
10	KOR	C2	1995	AUS	0.0388	20669275	4126252	0.2904039	0.097004	0.038731	0.0238446	25.124665	30.782666	8.946262	7.006294	8.51547
11	KOR	C3	1995	AUS	25.5322	7764307	3540305	0.2903328	0.094944	0.0355885	0.0235551	6.7114053	10.04398	2.648096	11.09749	2.67134
12	KOR	C4	1995	AUS	281.8741	2053368	89482542	0.5482656	0.2239736	1.1173378	1.2833924	12.35563	18.94677	5.277562	13.83306	6.51075
13	KOR	C5	1995	AUS	10.745095	34633804	1818374	0.161161	0.0046551	0.0223744	0.0234342	8.7177443	8.8975621	2.840824	6.634973	2.40751
14	KOR	C6	1995	AUS	0.0907	15698028	6272284	0.5946555	0.0026383	0.03969	0.0053813	5.6538707	9.3203459	2.448033	3.121311	2.45441
15	KOR	C7	1995	AUS	33.381594	8.7453916	28973307	1.9780633	0.0855518	0.2431667	0.1330635	12.789382	14.801767	3.6223355	14.676964	3.8922
16	KOR	C8	1995	AUS	5.6879394	4.512667	6.9194109	0.6721031	0.0248274	0.0832323	0.0631503	11.61023	15.57905	3.531603	16.410474	3.59275
17	KOR	C9	1995	AUS	133.00478	25.75372	82.7648	6.4205714	0.204756	1.027181	0.5779323	2.140164	31.431091	5.572018	125.41853	9.19023
18	KOR	C10	1995	AUS	10.72408	15.533217	39.138357	1.992593	0.1196937	0.32716	0.653754	11.99501	11.524872	2.988478	57.822545	3.16381
19	KOR	C11	1995	AUS	9.8033893	6.813439	10.39467	0.4750037	0.0222877	0.0764311	0.0237351	10.088993	10.173138	2.882499	19.01398	2.6770
20	KOR	C12	1995	AUS	117.64578	41.473156	6193872	3.718463	0.1722947	0.8962994	0.47062	30.950172	24.998339	5.8874025	116.6375	6.9510
21	KOR	C13	1995	AUS	66.153394	25.55788	2719879	1.2765165	0.0554962	0.295932	0.118397	15.380835	12.866759	3.289517	57.76898	3.40194
22	KOR	C14	1995	AUS	302.64388	67.593875	114.82282	1.5597463	13.282078	0.802578	0.3647014	29.874074	25.786283	5.5413385	214.40747	5.90360
23	KOR	C15	1995	AUS	58.35328	20147867	15972473	1.3064371	0.0468573	0.4739355	0.0723754	18.210864	10.847007	2.820935	226.84772	2.854

Why Inconsistency Rises

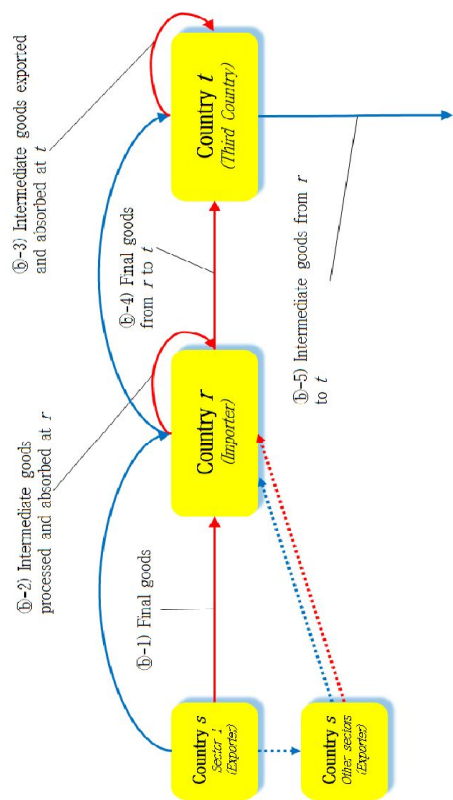


- ▶ Gross export of country B to A : \$ 3,100
 - ▶ VA of country B to A : \$ 3,100
- ▶ Gross Export of BM industry of Country B to A : \$ 2,100
 - ▶ VA Forward Linkage : \$ 3,000
 - ▶ VA Backward Linkage : \$ 2,000
- ▶ Gross Export of country B to D : \$ 0
 - ▶ VA Forward Linkage : \$ 3,100
 - ▶ VA Backward Linkage : \$ 3,100

Motivation

- ▶ Decompose the gross exports and consider both forward and backward linkages
- ▶ Generalized framework that all of the decomposed terms sum up to gross exports

Domestic Value-Added Export



The difference?

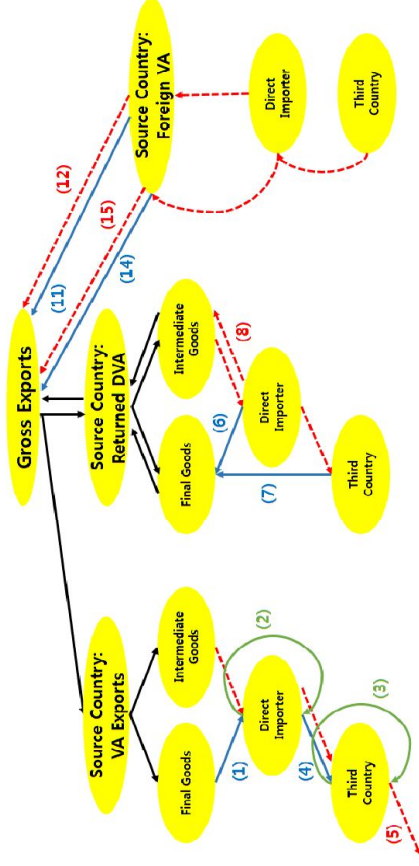
Decomposition

- ▶ Gross export from country s to country r can be decomposed as,

$$E'_s = DVA'_s + RVA'_s + \underbrace{IVA'_s + ThVA'_s + PDC'_s}_{FVA'_s}$$

- ▶ The difference is that foreign value added terms now also consider third countries' contribution

Big Picture



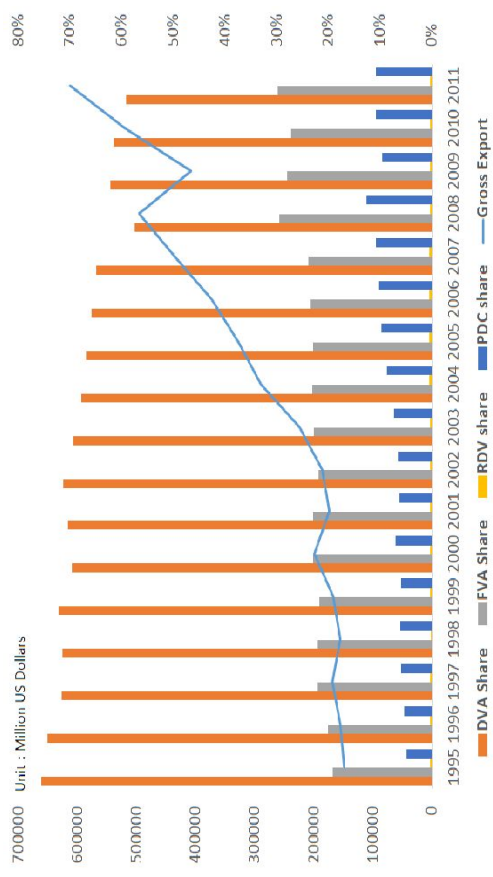
New Indexes

- ▶ New RCA measure

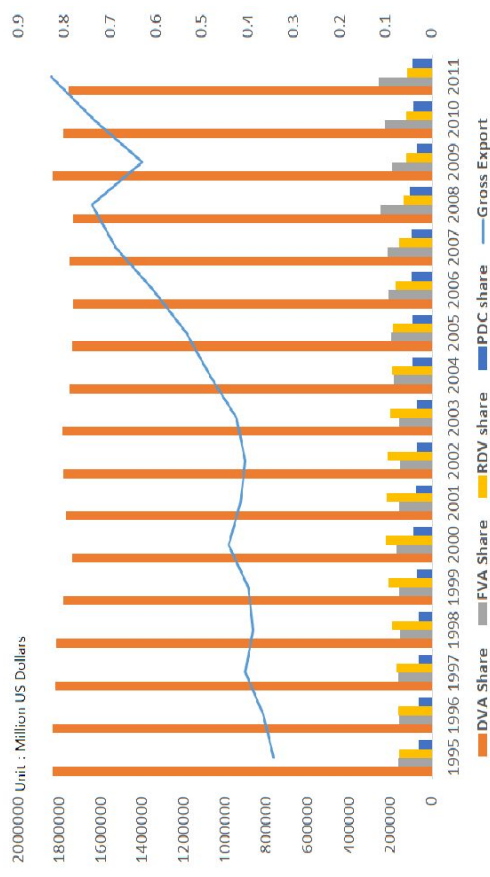
$$NRCA_t^i = \left(\frac{VAX_{F,i}^t + RVA_{F,i}^t}{\sum_{i=1}^N (VAX_{F,i}^t + RVA_{F,i}^t)} \right) \left(\frac{\sum_{j=1}^G (VAX_{F,j}^t + RVA_{F,j}^t)}{\sum_{j=1}^G \sum_{i=1}^N (VAX_{F,j}^t + RVA_{F,j}^t)} \right)^{-1}$$

- ▶ DVA
- ▶ FVA
- ▶ RVA
- ▶ PDC

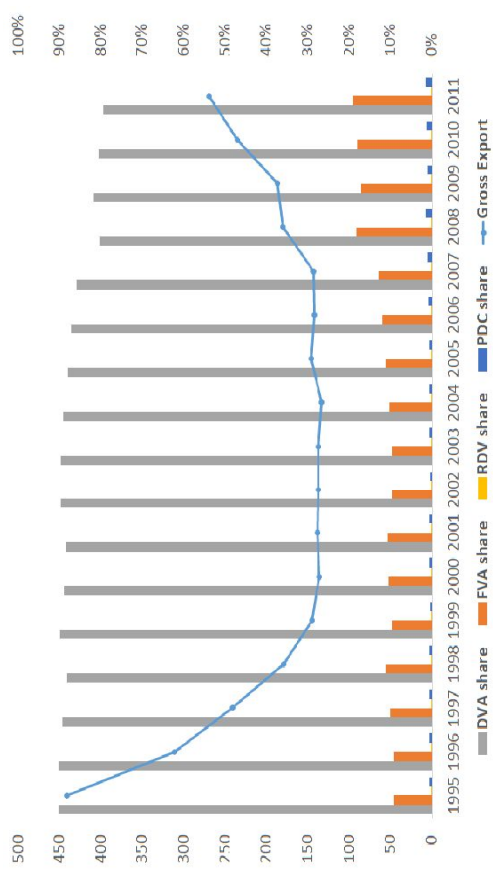
Decomposition of Korean Gross Exports



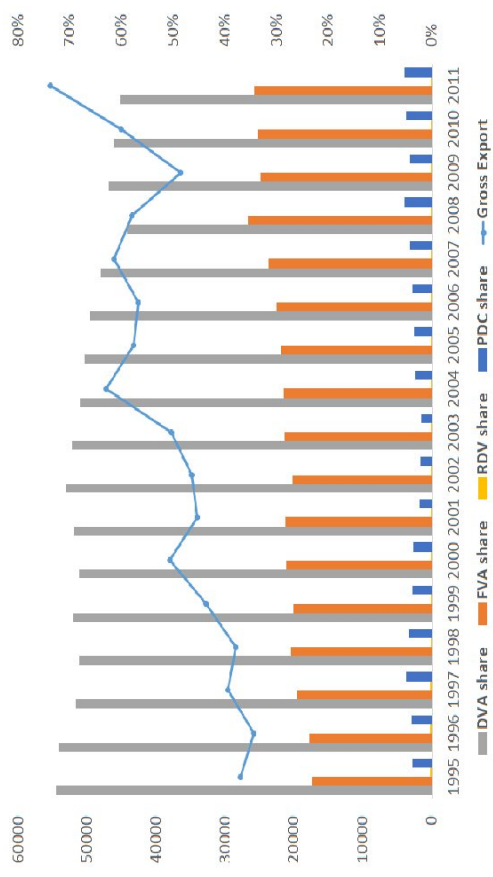
Decomposition of US Gross Exports



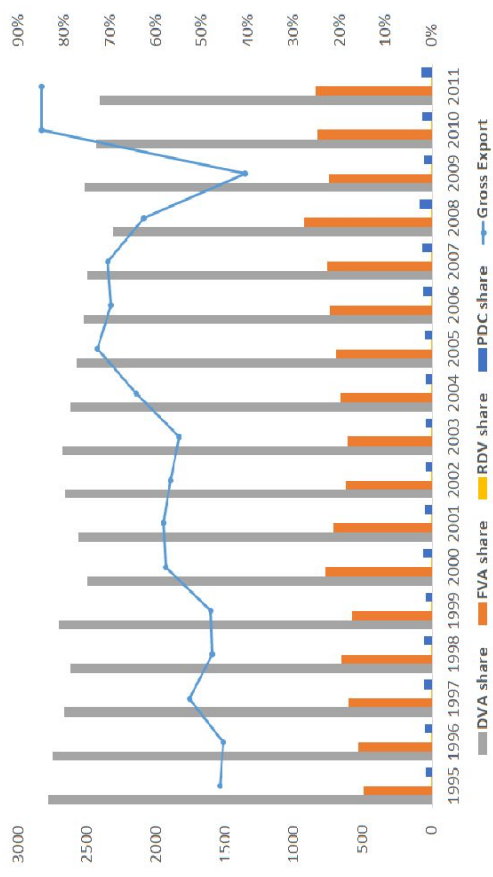
Korean Primary Industry to US



Korean Manufacturing Industry to US



Korean Service Industry to US



Comparison

- At the country aggregate level

$$\begin{aligned}E_s &= VT_s + DOM_s + FOR_s \\E_s &= DVA_s + RVA_s + IVA_s + FVA_s + PDC_s \\DVA_s &= VAX_{F,s} = VAX_{F,s}\end{aligned}$$

- At the country-sector level

$$\begin{aligned}E_{s,i} &\neq VT_{s,i} + DOM_{s,i} + FOR_{s,i} \\E_{s,i} &= DVA_{s,i} + RVA_{s,i} + IVA_{s,i} + FVA_{s,i} + PDC_{s,i} \\DVA_{s,i} &= VAX_{F,s,i} \neq VAX_{F,s,i}\end{aligned}$$

Comparison

- At the bilateral aggregate level

$$\begin{aligned}E'_s &\neq VT'_s + DOM'_s + FOR'_s \\E'_s &= DVA'_s + RVA'_s + IVA'_s + FVA'_s + PDC'_s \\DVA'_s &\neq VAX'_{F,s} = VAX'_{F,s}\end{aligned}$$

- At the bilateral-sectoral level

$$\begin{aligned}E'_{s,i} &\neq VT'_{s,i} + DOM'_{s,i} + FOR'_{s,i} \\E'_{s,i} &= DVA'_{s,i} + RVA'_{s,i} + IVA'_{s,i} + FVA'_{s,i} + PDC'_{s,i} \\DVA'_{s,i} &\neq VAX'_{F,s,i} \neq VAX'_{F,s,i}\end{aligned}$$

Conclusion

- ▶ In country to world level, methodology of KWW(2014) can be used
- ▶ In the sectoral and bilateral level, methodology of WWZ(2013) should be used
 - ▶ Forward linkage based measures should be replaced by more generalized approach of WWZ(2013)