Linking regions to value chains: A subnational input-output analysis of the spatial dimension of value-added trade measures for Brazilian regions

SUPPLEMENTARY MATERIAL

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Bilateral TiVA

Table S1. Bilateral TiVA flows (BRL millions)

State	RO	AC	AM	RR	PA	AP	TO	MA	PI	CE	RN	PB	PE	AL	SE	BA	MG	ES	RJ	SP	PR	SC	RS	MS	MT	GO	DF	RoW (exports)
RO	0	199	391	41	188	24	27	78	37	118	55	57	157	33	31	216	745	128	465	2520	667	425	694	185	663	298	258	1954
AC	198	0	176	12	58	17	11	46	13	58	30	25	82	29	14	93	177	38	153	587	149	86	165	45	100	88	72	81
AM	764	234	0	406	2022	206	196	742	312	935	419	385	1282	225	211	1713	1972	626	2175	8035	1243	1016	1522	371	971	1010	942	1856
RR	33	7	283	0	40	5	5	30	4	15	18	17	46	10	6	36	77	23	110	296	67	45	99	19	30	34	32	30
PA	276	66	489	55	0	256	540	595	497	963	331	325	1102	193	163	774	1964	498	1435	6412	1308	816	1451	320	665	1101	962	17,392
AP	13	8	35	4	80	0	15	52	23	47	36	28	59	13	12	78	107	32	152	379	80	48	100	18	23	35	87	128
TO	52	12	179	11	610	40	0	543	126	218	91	93	253	58	58	707	561	125	497	1469	318	220	350	84	155	381	579	1583
MA	114	28	268	25	1974	107	476	0	994	1100	529	413	996	197	181	1052	1121	336	1580	3829	812	604	1015	179	300	502	647	3101
PI	59	14	121	16	486	63	103	1038	0	846	402	235	648	147	116	841	353	171	411	1205	217	200	239	52	118	195	322	981
CE	189	63	501	58	1327	162	255	2071	1359	0	1304	1420	3793	228	175	2375	1416	345	710	3807	773	297	785	208	306	612	1054	2783
RN	58	22	259	29	315	65	26	487	194	2018	0	1976	1996	138	139	1247	238	213	860	1390	117	146	380	21	44	65	474	719
PB	97	25	146	16	326	61	66	526	170	863	1489	0	3049	565	190	1024	500	223	554	1498	234	209	328	64	119	195	455	314
PE	291	81	560	75	1274	146	263	1923	1246	2697	2931	5583	0	2184	820	5841	1876	508	1417	5523	664	316	1002	229	463	851	1375	1756
AL	74	40	238	16	343	48	78	377	184	486	537	869	2959	0	509	2327	903	145	564	1728	223	118	398	113	158	390	471	1076
SE	77	22	172	21	356	47	57	318	146	430	257	304	986	494	0	1941	511	226	722	1371	201	171	356	56	110	189	354	269
BA	155	62	659	80	1063	149	326	979	1017	2316	911	829	3530	1086	2079	0	6138	3262	5591	14,727	1915	1353	3533	737	1484	2939	5346	11214
MG	1143	359	2256	267	3524	433	889	2534	994	2907	1242	1259	3422	1059	1068	6443	0	3677	11011	46,004	6557	5248	5578	2053	3258	11711	6678	44,337
ES	145	44	451	43	1115	74	146	809	379	512	253	329	683	220	228	4468	3747	0	10772	5971	916	712	1024	258	387	836	945	12,887
RJ	751	172	1908	211	1706	340	752	1634	992	1926	1149	1449	2506	915	833	11,310	22830	6324	0	77,768	10082	6858	10580	2170	3760	5707	10007	52,549
SP	6870	1952	12,370	1854	18,133	2518	6097	12,922	6088	15,251	6862	7918	18,519	5744	4440	41,056	99,113	15,891	94203	0	83682	35648	52838	21,972	21321	19,995	12,700	165,216
PR	938	246	1494	194	1744	267	438	1134	539	1518	665	748	1777	549	485	3970	7889	2180	9426	64,417	0	10349	7172	2231	1944	3480	4434	30,801
SC	311	73	759	95	877	138	365	1452	542	568	243	548	791	236	266	2601	4907	781	3491	28,107	9964	0	10839	1002	1331	2293	2427	18,851
RS	1013	237	1961	274	2742	444	776	2961	1106	2116	1002	1298	2483	692	598	5135	7453	2154	7376	34,002	8254	8258	0	1901	2818	3994	4192	36,198
MS	339	86	534	58	608	102	129	401	165	391	179	187	501	153	116	977	1768	535	1947	11,967	2053	1308	1946	0	866	1316	1169	6747
MT	1012	202	1814	124	1414	147	266	765	301	811	357	390	1055	249	223	2328	3196	645	2466	7991	1582	1209	2211	707	0	2121	2094	16,989
GO	497	148	918	146	1763	204	606	1235	492	994	437	435	1263	376	322	1658	7030	1170	3821	17,072	1389	1703	2486	709	1647	0	8667	8345
DF	853	185	1108	112	2694	366	893	2152	816	2352	1402	1377	3158	858	818	3751	8647	2071	9264	20,851	3194	3699	4185	873	2048	9009	0	546
RoW (imports)	1503	395	10,479	258	6082	304	1224	3484	1343	5437	2641	1865	7745	1976	1988	16,264	34742	10019	50759	146,358	27,314	16,788	26,350	5085	7803	10,448	8246	0

Note: Brazilian regions in table: **(1) Macrozone North**: RO Rondonia, AC Acre, AM Amazonas, RR, Roraima, PA, Pará, AP Amapá, TO, Tocantins; **(2) Macrozone Northeast**: MA Maranhão, PI Piauí, CE Ceará, RN Rio Grande do Norte, PB Paraíba, PE Pernambuco, AL Alagoas, SE Sergipe, BA Bahia; **(3) Macrozone Southeast**: MG Minas Gerais, ES Espírito Santo, RJ Rio de Janeiro, SP São Paulo; (**4) Macrozone South**: PR Paraná, SC Santa Catarina, RS Rio Grande do Sul; **(5) Macrozone Midwest**: MS Mato Grosso do Sul, MT Mato Grosso, GO Goiás, DF Distrito Federal.

Decomposition of TiVA

Table S2. Decomposition of VA (selected indicators)

Macrozone	State	DVA	VA/GO	E/GO	E/VA	Inter-regional TiVA (BRL millions)					GVC [1]
						North	Northeast	Southeast	South	Midwest	
North	RO	32,309	28.6%	6.3%	11.2%	870	782	3,857	1786	1404	1954
	AC	12,304	30.9%	0.6%	0.8%	471	389	956	401	304	81
	AM	72,281	29.2%	2.1%	4.9%	3,828	6223	12,807	3780	3294	1856
	RR	9363	32.0%	0.3%	0.4%	373	182	506	210	115	30
	PA	117,550	31.2%	14.0%	24.3%	1,681	4943	10,309	3576	3048	17,392
	AP	12,680	32.7%	1.3%	1.8%	155	348	669	228	162	128
	TO	26,046	26.5%	6.6%	11.6%	904	2147	2653	889	1198	1583
Northeast	MA	69,370	31.2%	4.2%	7.1%	2,993	5463	6866	2432	1627	3101
	PI	34,723	30.1%	2.8%	4.5%	861	4273	2140	655	687	981
	CE	114,157	29.8%	2.4%	4.1%	2555	12,725	6278	1856	2179	2,783
	RN	50,889	29.8%	1.5%	2.6%	773	8193	2702	643	604	719
	PB	49,610	31.4%	0.8%	1.2%	737	7876	2774	770	833	314
	PE	134,105	27.9%	1.6%	3.1%	2,690	23,225	9325	1982	2919	1756
	AL	41,993	36.3%	2.8%	4.4%	838	8247	3340	739	1133	1076
	SE	34,415	32.3%	0.8%	1.4%	752	4876	2829	727	708	269
	BA	215,660	27.5%	5.5%	11.4%	2496	12,748	29,718	6801	10,505	11,214
Southeast	MG	457,284	29.7%	8.8%	17.6%	8869	20,930	60,692	17,384	23,700	44,337
	ES	100,343	29.7%	12.0%	23.7%	2018	7881	20,490	2652	2426	12,887
	RJ	556,164	31.4%	7.6%	14.7%	5840	22,714	106,923	27,520	21,644	52,549
	SP	1,633,314	28.2%	8.1%	16.5%	49,793	118,801	209,207	172,168	75,989	165,216
South	PR	327,047	28.8%	8.6%	18.3%	5322	11,385	83,912	17,521	12,090	30,801
	SC	209,667	29.6%	8.3%	16.5%	,616	7247	37,286	20,802	7052	18,851
	RS	334,842	28.2%	9.4%	19.7%	7447	17,392	50,985	16,512	12,904	36,198
MidWest	MS	74,086	29.1%	9.1%	18.4%	1856	3070	16,218	5307	3350	6747
	MT	97,283	26.7%	16.1%	37.0%	4980	6479	14,298	5002	4923	16,989
	GO	154,347	27.8%	5.6%	11.3%	4282	7211	29,093	5578	11,023	8345
	DF	183,769	30.9%	0.4%	0.6%	6210	16,685	40,833	11,078	11,930	546

Legend: VA – Value-Added, GO – Gross Output, E – Exports.
Note: [1] – exports TiVA.

Table S3. Distribution of VA to GVC

Macrozone	State	GVC (share of DVA) [1]	Distribution of TiVA to GVC [2]			
			Agriculture	Mining	Manufacturing	Tertiary
North	RO	6%	53%	1%	21%	25%
	AC	1%	81%	0%	11%	8%
	AM	3%	14%	1%	51%	35%
	RR	0%	77%	0%	17%	6%
	PA	15%	14%	55%	10%	21%
	AP	1%	21%	11%	46%	22%
	TO	6%	73%	0%	8%	19%
Northeast	MA	4%	61%	1%	20%	19%
	PI	3%	86%	0%	3%	10%
	CE	2%	28%	1%	40%	30%
	RN	1%	48%	8%	21%	23%
	PB	1%	10%	4%	66%	20%
	PE	1%	16%	0%	47%	37%
	AL	3%	23%	0%	57%	20%
	SE	1%	14%	0%	60%	25%
	BA	5%	34%	3%	33%	31%
Southeast	MG	10%	17%	25%	26%	32%
	ES	13%	13%	32%	21%	33%
	RJ	9%	0%	26%	17%	56%
	SP	10%	4%	2%	29%	65%
South	PR	9%	28%	0%	33%	39%
	SC	9%	11%	0%	44%	44%
	RS	11%	32%	0%	34%	34%
MidWest	MS	9%	49%	3%	24%	25%
	MT	17%	64%	0%	9%	27%
	GO	5%	44%	5%	21%	30%
	DF	3%	30%	0%	26%	44%

Note: [1] – It represents how much of the DVA is destined for GVC. [2] – The sum of the four columns is 100%, being the total of TiVA to exports broken down into four large industrial groups.

Table S4. Distribution of interregional TiVA by macrozones' destinations

Macrozone	State	Extension of DVC [1]				
		North	Northeast	Southeast	South	Midwest
North	RO	10%	9%	44%	21%	16%
	AC	19%	15%	38%	16%	12%
	AM	13%	21%	43%	13%	11%
	RR	27%	13%	36%	15%	8%
	PA	7%	21%	44%	15%	13%
	AP	10%	22%	43%	15%	10%
	TO	12%	28%	34%	11%	15%
Northeast	MA	15%	28%	35%	13%	8%
	PI	10%	50%	25%	8%	8%
	CE	10%	50%	25%	7%	9%
	RN	6%	63%	21%	5%	5%
	PB	6%	61%	21%	6%	6%
	PE	7%	58%	23%	5%	7%
	AL	6%	58%	23%	5%	8%
	SE	8%	49%	29%	7%	7%
	BA	4%	20%	48%	11%	17%
Southeast	MG	7%	16%	46%	13%	18%
	ES	6%	22%	58%	7%	7%
	RJ	3%	12%	58%	15%	12%
	SP	8%	19%	33%	28%	12%
South	PR	4%	9%	64%	13%	9%
	SC	3%	10%	50%	28%	9%
	RS	7%	17%	48%	16%	12%
MidWest	MS	6%	10%	54%	18%	11%
	MT	14%	18%	40%	14%	14%
	GO	7%	13%	51%	10%	19%
	DF	7%	19%	47%	13%	14%

Note: [1] – Represents how much each State (rows) sends from VA to the states destined to each macrozone (column). The sum of the columns is 100%, being the total interregional TiVA.

Table S5. Large industry level interregional TiVA

Macrozone	State (origin)	Agriculture' DVC					Mining' DVC					Manufacturing' DVC					Tertiary' DVC				
		NO	NE	SE	SO	MW	NO	NE	SE	SO	MW	NO	NE	SE	SO	MW	NO	NE	SE	SO	MW
North	RO	2%	2%	13%	9%	8%	0%	0%	0%	0%	0%	1%	1%	5%	2%	2%	7%	6%	26%	10%	7%
	AC	4%	5%	16%	8%	6%	0%	0%	0%	0%	0%	1%	1%	3%	1%	1%	13%	9%	19%	7%	5%
	AM	1%	2%	6%	2%	2%	1%	1%	2%	1%	0%	6%	10%	18%	5%	5%	5%	8%	17%	5%	4%
	RR	5%	4%	12%	5%	4%	0%	0%	0%	0%	0%	1%	0%	1%	0%	0%	21%	8%	23%	9%	4%
	PA	2%	7%	18%	7%	5%	0%	1%	3%	1%	0%	1%	3%	6%	2%	2%	4%	10%	17%	6%	6%
	AP	1%	2%	4%	1%	1%	0%	0%	0%	0%	0%	1%	2%	4%	1%	1%	8%	19%	35%	12%	9%
	TO	2%	5%	10%	5%	4%	0%	0%	0%	0%	0%	1%	2%	3%	1%	1%	9%	20%	20%	6%	10%
Northeast	MA	2%	5%	8%	3%	2%	0%	1%	1%	0%	0%	3%	4%	6%	2%	1%	10%	18%	21%	7%	5%
	PI	1%	6%	6%	2%	2%	0%	0%	0%	0%	0%	1%	4%	3%	1%	1%	8%	39%	15%	5%	5%
	CE	1%	5%	4%	1%	1%	0%	0%	0%	0%	0%	2%	10%	6%	1%	2%	7%	35%	14%	4%	6%
	RN	0%	4%	2%	1%	0%	1%	8%	4%	1%	0%	1%	10%	3%	1%	0%	4%	42%	12%	3%	4%
	PB	0%	6%	3%	1%	1%	0%	1%	0%	0%	0%	1%	11%	5%	1%	1%	4%	43%	13%	3%	5%
	PE	0%	4%	3%	1%	1%	0%	0%	0%	0%	0%	2%	13%	7%	1%	2%	5%	40%	13%	3%	5%
	AL	1%	16%	7%	2%	2%	0%	1%	0%	0%	0%	1%	7%	4%	1%	1%	4%	34%	11%	3%	4%
	SE	0%	6%	5%	1%	1%	1%	4%	4%	1%	0%	1%	8%	5%	1%	1%	5%	31%	15%	4%	5%
	BA	0%	3%	10%	2%	3%	0%	1%	2%	0%	0%	1%	5%	12%	2%	4%	3%	12%	24%	6%	10%
Southeast	MG	0%	1%	5%	2%	2%	0%	0%	2%	1%	0%	2%	4%	15%	3%	4%	5%	11%	24%	7%	11%
	ES	0%	1%	3%	1%	0%	1%	4%	17%	2%	1%	1%	3%	10%	1%	1%	4%	14%	28%	4%	5%
	RJ	0%	0%	1%	0%	0%	0%	2%	12%	3%	1%	0%	1%	8%	2%	1%	2%	9%	37%	10%	9%
	SP	0%	0%	1%	1%	0%	0%	0%	0%	0%	0%	1%	4%	9%	7%	3%	7%	15%	23%	19%	9%
South	PR	0%	1%	11%	2%	1%	0%	0%	0%	0%	0%	1%	2%	19%	3%	2%	3%	6%	35%	8%	6%
	SC	0%	1%	6%	4%	1%	0%	0%	0%	0%	0%	1%	3%	21%	9%	3%	2%	6%	23%	14%	5%
	RS	0%	1%	8%	3%	2%	0%	0%	0%	0%	0%	2%	4%	17%	4%	3%	5%	11%	23%	8%	7%
MidWest	MS	1%	2%	20%	7%	3%	0%	0%	0%	0%	0%	1%	2%	10%	3%	2%	4%	6%	24%	8%	6%
	MT	1%	3%	11%	4%	3%	0%	0%	0%	0%	0%	2%	3%	7%	2%	2%	11%	12%	22%	7%	9%
	GO	1%	2%	12%	3%	3%	0%	0%	1%	0%	0%	2%	3%	13%	2%	4%	5%	8%	25%	5%	13%
	DF	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	7%	19%	46%	13%	13%

Note: Each line is the state of origin, and in the columns is the destination macrozone of TiVA in four large industrial groups. The row' sum is 100%.

Table S6. Revealed Comparative Advantage (RCA) for specialized industries to foreign markets[1]

Industry	Non-Core				Core (Southeast)			
	North	Northeast	Midwest	South	SP	RJ	MG	ES
A - Agriculture, livestock, forest production, fisheries, and aquaculture	1.4	2.3	3.5	1.7			1.1	
B - Extractive industries	4.3					2.7	2.6	3.3
C - Manufacturing industries		1.2		1.3	1.1			
D - Electricity and gas	1.5	1.1	2.0	1.2			1.4	
E - Water, sewage, waste management and decontamination activities						1.1	2.0	2.2
F - Construction				2.1				1.1
G - Trade; repair of motor vehicles and motorcycles			1.1	1.2	1.2			
H - Transport, storage, and mail					1.2	1.3		1.3
I - Accommodation and food					1.6	1.8		
J - Information and communication					1.8			
K - Financial, insurance and related services					1.8			
L - Real estate activities					1.9			
M - Professional, scientific, and technical activities					1.3	2.0		
N - Administrative activities and complementary services					1.6	1.5		
O - Public administration, defense, and social security					1.2	1.3		
P – Education					1.1	2.0	1.3	
Q - Human health and social services					1.6	2.5		
R - Arts, culture, sport, and recreation					2.0	1.6		
S - Other service activities					1.2	1.1		1.1
T - Domestic services								

Note: Only RCA > 1.0 significant at 99% of significance are presented (z-critical of 2.575) calculated based on Moineddin et al. (2003).

Legend: NO (North), NE (Northeast), MW (Midwest), SO (South), S.P. (Sao Paulo), R.J. (Rio de Janeiro), M.G. (Minas Gerais), and E.S. (Espírito Santo).

Source: Authors 2021.

Table S7. Clustering results (K-means method)

Brazilian state	Macrozone	Cluster
AM	North	1
AP	North	1
BA	Northeast	1
PR	South	1
SC	South	1
RS	South	1
MS	Midwest	1
GO	Midwest	1
DF	Midwest	1
MG	Southeast	2
ES	Southeast	2
RJ	Southeast	2
SP	Southeast	2
PI	Northeast	3
CE	Northeast	3
RN	Northeast	3
PB	Northeast	3
PE	Northeast	3
AL	Northeast	3
SE	Northeast	3
RO	North	4
AC	North	4
RR	North	4
PA	North	4
TO	North	4
MA	Northeast	4
MT	Midwest	4

Note: The result is based on the Kmeans cluster, further proving a general classification of each Brazilian state in terms of value-added trade pattern considering both DVC – intraregional and interregional – and GVC trade flows.

Table S8. Variables considered in cluster analysis

Variables	Description
dva	Total domestic value-added for each state
gvc_to	Total value-added to exports for each state
intrazone_va	Total TiVA retained within each Brazilian admistrative macrozones, by state
intra_consumption	Total TiVA consumed within each Brazilian administrative macrozones, by state
intra_macro	Total TiVA generated within each Brazilian administrative macrozones, by state
interregional_share	Total interregional TiVA, by state
gvc_share_of_total	Share of TiVA in expors by the total TiVA traded by each state
gvc_agriculture	Relative participation of TiVA in agriculture by the total TiVA for GVC
gvc_mining	Relative participation of TiVA in mining by the total TiVA for GVC
gvc_manufacturing	Relative participation of TiVA in manufacturing by the total TiVA for GVC
gvc_tertiary	Relative participation of TiVA in tertiary industries by the total TiVA for GVC
agric_to_north	Total TiVA in agriculture for Northern states, by state of origin
agric_to_northeast	Total TiVA in agriculture for Northeastern states, by state of origin
agric_to_southeast	Total TiVA in agriculture for Southeastern states, by state of origin
agric_to_south	Total TiVA in agriculture for Southern states, by state of origin
agric_to_midwest	Total TiVA in agriculture for Midwestern states, by state of origin
mining_to_north	Total TiVA in mining industries for Northern states, by state of origin
mining_to_northeast	Total TiVA in mining industries for Northeastern states, by state of origin
mining_to_southeast	Total TiVA in mining industries for Southeastern states, by state of origin
mining_to_south	Total TiVA in mining industries for Southern states, by state of origin
mining_to_midwest	Total TiVA in mining industries for Midwestern states, by state of origin
manuf_to_north	Total TiVA in manufacturing industries for Northern states, by state of origin
manuf_to_northeast	Total TiVA in manufacturing industries for Northeastern states, by state of origin
manuf_to_southeast	Total TiVA in manufacturing industries for Southeastern states, by state of origin
manuf_to_south	Total TiVA in manufacturing industries for Southern states, by state of origin
manuf_to_midwest	Total TiVA in manufacturing industries for Midwestern states, by state of origin
tertiary_to_north	Total TiVA in tertiary industries for Northern states, by state of origin
tertiary_to_northeast	Total TiVA in tertiary industries for Northeastern states, by state of origin
tertiary_to_southeast	Total TiVA in tertiary industries for Southeastern states, by state of origin
tertiary_to_south	Total TiVA in tertiary industries for Southern states, by state of origin
tertiary_to_midwest	Total TiVA in tertiary industries for Midwestern states, by state of origin

FIGURES

AGRICULTURE

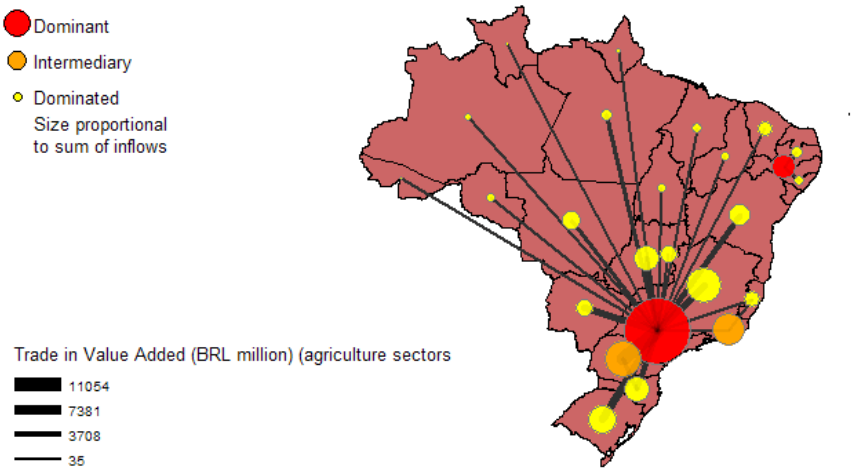

Figure S1. Interregional industry-level hierarchical TiVA (agriculture, all regions)

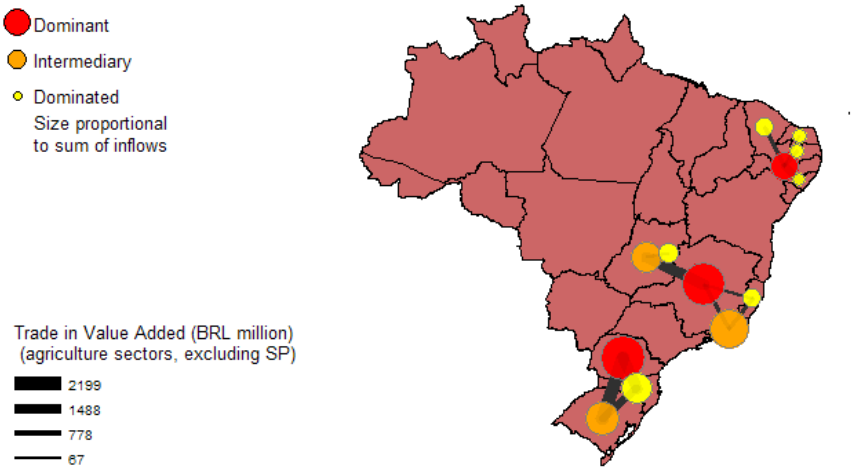

Figure S2. Interregional industry-level hierarchical TiVA (agriculture, excluding Sao Paulo)

MINING

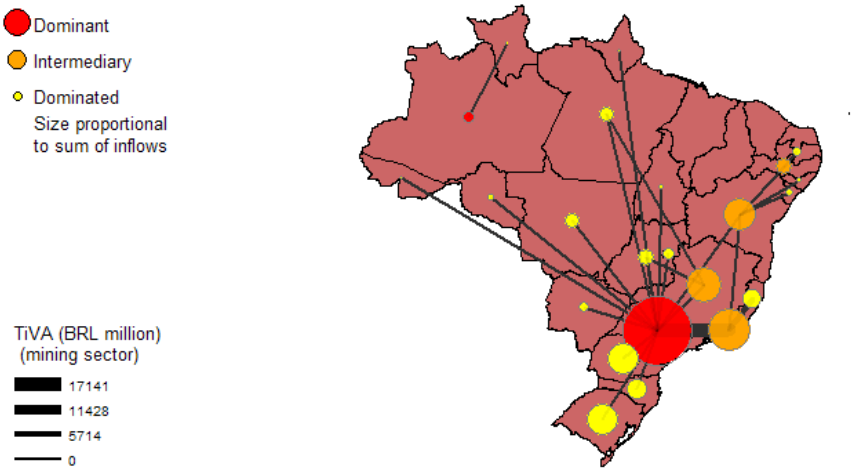

Figure S3. Interregional industry-level hierarchical TiVA (mining, all regions)

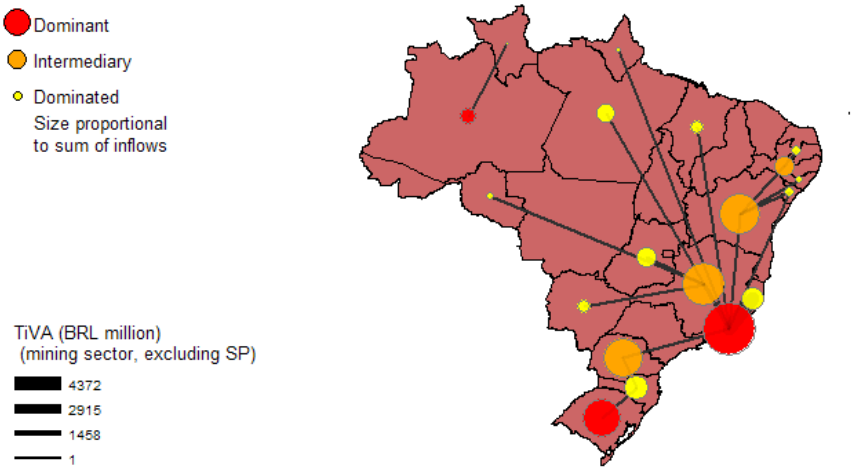

Figure S4. Interregional industry-level hierarchical TiVA (mining, excluding Sao Paulo)

MANUFACTURING

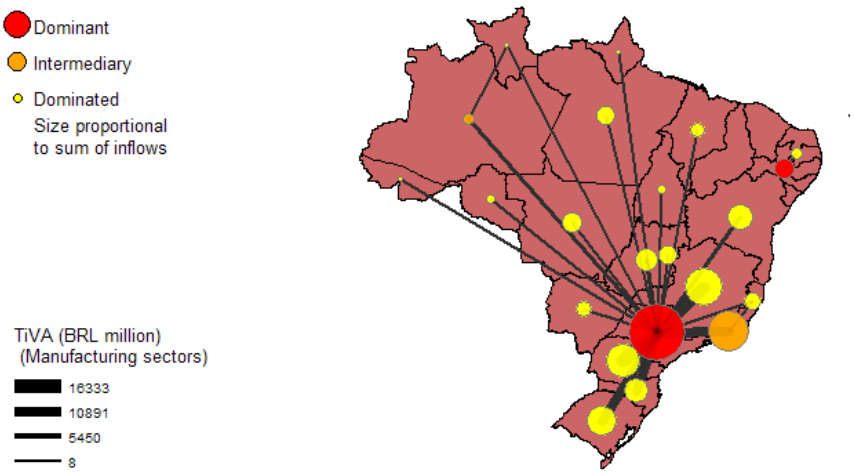

Figure S5. Interregional industry-level hierarchical TiVA (manufacturing, all regions).

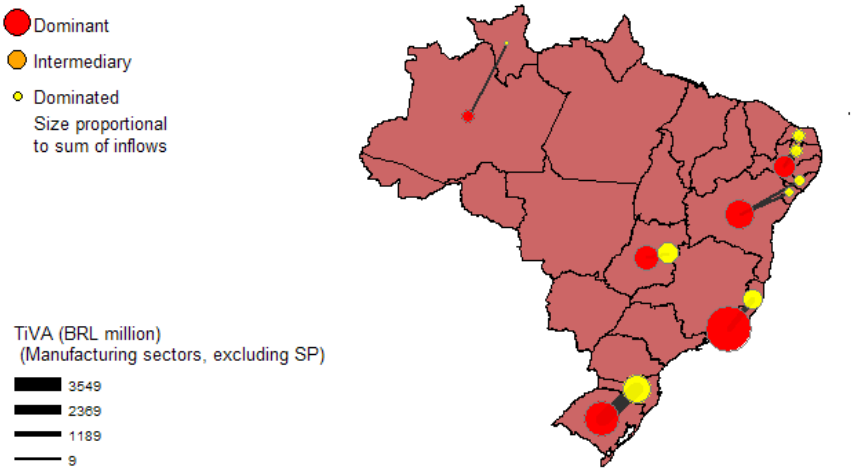

Figure S6. Interregional industry-level hierarchical TiVA (manufacturing, excluding Sao Paulo)

TERTIARY

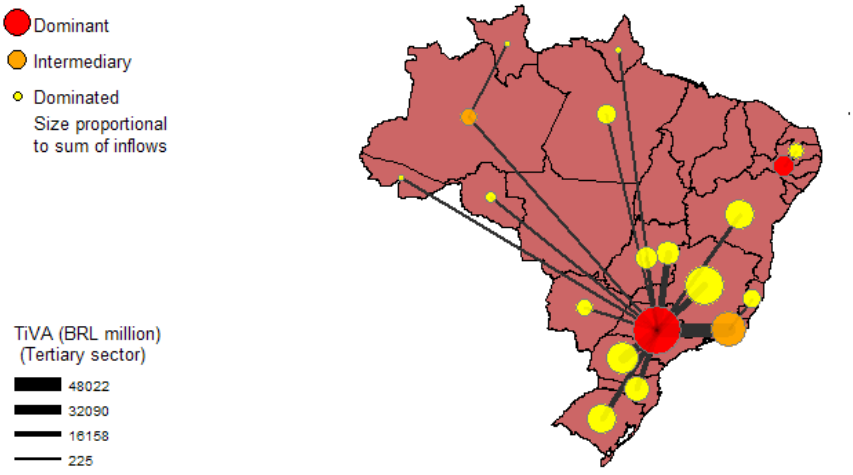

Figure S7. Interregional industry-level hierarchical TiVA (tertiary, all regions)

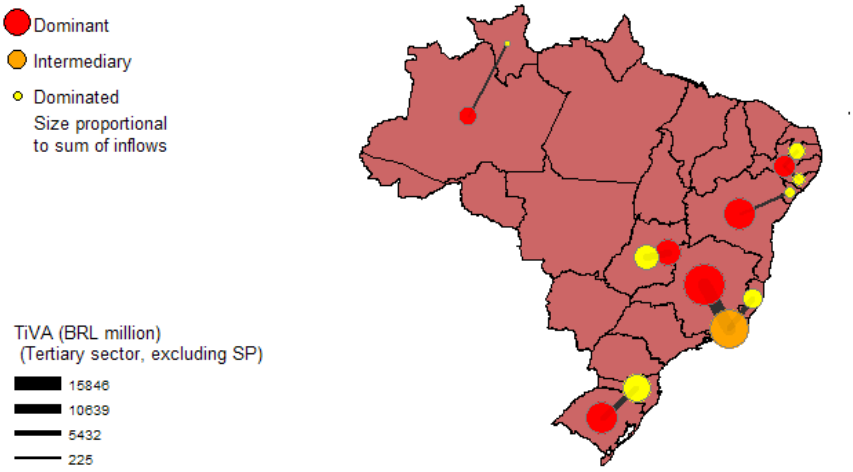

Figure S8. Interregional industry-level hierarchical TiVA (tertiary, excluding Sao Paulo)

Figure S9. Connectivity trade levels by Brazilian region