CONSTRUCTING AN URBAN FREIGHT EXPOSURE INDEX FOR A LARGE CITY

Conference Croatia 2019

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There are dozens of freight metrics – but what does the public observe?

(Easily searched in the Literature)

The contention is there are four variables observed by the community:

1 - Number of Trucks observed
2 - Dwell time of trucks on the road network
3 - Emissions…Diesel Particulate Matter (PMx)
4 – Crashes – causing delays

Australian Bureau of Transport and Regional Economics

Recent report
Freight Measurement and Modelling in Australia

http://www.btre.gov.au/publications/76/Files/R112.pdf

March 2006

Two metrics ONLY
Tonne Kilometers, Tonnes

Pick a target City that we have data for

Melbourne (Australia)

State Capital City Victoria

Population 5 million (2018)

Constructing an Index from the four variables for Trucks > 4.5 Tonnes GVM operating in the city

Input Variables

1: City Truck Numbers (In PCU Equivalents) ✓
2: Truck Active Dwell Time on roads ✓
3: Estimated Particulate matter output ✓
4: Truck Crashes (per 1000 insured freight units) ✓

Possible to start the index construction

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Getting Started

Trucks Numbers in the City

- Yes: This is available for Australian Capital Cities by truck configuration
- But trucks have different lengths and are getting longer
- Use Passenger Car Units as a measure of length (PCU equivalents)

- Basic unit – PCU 1 = a Toyota Corolla

Melbourne Trucks 1998 - 2016

Vehicle Type	1998 Trucks	PCUs	2016 Trucks	PCUs	PCU Growth p.a.	Length
Total 2 Axle Rigid	43869	109377	55716	159593	1.00%	6.6 to 16.5
Total 3 and 4 Axle Rigid Trucks	87738	218754	111432	319186	4.29%	9 to 19
Total Articulated and Other Trucks	230914	592773	294768	865853	2.20%	12.5 - 26

Trucks Operating in Melbourne (ABS SMVU Special data cubes)

2. Calculating Operating hours per day (*) 1998 - 2016

Year	1998	2001	2004	2007	2010	2013	2016
Truck PCUs	109377	116486	124057	132120	140708	149853	159593
Ave speeds arterial roads	45.0	43.0	40.0	40.6	41.0	41.0	40.3
Ave Truck kms p.a	57600	57569	57301	57034	57486	60050	60600
Ave Operating hrs p.a	1280	1339	1433	1405	1402	1465	1503
Ave Operating hrs / day (*)	**3.5**	**3.7**	**3.9**	**3.8**	**3.8**	**4.0**	**4.1**
PCU hrs/day *	383569	427269	486889	508492	540507	601311	657371

*Note *: based on a 24 hour day and a 365 day year*
Source: ABS SMVU , various years, AAA 2018, VicRoads estimates)

3. Calculating Particulate Truck emissions 1998 - 2016

Emission Rating	Introduction Date	PM grams/km
ADR70/00	1979	0.192
Euro 1	1995	0.140
Euro 3	2002	0.080
Euro 4	2007	0.025
Euro 5	2011	0.005
Euro 6	Not as yet	0.005

3a. Calculating Particulate Truck emissions 1998 - 2016

Year	1998	2002	2007	2011	2016	Growth p.a
Rigid Trucks	34474	35538	36915	38054	39528	0.76%
Articulated Trucks	9395	10602	12332	13917	16188	3.07%
Kms p.a Rigid	21400	21500	21300	24200	25400	0.96%
Kms p.a Articulated	36200	36000	35700	35500	35200	-0.16%
Tonnes PM	**202.8**	**206.5**	**187.2**	**156**	**125**	**-2.65%**

4. Calculating Truck Crashes 1998 - 2016

Year	1998	2001	2004	2007	2010	2013	2016	% Growth
Accident Rate/1000 Units	3.37	3.45	3.95	2.60	2.50	3.10	3.17	-6%

No exact figures but estimates based on very large insurer , rates for Melbourne per 1,000 insured units (NTARC various years)

5. Getting the weights for Index Inputs

Survey	Input 1 Truck Numbers	Input 2 Dwell time	Input 3 PMx	Input 4 Crashes	Total
Average Score	6.0	6.5	7.5	4.5	**24.5**
Final Weight	**0.245**	**0.265**	**0.306**	**0.184**	**1.00**

Done by survey: n=24 for pilot weights. Who was surveyed?

6. Putting it into an index

Inputs	1998	2001	2004	2007	2010	2013	2016	Total % Growth
Truck PCUs	109377	116486	124057	132120	140708	149853	159593	46%
PCU hrs/Day	383569	427269	486889	508492	540507	601311	657371	71%
Major Accident Rate per 1000 Units	3.37	3.45	3.95	2.60	2.50	3.10	3.17	-6%
Particulate Matter (tonnes)	202.8	204.8	198	185	161	138	122	-40%
Index Weights	1998	2001	2004	2007	2010	2013	2016	
0.250	0.250	0.266	0.284	0.302	0.322	0.343	0.365	46%
0.263	0.263	0.293	0.334	0.349	0.371	0.412	0.451	71%
0.184	0.184	0.188	0.216	0.142	0.136	0.169	0.173	-6%
0.303	0.303	0.306	0.296	0.277	0.241	0.206	0.183	-40%
1.000 (the FEI)	1.000	1.053	1.129	1.069	1.070	1.130	1.171	17%

7. What does it look like?

Heavy Truck Freight Exposure Index - Melbourne 1998 - 2016
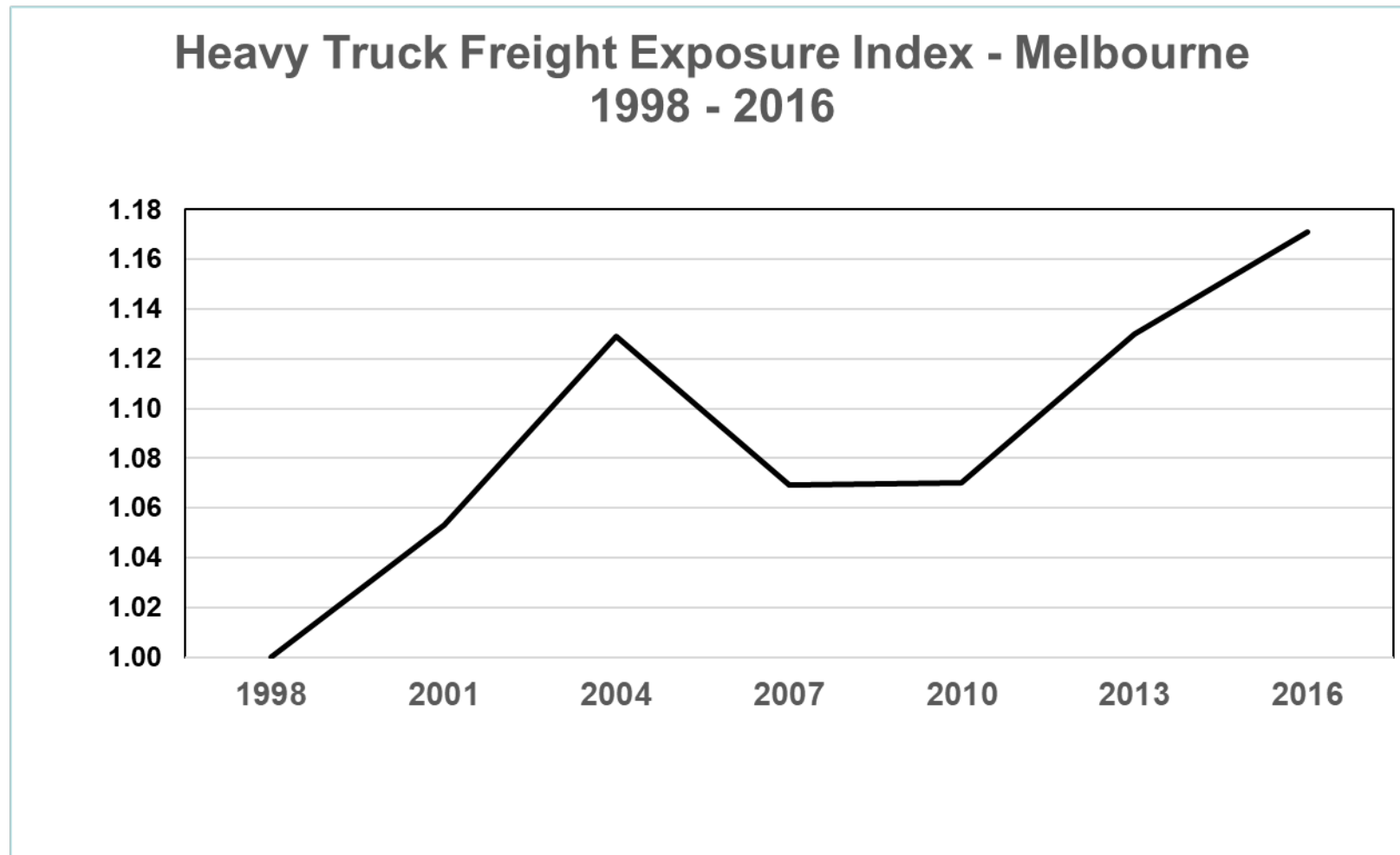
All Melbourne Freight Vehicles 1998 - 2016

Vehicle Type	1998	PCU Equivalents	2016	PCU Equivalents	Per annum growth %
Light Commercial Vehicle	194855	199045	242219	247428	1.21%
Light Truck < 4.5 T GVM	7229	8535	15301	18065	4.25%
Heavy Trucks > 4.5 T GVM	43869	109377	55716	159593	2.12%
Percentage Heavy Trucks vs Light commercials Vehicles and Light Trucks	**21.7%**	**34.5%**	**21.6%**	**37.5%**	na
Total	245,953	316,957	313,236	425,086	1.64% (PCUs) 1.35% (Vehicles)

How do you offset
Urban Freight Exposure ....?

By Reducing any one or more of
the four exposure variables

What would the Freight Exposure Indices look like for say 100 important cities???

Thank you and Questions?

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