City logistics – how to create an OD matrix for goods transports within the city of Oslo?

Abstract

In this paper we will examine the advantages of using existing trade statistics to construct an OD matrix for freight transport for a city area. The OD matrix is constructed by examining how a wholesaler relate to the retailer industries. If this work is successful it will improve the quality of data quite substantially for city models. The result from use of such information may give more accurate results and have the potential for improving the planning of a city area. The outline of this paper will first be a stepwise recipe for constructing the OD –matrix and finally discuss some of the assumptions we have done in order to arrive to the result of construction of a matrix. We will finally discuss how robust is this method compared to survey data.

Key words: City logistics, trade, freight modelling, urban transport

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The outline of the paper is first to give a background for why this was an important matter to address. This is done in section 1. In the next section we look briefly upon how to get data for freight models and why the described method is to recommend. In the third section we go through the suggested method step by step. In section 4 we go through some of the problem applying the method we recommend. Section 5 outlines the link the trade has to the service sector in urban transport. The sixth section deals with a luxury problem of cutting off too much information applying the method. Lastly we look upon further work and concluding remarks from the work we have done in this field.

1 Introduction

The Oslo area (Oslo and Akershus counties) houses the main supply of the national markets for most commodities in Norway. In this area live 1 million persons of the total population in Norway (4,6 mill). In addition there is a net inflow of employment from the neighbouring municipalities. The area employs 600 000 persons. In this area as opposite for the rest of the country; trade is more important for employment than manufacturing.

The city authorities of Oslo tries to keep the town tidy and let the suppliers (wholesalers and transporters) establish outside the town due to environmental problems. Oslo is lying by the sea with high hills surrounding the city. The traffic pollutes a lot when in addition wood is used during to heat the houses during the winter. The pollution creates health problems for the population.

The authorities have established a toll ring around the city area. But still the traffic from both cars and lorries are heavy. They are therefore investigating whether all the goods traffic is necessary for supplying the city with commodities.

To understand the logistics in detail we need a PWC- matrix (production- wholesale – consumption), which shows us the supply (imports or production) and on the other side the demand for goods (consumption, intermediates or commodities delivered to capital formation). This is solved by the agent in the economy and can be observed as the OD matrix (origin and destination matrix). This matrix gives the flow of goods between smaller areas of Oslo.

Oslo is a capital and the main supplier of goods for the country. In the Osloregion most of the national wholesalers are established. They supply their chain of regional wholesalers with goods. Because Oslo is an important hub for wholesalers, most retailers will have their supply from an Oslo wholesaler. This is an assumption we have made to use the method b) suggested in the paper. (Genrally, one might come around this if your area is not a capital with an assorted wholesaler business by doing assumptions that the supplier should be in the neighbouring area if not in the town one is looking at.)

2 Two approaches to get data for freight modelling

There are two main approaches to get data for constructing a matrix:

a) Collection of data from goods sent by or received by businesses in the Oslo area through a survey

b) The use existing data collected for other statistical purposes

Method a) is expensive if data should be collected to give disaggregated information by location and type of commodity – where we not only catch the main streams of traffic but also have ambition to cover more marginal transports in the outskirt areas of Oslo.

There is also a problem of how to design a representative study in order to get non-biased results. Questions to ask are:

- Do you know what would be the weakness and the flaws in your survey? There are little available data to compare the results from such survey.
- But the biggest problem is whether you have collected a true picture through your survey or a biased one.

Method b) is inexpensive but not as accurate as data from method a). But if we are able to handle the problems with the method, we will be able to give an overview of the logistics at lower costs.

The main problem with this method is whether you know exactly which wholesalers are delivering to which retailers within a branch (wholesale/retail branch combination).

A small retailer will probably only have deliveries from a few wholesalers. A bigger retailer will have deliveries from many wholesalers within one or more branches. (A branch in this context is the most detailed NACE Rev adapted to the Norwegian Standard KAU – Kind of Activity Unit used by Statistics Norway).

3 Suggested Method step by step

In this paper we will examine the advantages to use method b) to construct an OD matrix for a city area. If this work is successful it will improve the quality of data quite substantially for such models.

The outline of this paper will first be a stepwise recipe for constructing the OD –matrix and finally discuss some of the assumptions we have done in order to arrive to the result of construction of a matrix.

Step 1 – Who are the customers to a specific wholesaler in a branch?

In Norway we have at the disaggregated level around 8 sectors of agents of tradables, 55 wholesalers' industries and 65 retailers' industries. The first job was to combine these in such way that we could give an answer to which wholesaler and/or agent deliver to which type of shop. In the national accounts one would think; is this or this sector the main delivering sector and which sectors are bi-deliverance sectors? We constructed such system from general knowledge[1] of the trade sector. Some wholesaler are not delivering commodities to retailers but to manufacturing or the construction sector. We did not bother to include these deliveries, as most often they are not sent into the city, but delivered to plants located outside the city area.

Step 2 - Ordering the trade statistics – at which aggregation level would be best?

We ordered two years (2000 and 2001) of trade statistics from Statistics Norway. The statistics contained information that could harm the competition between traders. We signed a petition that the statistics just to be used for research and that the information should be

[1] We had some support from a Statistics Norway report, which scrutinized the deliverances in the trade sector of Norway. The report was accomplished in the 80ies for the use of the National Accounts (NA) of Norway but was never used because the trade sector has never been divided in to wholesale- and retailing in the Norwegian NA.

deleted when the work was finished. We chose the aggregation level that included the most detailed level (both by location and by industry) we could get the data.

Step 3 – All estimates converted to basic prices excluding indirect taxes and trade margins

After receiving the data we deducted the margins in such way that the data was in value terms excluding vat and margins. The data on the wholesaler (supply side) and retailer (demand side) was then transformed into basic values.

Step 4 – Calculating all estimates in to basic values

In value terms we had transformed the data in to basic values equal values for both the wholesaler and the retailer. (The data also included the agent side for those we used the wholesalers margins. (We were lucky for the Statistics Norway had just published a survey[2] of the wholesalers' margins for different sectors corresponding to the sectoring of the trade statistics. The margins of the retailers had to be calculated from a year far back and looking at the price statistics for a wholesale price index and compare it to price statistics of the CPI. (The retailers margins were distinctly higher earlier compared to recent years.)

Step 5 – "Translation" of the value figures to ton estimates

In transport we like to see the tonnes to be transported although the values per ton of a commodity tells us to what degree is it necessary to fill the lorry or not. In order to do this the only known source of information is the foreign trade statistics. The "translation" can obvious be done more or less sophisticated. But as one have both the values and the volumes of all HS commodities, this was done on the second digit level (less than 100 commodities). We used mostly the same values for the delivering wholesaler and the recipient retailer. (This assumption may well be discussed; the arguments are that the average incoming price of retailing commodities will generally be higher than the average outgoing price of wholesaling due to that relative more expensive commodities (within a specific commodity group) are handled in retail compared to the ones directly handled through wholesaling.

Step 6 - Comparing demand and supply in the Oslo market

Take one market where the supply (the sum of all commodities (in tons) from the wholesalers ion Oslo (W_j where all the j's are the different commodities defined)) compares to the demand (the identical sum (in tons) for the same commodity of the retailers R_j).

If Sum (W_j) > Sum (RIf Sum (R > Sum (W_j)=> we assume that the retailers not just receive the commodities from the wholesalers in the Oslo area, but they also receive from wholesalers in other areas or that the retailers are importing the commodities directly, skipping the wholesale traders.

4 Problems of the applying the suggested method

We will look at some of the problems of applying this method and for some we are discussing how the problem is solved.

Some bigger retailers skip the wholesaling business and order the traded commodities directly from a producer or a foreign wholesaler.

We know from earlier studies that some retailers are skipping the wholesale trader. Why are retailers and others skipping the wholesale traders? Possibly because they have knowledge of

[2] The Survey on Wholesalers' Trade margins in Norway was published in 2000 on 1998 data. The survey was made from a stratified random sample containing 3590 establishments from a population of 17 818 wholesale establishments. It contains detailed data on the margins.

their customers' needs just for larger volumes of a specific commodity. Then they do not see any need to let the commodity go through a wholesaler. It will just make their business less profitable.

This is difficult problem to deal with. We have so far just assumed that all retailers are buying the commodities from a national wholesaler. We have not collected other information.

Another severe problem; within a commodity group which retailers receive from which wholesaler in Oslo?

We do not know. The first thought of a transport economist would be to think of a gravity model, but on second thoughts, this is not a good idea. No one would rule out a supplier because he is 30 kms distance away from your shop compared to the supplier that is only 5 kms away. There are probably other criteria for the selection that are more important than the distance from the supplier to the retail store.

The selected solution is that all suppliers feed all the shops within a commodity group. That is the best we can do. Other solutions will be biased. The biggest suppliers (wholesalers) have organised routes of supplies of their products to the shops in town. These wholesalers have trade marks products that are very "in", say in clothing, sports equipment and in other branches where there are focused on trends. In other branches t ex in the food supply the shops are organised in chains where there is a purchasing unit which bargains with the wholesalers on behalf of all the shops in the chain. The central unit organises in and out transports for the shops (traded commodities in and rubbish and waste out). Still some products are more difficult than others. In Oslo such products are food products as milk, fresh meat and fresh fish.

Another problem we so far have not dealt with is the problem of how the tons represent in terms of transport.

Transports of expensive goods have smaller than full truckloads (FTL) compared by low value goods. Transports of jewellery of gold and silver have hardly a transport of higher weight than 50 kg while other transports have a FTL that is up to the vehicle's capacity in tons or m^3.

5 The link to the service sector

Some of the wholesalers (t ex printing and office equipment and machinery) will deliver commodities to the service sector located in a city area. It would be of interest to include such activities in the network because the service sectors are most important for city freight transports. If the service sectors constitute the major share of the wholesalers' budgets, this is easy. If not one need an interview to find out who is the main supplier of such products to the service sector.

We have not included the service sector in our work, but as long as there is an establishment registry for the city area where postal and activity codes are defined, there should not be difficulty in including the demand from offices as a receiving sector. But the demand for paper and office machinery such as pc's, printers and copy machines from every office is not specified.

We know the supply from the wholesalers, but we do not know the size of the demand from the city area compared to the rest of the country. Wigan et al (2002) presented an interesting work where distinguishing between transport flows usually reflected in freight modelling and those that are not included. Work done at our institute indicates that the traffic from the area

not obviously covered by either freight or passenger models can be substantial in some of the areas in the city.

6 A necessary cut off

Applying method b) for the 16 600 establishments specified by the different 55 trade wholesale – and retail sector combinations gave more data that could be handled by excel program in the pc[3]. We had to cut off the smaller deliveries to the smaller shops. But that is probably a wise thing to do. The argument is that smaller shops have few different deliveries than bigger shops. It is of course a problem to know if it is the smaller wholesaler or bigger ones that you cut off. But if you have a shop that has a value of output of maybe only 10 – 15 000 Euro yearly, it is likely that the goods are delivered to the shop only from only one or two wholesalers. The cut off of the smaller deliveries seem therefore a right thing to do. But this has to be further investigated, branch by branch.

But what if you have a small retailer supplied by a big wholesaler? This is likely, because bigger wholesalers have pretty good logistics so the small retailer can be served for small resources. But in this case the deliveries are also cut off. This have we looked upon as unimportant because the deliveries are small and that the big wholesaler is well represented in the data anyway.

Compared to the survey method we will get data spread out in the whole matrix. We are facing the opposite problem from survey data where thin transport links tend to have low representation. Our method give data spread over the whole matrix and the thinnest links are cut off in order to handle all the data.

7 Concluding remarks

Around 22 % of the Norwegians are living in the Oslo area. If we define the logistic industry comprising

- Manufacturing
- Trade
- Other commodity producing industries

Oslo has a lower share than for other areas in Norway due to the big service sectors in cities. But if we look at the mix between the three segments, we see that trade is more important for Oslo area compared to other areas in Norway.

The trade means 51 % of the freight sector (not service industry) in the Osloarea while only 30 % for other areas in Norway (in terms of employment[4]). Consequently the manufacturing and other commodity industries are of less importance. (The main manufacturing industrial subsector in Oslo is the printing sector with a share of nearly 50 % of manufacturing.) Trade may for many cities be the most interesting sector to study for the demand for freight transport.

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[3] We started out with close to 200 000 combinations (over 500 postal codes corresponding to parts of the city) among the 7 000 wholesalers and 9 600 retailers are distributed over 55 business areas (range of traded commodities). This was cut down to 24 600 biggest transports in value terms. Around 170 000 of the smallest combinations of the observed material were deleted and cut off from further calculations. In traded value this was only around 2 % of the total retail trade.

[4] The ratio tonnkm per employed is generally higher in trade than in manufacturing.

References:

Wigan M, Browne, M and Anderson S:

Understanding the growth in service trips and developing transport modelling approaches to commercial, service and light goods movements. Paper presented at PTRC 2002. Association for European Transport 2002.

Statistics Norway:

Trade statistics data for Oslo and Akershus by postal zone and by NACE Rev. division. 2000 and 2001.

Statistics Norway:

Survey on trade margins for Norwegian wholesalers. Collected data from the year 1998. Internet page for Statistics Norway.