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The corner-shop to supermarket transition in retailing: the beginnings of empirical evidence

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ABSTRACT

It was proposed in an earlier paper (Poston and Wilson, 1976) that a catastrophe theory like mechanism might explain the relatively sudden transition from corner-shop retailing to a supermarket system. In this paper, some extensions of this mechanism and some alternatives are presented. But most importantly, the first steps are taken in relating these theoretical explorations to empirical data. We consider change in Nottingham from 1956 to 1979.

THE CORNER-SHOP TO SUPERMARKET TRANSITION IN RETAILING: THE BEGINNINGS OF EMPIRICAL EVIDENCE

1. Introduction

It is evident to anyone who was alive during the 1950s that since that time there has been a major shift of the mode of retailing of food goods - from a 'corner-shop' spatial economy to a 'supermarket' one. (And it may now be necessary also to distinguish hypermarkets, superstores or whatever.) It is likely that when the transition took place it was a relatively rapid one and this has encouraged theoretical explorations in terms of catastrophe theory or bifurcation theory.

In this paper, we begin from that kind of theoretical background (which is sketched in section 2) and relate it to some empirical evidence which has been collected for Nottingham. This part of the argument illustrates the difficulties of collecting appropriate data. We offer it here because it does generate some useful preliminary evidence, and also in the hope that it will encourage others to do better in other places. The data gathering exercise is described in section 3, and the main results are collected together and interpreted in section 4. Some concluding comments are made in section 5.

2. The theoretical background

We take as theoretical background the ideas presented in Poston and Wilson (1977) (together with an extension of these) and those in Harris and Wilson (1978). All have been collected together and discussed at length in Wilson (1981). Initial numerical experiments on the latter ideas were presented by Wilson and Clarke (1979) and are being collected together in Clarke and Wilson (1982). We refer the reader to these references for the details of the argument. Here, we simply establish a take-off point for the empirical investigation.

The Poston and Wilson (1977) argument turns on assumptions about the utilities and disutilities of travel. These are assumed to be size benefits (u_1) and transport costs (u_2) which take the form shown in figure 1. u_1 is assumed to increase in a logistic way up to some bound, while u_2 decreases linearly - in each case when plotted against average facility size (with facility size assumed to be monotonically related to average distance travelled). A plot of u_1+u_2, for two cases, is shown in figure 2. In case (a), the u_2 line is shallow (easy travel) and there is a clear non-zero optimum size (W^*). In case (b), the u_2 line is steep (difficult travel) and u_{max} is at zero size. Case (b) is not interpreted literally - but as the corner shop solution; case (a) is then the supermarket solution. If $-\beta$ is the slope of the u_2 line, W^* can be plotted against β with the result shown on figure 3. The result is characteristic of the fold catastrophe. If β changes smoothly and increases, then at B, there will be a transition from a supermarket system to a corner shop system; and vice versa, though the transition comes at A (at the latest) rather than B. In the AB-region, the two systems can co-exist or there could be a jump according to the delay convention operating.

In our empirical results, we plot *average* shop size against time. Then if the average is an approximation to optimum shop size, and if ease of travel (measured by β) has changed smoothly on average, such a plot could resemble figure 3. Since we expect β to have decreased over time, we are seeking plots which are the mirror image of figure 3. Possibilities are illustrated in figure 4. In case (a), we see a sudden (catastrophe jump) transition; in case (b), a less sudden one, where it might be assumed that the period A'B' corresponded to β-values in the range AB of figure 3. Our aim, then, is to produce plots of W_{av} against calendar time and to see if we can interpret then in terms of the figure 3 mechanism. As a preliminary, however, we consider other mechanisms which could produce similar changes. These make the ultimate problems of interpretation much more complex.

First, consider an extension of the Poston and Wilson (1979) argument. The discussion above has been conducted in terms of the slope of the u_2 line, β. It could just as well be related to the shape of the function u_1. If the upper bound is depressed for example, a criticial point is reached at which there will be no supermarket solution. The u_1 curve can be described by (say)

$$u_1(W) = \frac{\delta}{1 + \gamma e^{-\varepsilon W}} \tag{1}$$

for facility size W - so that $\exp(u_1)$ would be the term which appeared in a spatial interaction shopping model (instead of W_j^α in equations (2) and (3) below). The lower bound of this is $\delta/(1 + \gamma)$ and the upper bound is δ. The 'speed' with which δ is achieved for increasing W is governed by ε: the larger ε, the faster the upper bound is reached. A little experimentation shows that decreasing δ or decreasing ε each makes a supermarket solution less likely. Conversely, it could be increasing δ or ε which generated a sudden transition to supermarkets rather than a β decrease. More likely, reality will result from a combination of all such parameter changes.

An alternative mechanism altogether was offered by Harris and Wilson (1978). Their model predicts the equilibrium values of $\{W_j\}$ - the spatial pattern of shopping centres. The problem with this for the present analysis is that the basis of the model is all the floor space in each zone, rather than number of shops or average shop size. However, if there is a large number of zones at least, their results may be applicable in this context. The standard spatial interaction shopping model can be taken as

$$S_{ij} = A_i e_i P_i W_j^\alpha e^{-\beta c_{ij}} \tag{2}$$

with

$$A_i = 1/\sum_k W_k^\alpha e^{-\beta c_{ik}} \tag{3}$$

with S_{ij} the flow of cash from i to j; e_i, the per capita expenditure in zone i; P_i, the population of zone i; W_j, the facility size taken as a measure of attractiveness; and c_{ij} the travel cost from i to j. Then Harris and Wilson (1978) show that there will be fewer larger facilities if α is larger and/or β is smaller. The β parameter corresponds to that of the Poston-Wilson analysis and at least the result is in the same direction. The α-parameter is represented by a mixture of δ and ε behaviour in the preceding analysis. But the main point to note is that there could, again, be a sudden transition from one kind of system to another - which, say, could be interpreted as from corner shops to supermarkets - for small, smooth changes in (α, β) parameters.

With that background, we now turn to the empirical evidence and return to problems of interpretation in section 5 below.

3. Some empirical evidence for Nottingham

Since the theory is cast in terms of optimum retail facility size, we need data on the change in shop size over a period of time. We discovered two sources of data which we present separately and then use in combination. The Nottingham Yellow Pages provided a count of grocery/food retailing outlets for the whole city which allowed a division into 'grocer' or 'supermarket'. This had the advantage that it was available at reasonably close intervals from 1956 (though we should bear in mind that the numbers may not be wholly accurate because of omissions - but the proportions should be reasonable). The second source, which included floorspace data, was the rates assessment for each Nottingham valuation district. Unfortunately, the floorspace figures are confidential and we had to work backwards from gross rateable value via a sample survey of a small number of shops. Inevitably the results are rough, but they provide some useful information in relation to the issues described in the preceding section. Because of the difficulties of working with the rateable value data, this part of the exercise could be undertaken for selected areas within Nottingham only. We refer to this as the 'sample area' data in contrast so the shop counts which we refer to as 'whole area' data. We describe each in turn.

The whole area data is simple enough. Grocery shop numbers and supermarket numbers for the city as a whole are presented as figures 5 and 6. They show the steady decline of numbers of small shops, and the rapid increase, beginning in the early 1960s, of supermarkets.

The sample area data is more tricky. Gross rateable value is a reasonable index of facility size once a number of adjustments are made. Location is also important, but we can neglect this by working with shops within small sample areas individually (and by not taking the central area of Nottingham, which is complicated in this respect, as one of the examples). Valuations were carried out in 1956, 1963 and 1973. The first task is to adjust these figures for inflation to obtain what we call *real gross value* (RGV), and then these figures have to be adjusted to allow for floorspace not used for retail purposes - such as house or garage.

The rateable value data was obtained and adjusted for each of the five sample areas which are shown on figure 7. For each area, a list of grocers and supermarkets had to be compiled from directories (Kelly's, Post Office and Yellow Pages) because the Rating Lists do not specify type of premise. It was possible to note, however, whether the premises included a house and/or a garage since this information is in the Rating Lists.

The effect of inflation was calculated by taking a sample of outlets which were unchanged through the three dates and obtaining an average adjustment factor for rateable values for each sample area. This allows us to obtain estimates of RGV for each shop/supermarket in each of the sample areas. A percentage deduction was made for each outlet that included a house and/or garage (30% for home and garage), and a further deduction from the supermarket figures in respect on non-grocery goods (28% on average). Each outlet now had a retail-floorspace proportion of its real gross rateable value. Intervals of £70 were used to define size categories which ranged from 1-20. This data was used to calculate the percentage in each size category for each sample area and the results were plotted as histograms for each sample area for each time period. They are presented as figures 8-12. 1956 is clearly shop-dominated and 1973 supermarket dominated. 1963 was a period of transition - as was already evident from figure 6.

As a final step, we related floorspace to rateable value by a sample of a number of premises in some of the value-size categories in each sample area. The results of doing this are added to the horizontal axes in figure 8-12. One problem, of course, is that there is not a linear relationship between floorspace and rateable value. The sample floorspace data was therefore used in another way. We took (rateable-value) size categories 1-7 to be 'shops' and categories 8 and over to be 'supermarkets'. For each sample area, we then worked out, via the shops whose floorspaces were measured, an average size in each sample area at each of the three times. The results are presented in table 1 and plotted in figure 13 so that linear interpolation can be used for intervening years. These average shop and supermarket sizes can then be applied to the city-wide count of shops and supermarkets presented in figures 5 and 6, and and overall average outlet size can be calculated at roughly two-year intervals. These are plotted as figure 14.

Fig no	Estimated av size in sq ft (Cats 1-7)			Estimated av size in sq ft (Cats 8-20)		
	1956	1963	1973	1956	1963	1973
9	250	380	280	1350	1350	2340
10	260	305	520	1805	*	3620
11	425	465	365	1720	1720	3940
12	230	235	240	1295	*	2935
13	375	555	590	1220	2060	2060
Averages	308	388	399	1478	1710	2979

Table 1

4. Interpretation

The histograms for each sample area (figures 8-12) show a corner shop to supermarket transition between 1956 and 1973. The plot which is most directly compatible with the theory, however, is figure 14 above. This is (or should be!) the (left-to-right) mirror image of figure 3 - if it is assumed that 'east of travel' or some equivalent parameter has improved smoothly with time. In practice, because of the existence of the region AB in figure 3 with both solutions possible, we would not necessarily expect a sudden change as we anticipated with our earlier presentation of figure 4(b). Figure 14 suggests a relatively rapid change between (say) 1966 and 1974 and in this respect does resemble figure 4(b). In some ways, the averaging of shop size and supermarket size in this figure blurs the result. It can be presented more dramatically and simply (though less *directly* related to the theory) by returning to figures 5 and 6 and computing (for each two years) the ratio of supermarkets to shops. If we reverse the time on the horizontal axis and plot the results, we get figure 15. This plot of a proxy index looks strikingly like figure 3 and perhaps more accurately dates the period of transition as (say) 1962-1970 - four years earlier than apparently implied by figure 14.

5. Concluding comments

The main weakness of the argument as presented is that we have no direct evidence on the way the parameters used in the model have changed over the period. We can assume that ease of travel (at least in relation to food shopping) has improved smoothly on average for the population because of increasing car ownership, but we cannot be sure that this has a linear relationship with time. Nor can one be sure that the change in structure is the result of transport changes alone - what were defined as δ and ϵ parameters may have an influence also. This, therefore, opens up the next obvious line of research: to compare the kind of data we have presented here with parameter values from model calibration over a period of time. That, of course, is a very difficult task indeed.

References

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B. Harris and A.G. Wilson (1978) Equilibrium values and dynamics of attractiveness terms in production-constrained spatial-interaction models, *Environment and Planning A, 10,* 371-88.

T. Poston and A.G. Wilson (1977) Facility size versus distance travelled: urban services and the fold catastrophe, *Environment and Planning A, 9,* 681-6.

A.G. Wilson (1981) *Catastrophe theory and bifurcation: applications to urban and regional systems,* Croom Helm, London; University of California Press, Berkeley.

A.G. Wilson and M. Clarke (1979) Some illustrations of catastrophe theory applied to urban retailing structures, in M.J. Breheny (ed) *Developments in urban and regional analysis,* Pion, London, 5-27.

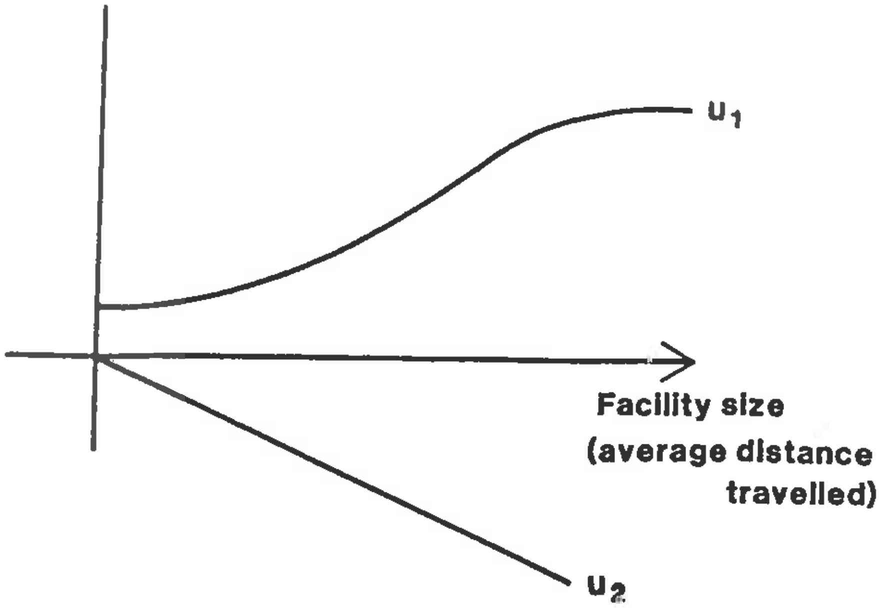


Figure 1. Utilities for size benefits and travel costs

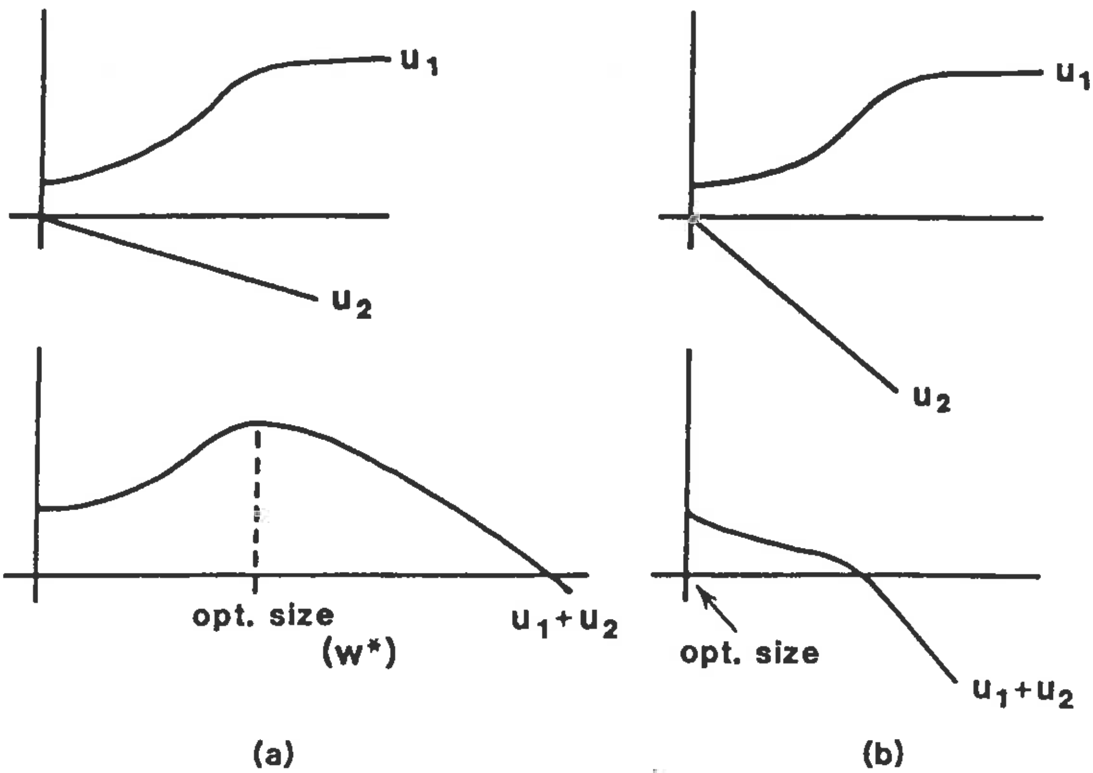


Figure 2. Utility-sum curves for two cases

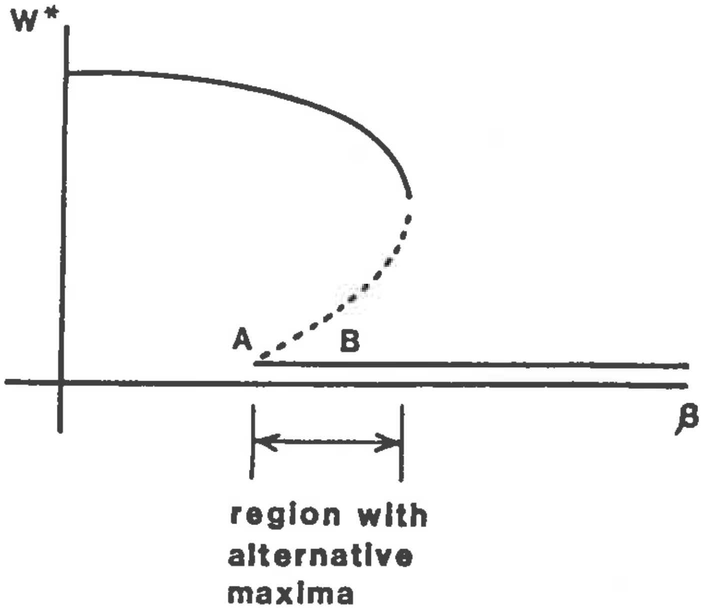


Figure 3. Optimum facility size and the fold catastrophe

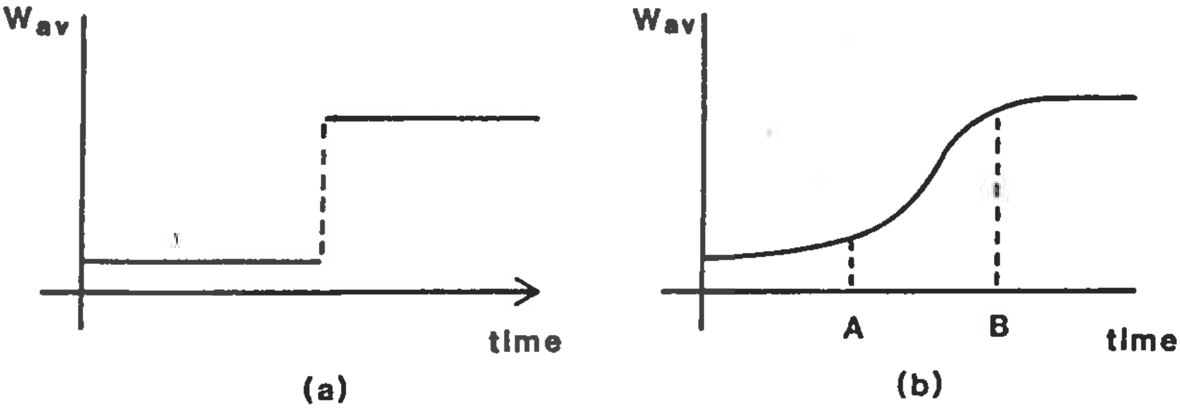


Figure 4. Possible plots of average facility size against time

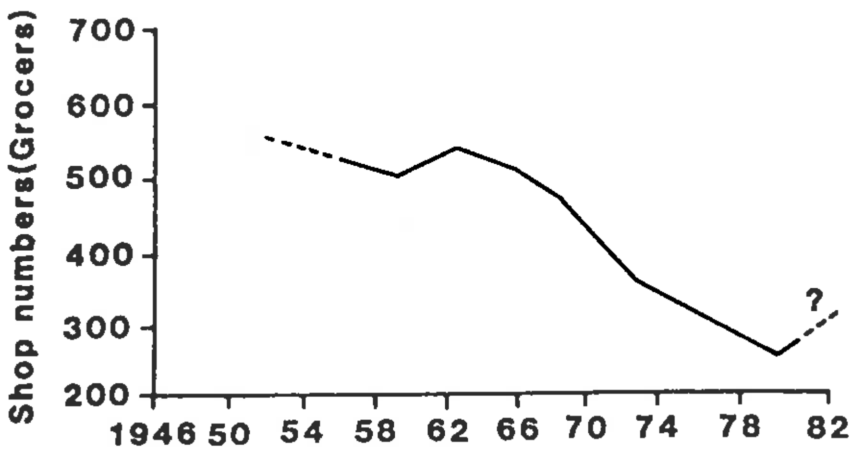


Figure 5. Shop numbers (grocers) for Nottingham

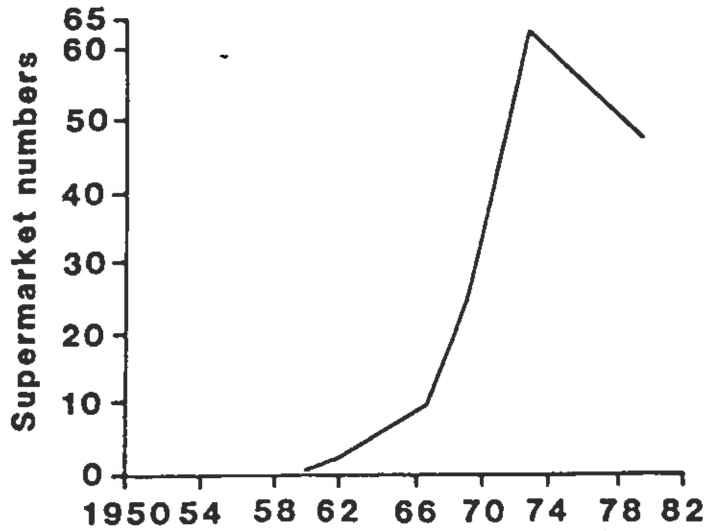
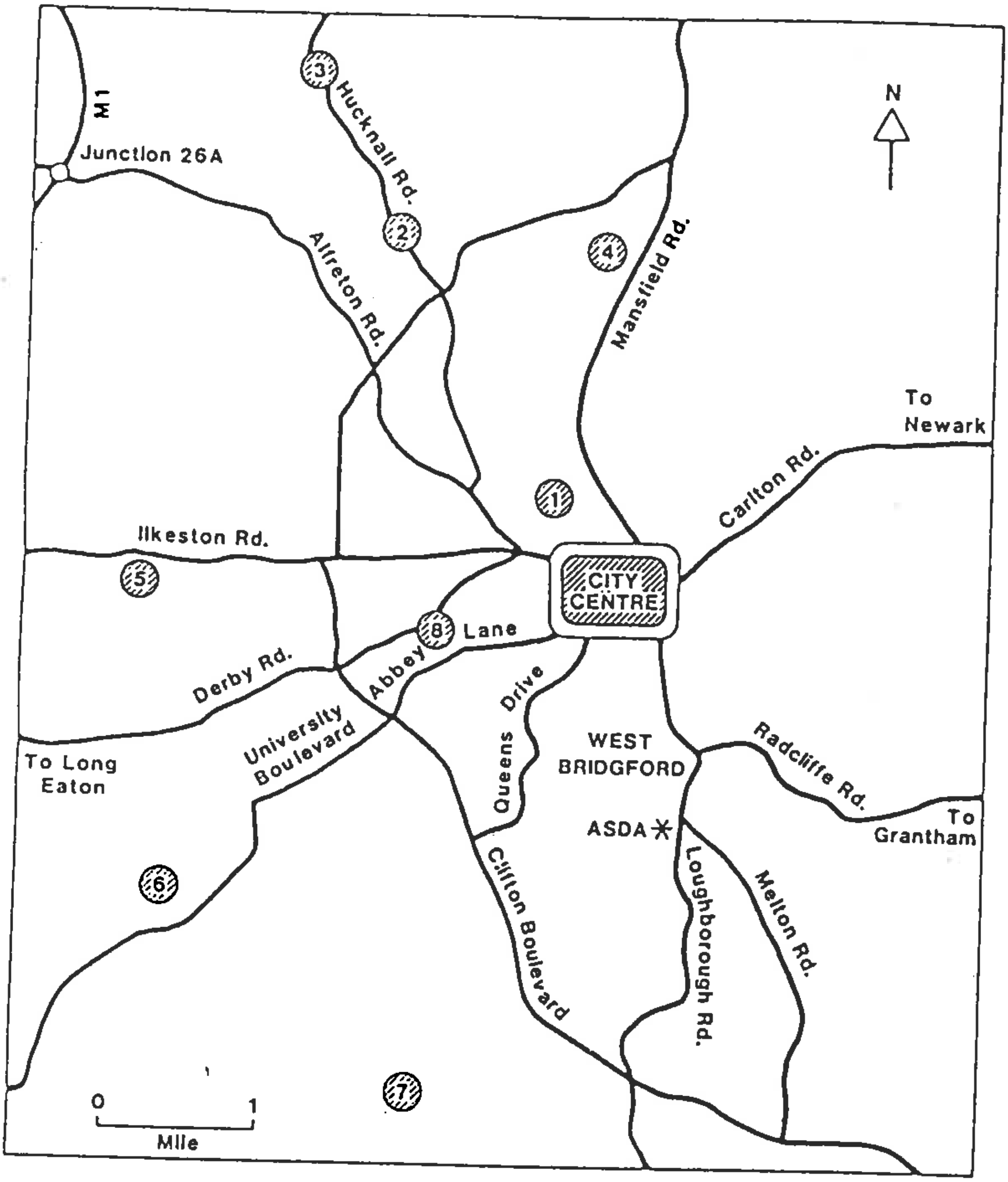


Figure 6. Supermarket numbers for Nottingham

Figure 7. The location of sample areas in Nottingham



KEY

1 HYSON GREEN
2 BASFORD
3 BULWELL
4 SHERWOOD
5 WOLLATON

Recomended for further study:

6 Beeston
7 Clifton
8 Lenton

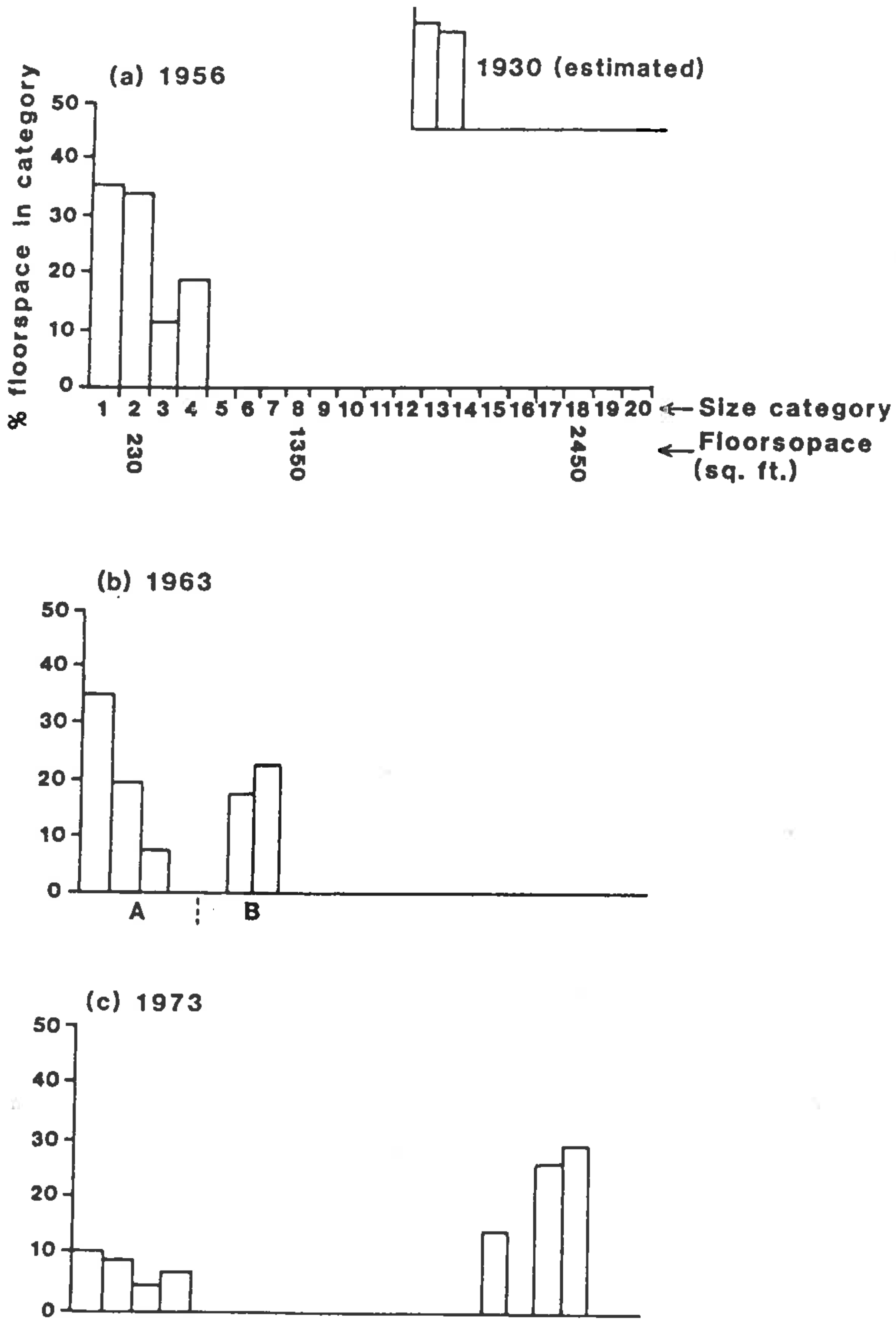


Figure 3 Floorspace distributions for Bulwell

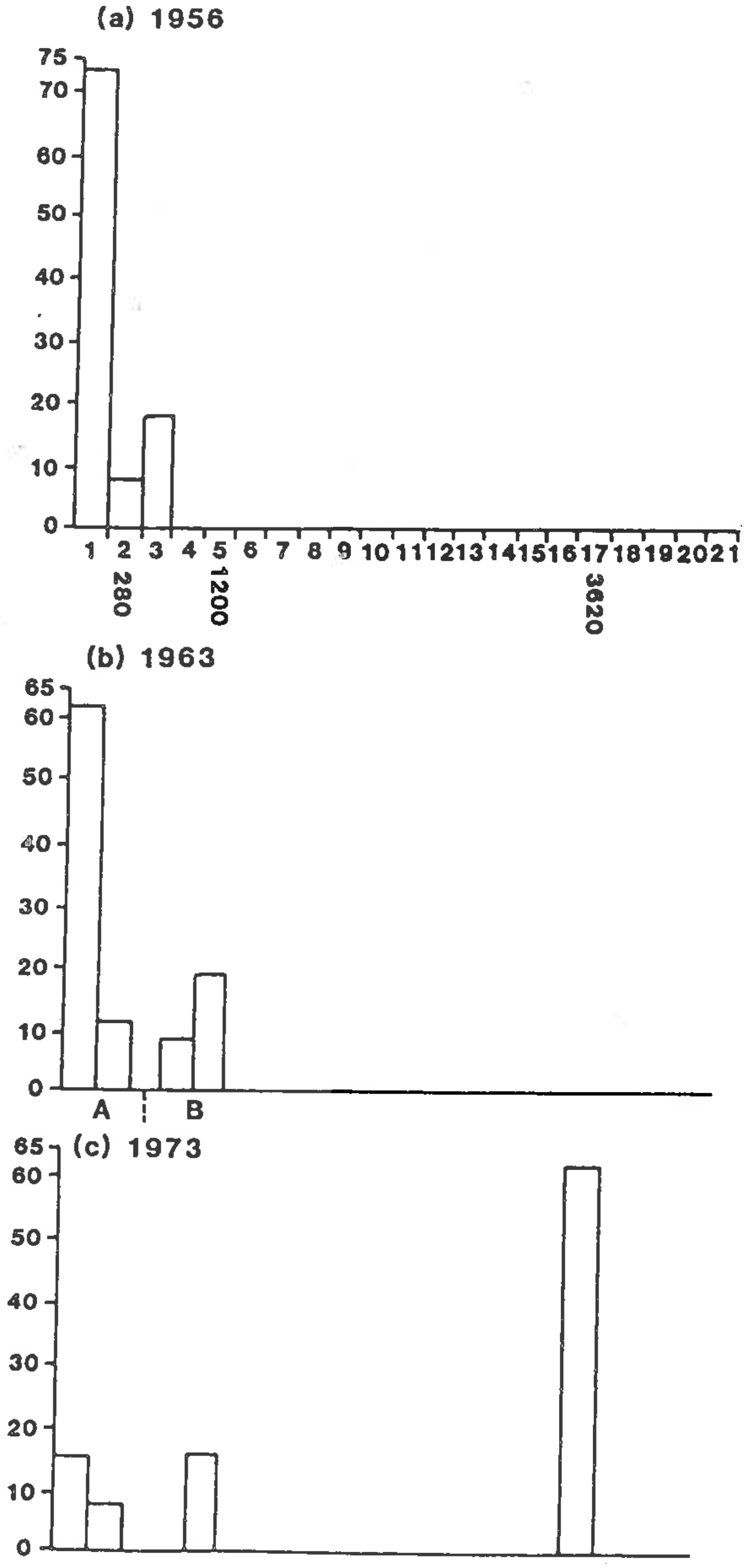


Figure 9. Floorspace distributions for Basford

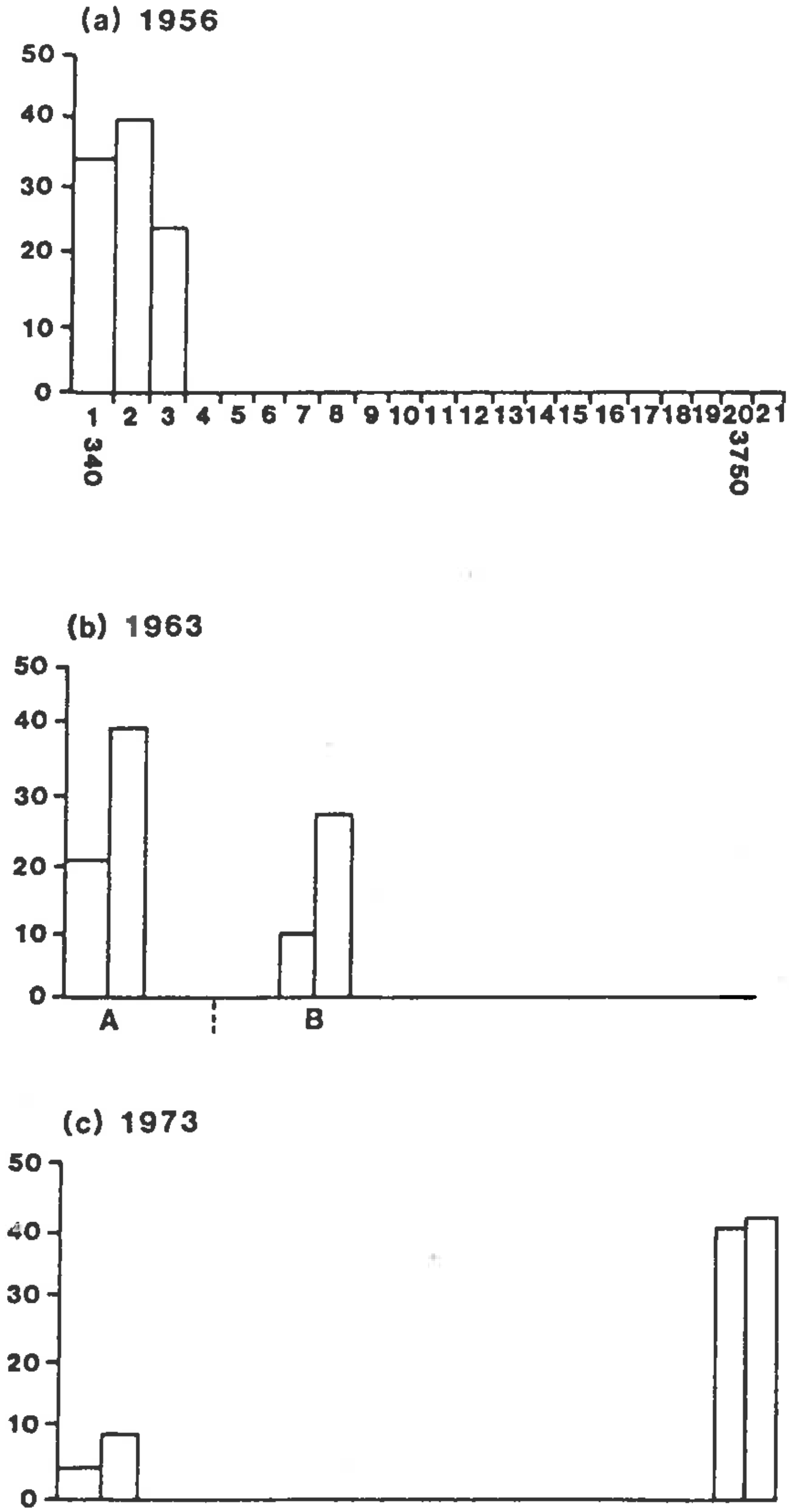


Figure 10. Floorspace distributions for Sherwood

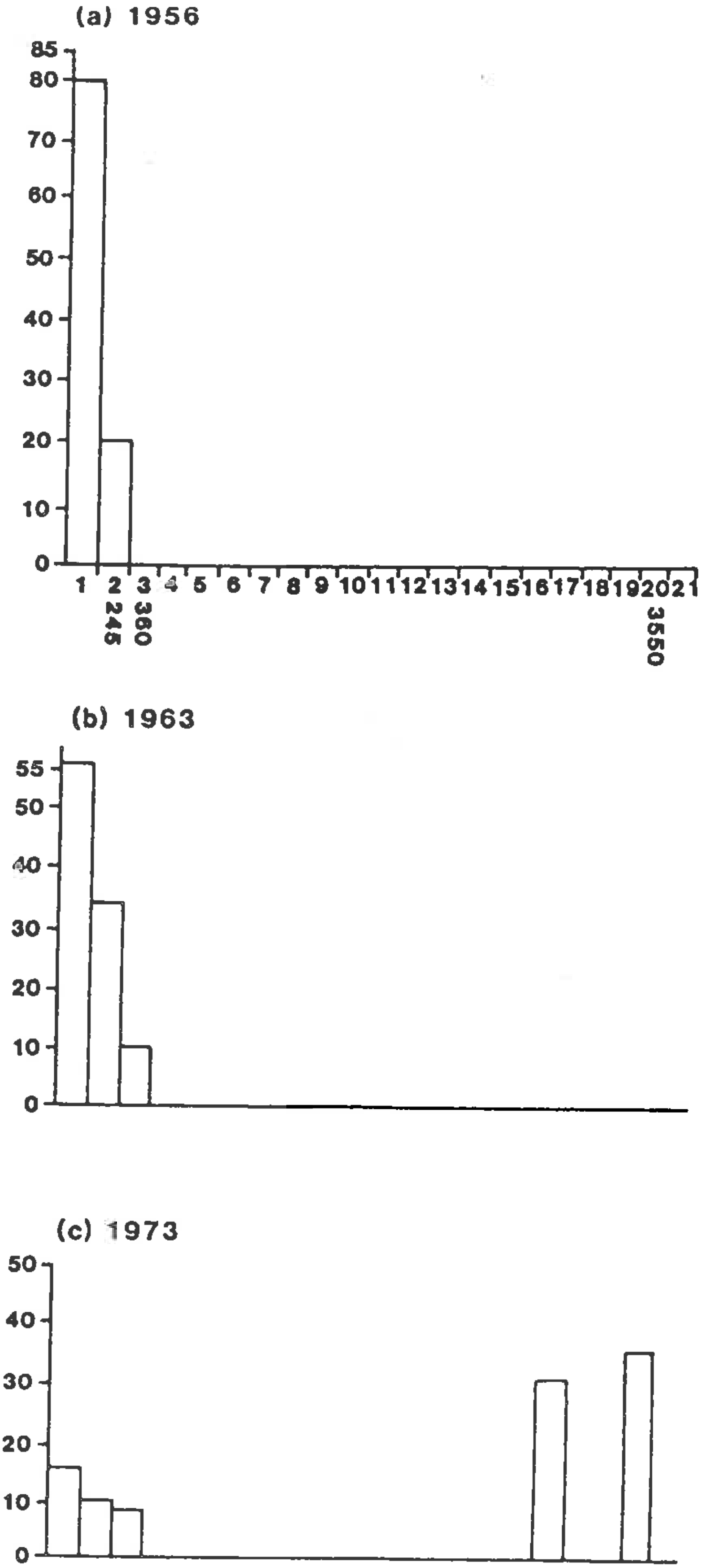


Figure 11. Floorspace distributions for Hyson Green

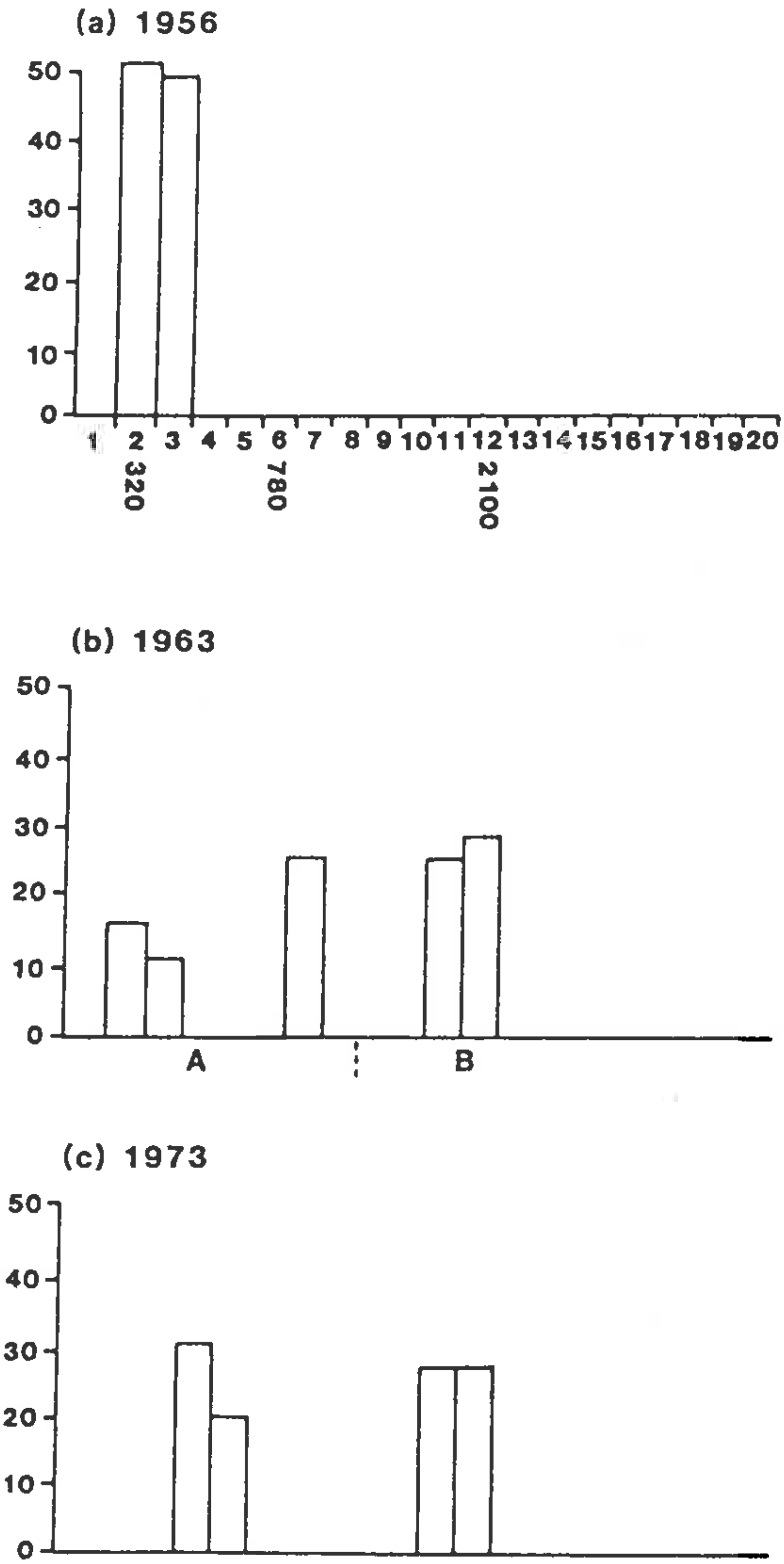


Figure 12. Floorspace distributions for Wollaton

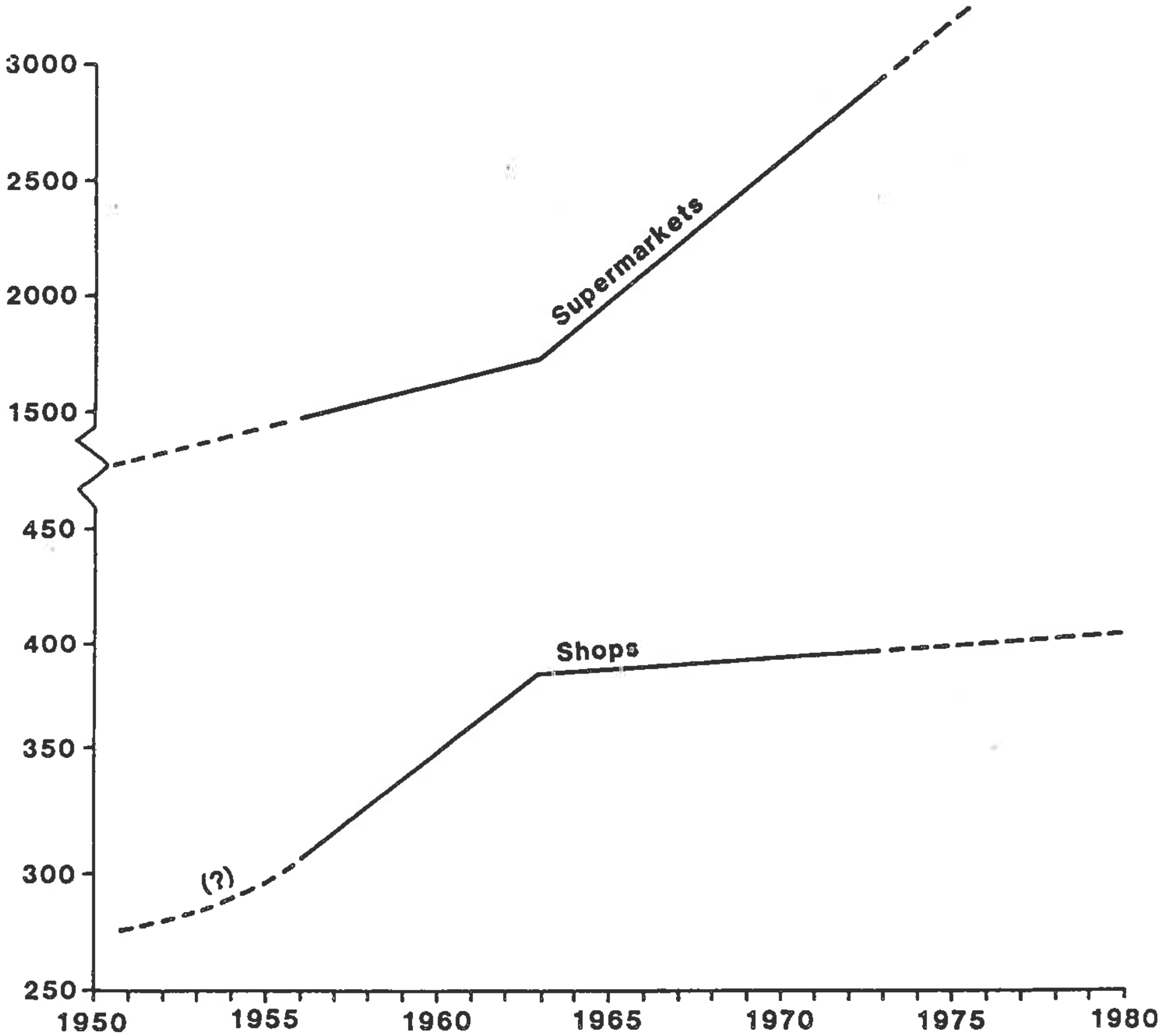


Figure 13. Average floorspace for shops and supermarkets

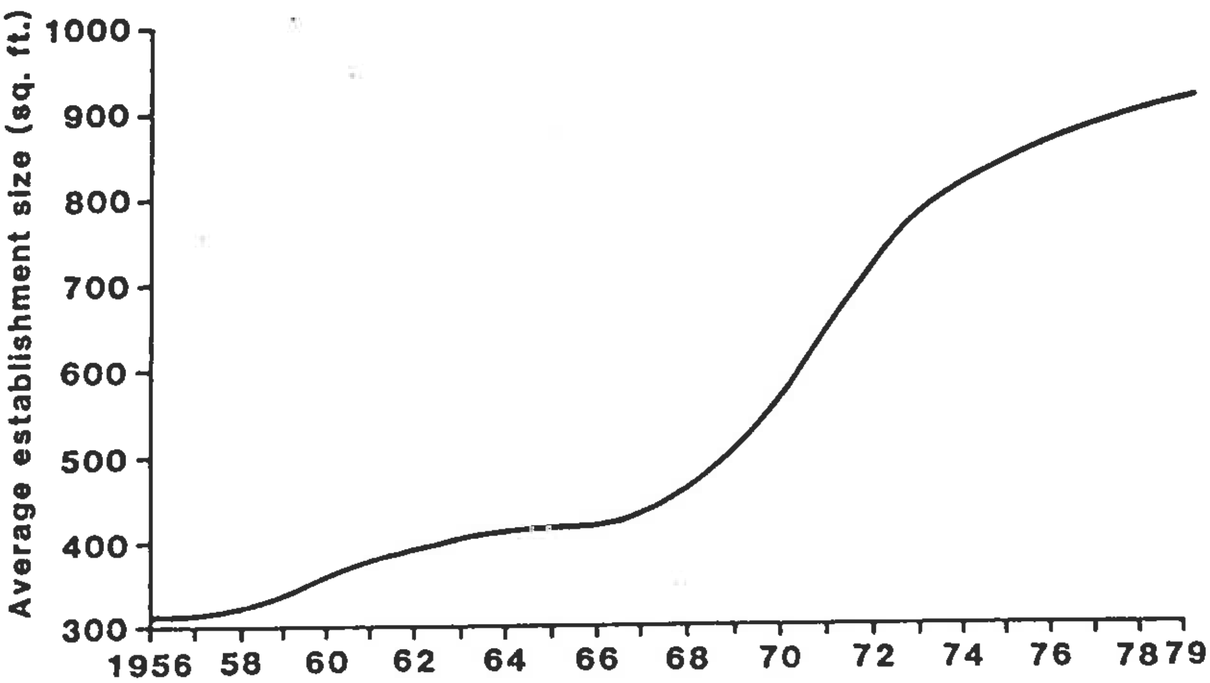


Figure 14. Average establishment size

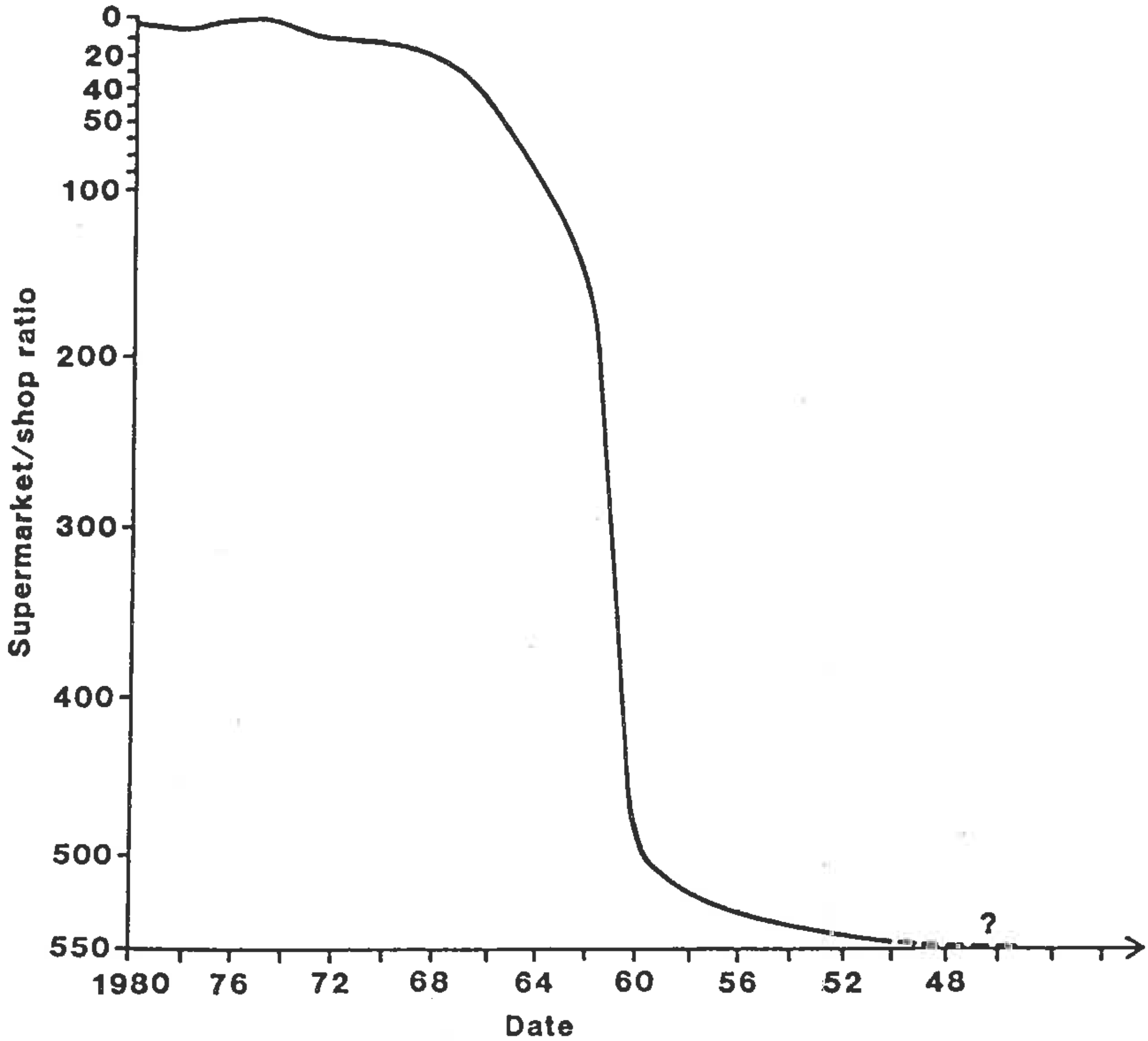


Figure 15. Supermarket/shop ratio for Nottingham