The WTP for facilities at the Amsterdam Zuidas

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Abstract. This paper reports the results of a stated preference study investigating the willingness-to-pay (WTP) of employees at the Amsterdam Zuidas for the presence of nonshopping and shopping facilities. The Amsterdam Zuidas area, surrounding the current train–metro–tram station Amsterdam Zuid World-Trade-Centre, is the largest multifunctional land-use project currently under development in the Netherlands. For nonshopping facilities, the results show that employees have the highest WTP for the presence of day-care centres and public transport facilities, and the lowest for public and recreation facilities. The average WTP for the presence of nonshopping facilities amounts to approximately €29 per month per employee. The WTP for the presence of shopping facilities is estimated at €25 per month per employee on average, and is in absolute value highest for supermarkets and lowest for flowershops and dry cleaners.

1 Introduction

Railway stations can function as local centres of economic activity. In particular, larger stations, located at strategic nodes of the network, can benefit from economies of traffic density. Such economies, and the number of passengers passing the railway station, often grow substantially more when the station acts as a node both for (inter) regional heavy rail and for (urban) light rail systems or bus networks. Stations such as Euston, Paddington, or Victoria are well-known examples from the London network. They are often capable of attracting a wide variety of economic activity, not only including shops of all sorts, but also employers and companies from the services industry that put a high value on public transport accessibility. Economies of traffic density and the perceived attractiveness of the location are then generally mutually reinforcing.

This mutually reinforcing character implies that the establishment of such subcentres may not always arise spontaneously, but may instead require coordinated planning of transport networks, station areas, and real-estate investments in the direct vicinity. When public governments are the key actors in such planning procedures, they will often require a clear insight into the social costs and benefits of alternative development plans. But such costs and benefits cannot always be observed directly in actual markets, especially not when these concern external effects such as economies of agglomeration or congestion, or when the markets concerned simply do not exist. It is then natural to try to evaluate such effects either by looking at actual behaviour in related markets ('revealed preferences') or by studying hypothetical behaviour in imaginary markets through questionnaire research ('stated preferences'). This paper presents a study of the second type, focusing on employees' evaluation of various services in a so-called multifunctional development plan that is currently being considered for the

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Amsterdam Zuidas Area, surrounding the current train–metro–tram station Amsterdam Zuid World-Trade-Centre (WTC).

Multifunctional land-use projects aim to concentrate and combine several socio-economic functions in one and the same area in order to save and to exploit synergies between land-use functions (see for example, Coupland, 1997; Jacobs, 1961; Priemus et al, 2000). Such areas are often planned close to public transport nodes, so that economies of density in public transport can be exploited and road traffic congestion reduced.

The *ex ante* assessment of costs and benefits of multifunctional land-use projects is important for judging the overall social desirability and, through the identification of potential winners and losers, for gaining insight into possible financing schemes. Because many of the benefits cannot be measured directly (eg Nijkamp et al, 2003), valuation methods are needed. Previous research indicates that people attach positive values to multifunctional land-use projects. Typically, this research focuses on the impact of multifunctional land use on housing prices. Geohegan et al (1997) found that diversity and fragmentation of land use have a (marginal) positive effect on housing prices. More recent research shows that housing prices increase with increased proximity to and availability of public parks and commercial activities (Song and Knaap, 2004) or with permanently preserved open space (Irwin, 2002; Irwin and Bockstael, 2001) close to the residential property. One of the reasons may be that multifunctional land use has a positive impact on the way people perceive and appreciate the built environment (Van Wee, 2003). Another possible reason is the existence of an ‘option value’ that people derive from having access to goods or services, independent of whether or not they actually use them (Johansson, 1987; 1991; Weisbrod, 1964). In railway station areas, an option value could stem from accessibility to multiple transport modes and many destinations (Geurs and Ritsema van Eck, 2001). A more conventional ‘use value’ arises from the actual consumption of goods and services offered at the site. Visitors may value these because it saves them time when consuming them at a multifunctional site. In this paper we will concentrate on such more tangible ‘use values’ for the presence of different facilities at the Amsterdam Zuidas area by a particular group of stakeholders, namely, the employees.

The Amsterdam Zuidas area is the largest multifunctional land-use project currently under development in the Netherlands, and is situated in the southwestern part of Amsterdam, along the orbital motorway near the current train–metro–tram station Amsterdam Zuid-WTC. In the mid-1990s, major private investors started to express interest in the Zuidas area. The goal of the city government is to develop the Zuidas as an internationally oriented office location, well accessible from Schiphol Airport (7 minutes by train) and in the future even more so when Amsterdam Zuid-WTC becomes a high speed train station (Amsterdam, 2004). Over the years, the development plans for the Zuidas area have changed from a high-end office district towards a multifunctional area with a mix of offices, houses, and facilities (DRO, 2004). In one of the current development plans, all transport infrastructure will be integrated on a subterranean level over a length of 1 kilometre, with a mixture of houses, offices, and facilities on the ground level. As a result, the railway station is predicted to develop into the fifth largest station in the Netherlands.

Various considerations complicate the valuation of benefits of a project like this. First, since the presence of particular facilities at a particular site is a nontraded good, it is not possible to derive its value directly from market transactions. Instead, indirect measures have to be used. A hedonic wage analysis could explain the incomes of employees at the Zuidas, and those of employees elsewhere, from various characteristics of the site. The problem with this approach, however, is that at the Zuidas the

availability of the facilities to be valued is currently still relatively low, and comparable areas do not (yet) exist in the Netherlands.

An alternative, to be used here, is to make use of individuals' stated behaviour, on hypothetical markets for multifunctional land-use characteristics. The most straightforward economic measure to express how employees assess (the use of) a multifunctional site is their willingness to pay (WTP) for the relevant characteristic of multifunctional land use, which can be identified by means of a stated-preference survey (for an overview of stated preference surveys see, for example, Louviere et al, 2000). WTP surveys allow one to infer price-related changes in behaviour from hypothetical price changes. They basically measure potential demand for products or services by asking consumers questions such as: "Would you purchase this product or make use of this service if it was offered at this price?" In this paper we use such a questionnaire approach, focusing on current office employees in the Zuidas area. Note that these people's perceived benefits may often implicitly reflect time savings, namely when the use of facilities at the Zuidas displaces their use at less convenient locations. Office employees will form a substantial share of the users of the Zuidas, since, in current development plans, 45% of the area consists of office space.

This study focuses on the 'use value' that employees attach to the availability of various facilities near the workplace in a multifunctional area. There are of course other elements of multifunctional land use that employees might value, such as the presence of employees of other companies at the location, and status or reputation of the location. These will not be taken into consideration in this study. A questionnaire was developed that aims to establish the WTP both for shopping and for nonshopping facilities. To minimise the burden of going through a long list of similar stated preference questions, respondents were asked to answer questions relating only to their most preferred facilities. While different types of shops were to be valued individually, for nonshopping facilities only a single bundle was presented. The advantages are that fewer questions had to be answered, and that the risk of overstating is reduced. Special care is required, though, to prevent biases in the estimation of WTP values arising from selection effects. We will turn to this more explicitly in section 5. The remainder of this paper is organised as follows. The next section deals with the issue of how to derive WTP values for both shopping and nonshopping facilities. Subsequently, a short overview of the questionnaire as well as an overview of the general characteristics of the dataset will be given in section 3. Next, in section 4, the basic survey results are presented and discussed, whereafter the econometric issues and estimations required to obtain unbiased estimates of WTP values are dealt with and discussed in section 5.

2 Derivation of WTP for facilities at the Amsterdam Zuidas

2.1 Questionnaire design

Employees may, of course, have rather different preferences on the most desired type of facility, so various types of facility were considered. We make a major distinction between shopping and nonshopping facilities. To avoid excessive repetition and fatigue for the respondents, we decided to let them value only their most desired or frequently visited facilities. An additional benefit of this choice is that, because respondents base their answers on most preferred or visited facilities, they are most likely well experienced in using those facilities in the 'real world'. This enhances the realism of their answers because the facility the respondent chooses is usually a facility he or she actually uses. This comes close to what Train and Wilson (2006) label 'pivoting' the stated preference questions.

The next subsection provides information on the questionnaire design for nonshopping facilities, after which we will turn to shopping facilities.

2.2 Nonshopping facilities

In deriving a valuation of consumers for nonshopping facilities that do not yet exist, several biases can emerge, of which the so-called ‘part–whole bias’ might be particularly relevant in this context. This occurs when the respondent values a different (set of) good(s) than the researcher intends. When valuing the presence of one facility, respondents may for example ‘forget’ that other facilities might be valuable as well, and therefore overstate their WTP for the single facility under consideration. They may also implicitly assume that the presence of a certain facility is indicative of the likely copresence of another one, which could also lead to an overestimate of the ‘true’ WTP. To avoid this type of bias, people were asked to value a bundle of (most preferred) nonshopping facilities.

In the questionnaire, we asked for the WTP of nonshopping facilities as follows. First, for a number of nonshopping facilities the respondents were asked to indicate how important (on a scale from 1 to 5) they personally judged the presence of that facility at the Zuidas. Next, a bundle of three nonshopping facilities was generated, which included the three facilities that are most important to the respondent (say A, B, and C). To get a WTP value for this bundle, first a two-stage dichotomous choice question was asked. In this question we asked respondents twice to answer ‘yes’ or ‘no’ to the question of whether they are willing to pay a certain amount of money for having access to the particular combination of facilities shown. The amount of money presented to the respondents in the second question differed from the first question, and depended on the answer to the first question. The second dichotomous choice question was followed by an open-ended contingent valuation (CV) question. The dichotomous choice question that respondents had to answer was the following: “Suppose that you had to buy a ‘Zuidas area employee card’ in order to be allowed to use the following facilities in the Zuidas area: A, B, and C. With this card, the actual use of the facilities in the Zuidas area would have the same price as facilities that you would use outside the Zuidas area. Would you be willing to pay €25 per month for such a card?” If the respondents accepted the payment in the first question, they were asked whether they would also be willing to pay €50. If not, they were asked whether they would be willing to pay €10. Finally, they were asked to express an exact maximum amount of money that they would be willing to pay for the use of the bundle of facilities in an open-ended question. Their answer was considered to be valid only if it was consistent with the two previous dichotomous choice questions. Note that this formulation is explicitly and intentionally targeted at measuring the extra WTP for the availability of facilities at the Zuidas, and should not be influenced by characteristics such as access prices for the use of facilities.⁽¹⁾

This specific approach raises two methodological issues. First, it is not the WTP for specific facilities that is being asked, but the WTP for a bundle of facilities. This means that the average or total WTP for individual facilities cannot simply be estimated by aggregating over respondents. Second, this approach raises a selection issue. Because individual WTPs are obtained for a bundle of the three *most preferred* facilities, average WTPs for the total sample are likely to be lower than the average over those respondents who valued the facility. The first issue is addressed in section 4, the second in subsection 5.1.

⁽¹⁾ One referee raised the problem of incentive compatibility that might arise here. Although it might indeed pose a problem, note that an overestimate of the individual’s WTP could be expected (by the individual) to result in a high access fee while an underestimate would reduce the probability of supply. Even if there is an effect, therefore, the sign is unclear because of these opposing forces, and the individual does not seem to have a clear incentive why he or she should either overestimate or underestimate the true WTP.

2.3 Shopping facilities

Because individuals are not used to ‘paying’ for access to shops, we used a different approach for the valuation of shopping facilities than for nonshopping facilities. Again, to avoid excessive repetition, we first asked respondents for their two most frequently visited shops and, thereafter, we asked respondents about their changes in ‘expenditure shares’ in both shops for four different hypothetical price levels when those two types of shops would also be present at the Amsterdam Zuidas.⁽²⁾ The ‘expenditure share’ is for this purpose defined as the share of the total expenditure in a certain type of shop that the respondent expects to spend on the Zuidas if that type of shop is present there. Changes in expenditure shares, not quantities, are more natural to formulate in a questionnaire and easier to answer.

In the open-ended CV question, four scenarios were presented. In the first scenario we hypothesised an equal price level at the Zuidas (p_{ZA}^0) compared with alternative options (eg shops that respondents currently use). In the three subsequent scenarios, the (relative) price level in the Zuidas area (p_{ZA}) was presented as being 10%, 25%, and 50% higher, respectively. For each scenario, respondents had to indicate which percentage of their total expenses (E) on a specific type of shop (eg supermarket, dependent on earlier answers) they expect to spend in their current outlet(s), and which percentage in an outlet in the Zuidas area.

Figure 1 shows these four budget shares (q_{ZA}) with their respective associated price levels (p_{ZA}), for which the initial non-Zuidas price and quantity (and hence initial expenditures) are normalised at one. These budget shares at different price levels reveal indirect information about the ‘excess WTP’ of employees for the use of shopping facilities in the Zuidas, over using their current outlet. The extent to which demand decreases when relative prices exceed unity can be regarded as a measure for respondents’ WTP for the use of shopping facilities in the area. This measure for WTP is

Figure 1. Relation between price level (p_{ZA}) and expenditure level (q_{ZA}) at the Amsterdam Zuidas (ZA).

⁽²⁾ Note that we asked for most frequently visited shops, not the most preferred shops. These two indicators are strongly correlated, so the consequences are not strong. When they differ, we expect that the former is a better indicator of the respondent’s expenses in the shop, which forms the basis for calculating his or her WTP as will be explained in the main text.

displayed in figure 1 as the area between the estimated demand curve fitted through the four observation points and the horizontal line at $p_{ZA}^0 = 1$. We refer to subsection 4.2 for an implementation and further discussion of this measure.

Self-selection is again an issue, since respondents were asked to respond to the four scenarios for the two most frequently visited types of shops. However, because we have information on the importance that employees attach to the various shops as well, we are able to correct for possible self-selection bias, insofar as frequency coincides with the importance attached to the shopping facilities. Again, we refer to subsection 5.1 for the actual implementation.

3 The questionnaire

3.1 The survey

The questionnaire was developed in electronic format (both in Dutch and in English), which respondents could fill out on the Internet. An invitation to participate was sent to about 6600 employees via an internal mailing by companies located within the Zuidas area. The questionnaire consists of three main parts:

1. The first part contains general questions, such as the number of days a week employees travel to work, their commuting mode, and the average travel time between home and their work location. This information is important to relate responses to individual characteristics of respondents.
2. In the second part, employees are asked to express their preferences as well as their expected frequency of use for different types of facilities nearby their work location: shops, catering facilities, transport facilities, and other facilities such as a museum, a day-care centre, or a post office. The answers to these questions were used to create scenarios for which respondents were subsequently asked to express their (indirect) WTP.
3. In the final part of the questionnaire we ask about personal characteristics of respondents, such as age, gender, education level, income, family situation, and location of residence (zip code).

3.2 The respondents

The second column in table 1 presents the descriptive statistics of the distribution of respondents in the stated preference survey. For comparison, we present data for the active workforce in the Netherlands in 2003⁽³⁾ (CBS, 2004) in the third column of table 1 (these descriptives are not available for the Zuidas as an area). A comparison of the two datasets reveals characteristics in which the representative Zuidas employee differs from employees in the Netherlands. We see quite distinctively that the average employee at the Zuidas is highly educated compared with the average employee in the Netherlands, which is reflected in average income as well. This difference is probably caused by the type of companies present at the Zuidas—being predominantly head offices of international companies and law offices—and, consequently, the types of workers they employ. Furthermore, the active workforce at the Zuidas is relatively young compared with the active workforce in the Netherlands, and employees at the Zuidas more often live alone or together with a partner without children. Finally, we see a very high share of employees at the Zuidas using public transport. This might be because the Dutch government singled the location out as one that should be easily accessible by public transport. Therefore, the Amsterdam Zuidas may have attracted companies that attach relatively great importance to accessibility by public transport, which is reflected by the fact that, as the distance from the Amsterdam Zuid-WTC railway station shows, most employees in the dataset work close to a large (and expanding) railway station.

⁽³⁾ The data for the national distribution of net personal income stem from 2000.

Table 1. Characteristics of the respondents (percentages of population).

Characteristics	Value	
	Zuidas	Netherlands
Gender		
male	59	59
Age (years)		
≤ 30	26	23
31–40	35	29
≥ 41	39	48
Highest educational degree		
bachelor/master	82	27
high school	16	64
other	2	8
Working days per week		
≤ 3	10	17
4	31	20
5	59	63
Main mode of commuting		
car	29	60
public transport	38	8
bicycle	30	25
other transport modes	3	7
Net personal monthly income (€)		
<2000	35	90
2000–3000	30	3
>3000	27	1
unknown	5	6
Family situation		
living alone without children	26	14
living alone with children	2	3
living with partner and with children	38	54
living with partner and without children	34	29
Partner (when living together)		
works full-time	51	14
Work location		
<2 min walking from Amsterdam Zuid-WTC railway station	50	

3.3 Representativeness

The database contains 1952 respondents (implying a response rate of 32%). Of these respondents, 1492 went through the entire questionnaire, and 1188 answered all questions.⁽⁴⁾

Selection biases might result from several sources. Because we conducted an Internet survey, a selection bias might arise if not every employee has access to the Internet. In business companies this may be the case for those employees who do not need Internet access to be able to carry out their jobs. Furthermore, the sample might not be fully representative for employees at the Zuidas, since not every company in the Zuidas area was willing to participate in the survey. Most participating companies are located close to Amsterdam Zuid-WTC railway station, which might lead to a distorted picture in terms of, for example, commuting mode used, assessment of accessibility of the Zuidas, and preferences for facilities. Most companies located close to

⁽⁴⁾ The response rate is satisfactory for this type of research. For comparison, Sheehan (2001) found in a literature review for the period 1998–2000 an average response rate of 31% for studies using e-mail surveys.

Amsterdam Zuid-WTC railway station are financial institutions and lawyer’s offices, whereas other kinds of employment (eg the public sector) are located somewhat further from Amsterdam Zuid-WTC railway station.

4 Survey results: averages

4.1 Nonshopping facilities

The average maximum WTP of employees for the most-preferred combination of three nonshopping facilities at the Zuidas is €6.88 per month. Figure 2 shows the frequencies of WTP values chosen by respondents. There is a large variation in WTPs. The WTP of 84% of the respondents is €10 or lower and only about 5% of the respondents is willing to pay €25 or more per month. More importantly, up to 49% of all values are zero, meaning that our data are strongly censored.

Figure 2. Frequencies of WTP values for sets of three most-preferred nonshopping facilities.

There are good reasons to expect an individual’s WTP to depend on the set of facilities that he or she prefers. Figure 3 shows for the indicated facilities the average WTP, and the 90% confidence interval, for the bundles of three most-preferred facilities in which the indicated facility is included. The straight line shows the average WTP of all respondents (€6.88), irrespective of the bundle of facilities concerned. The right axis normalises the WTPs with respect to the grand average.

The confidence intervals have been constructed using the estimated sample variance. They illustrate that the differences in WTP are statistically significant for several bundles in which a specific nonshopping facility is included (that is, their confidence intervals do not overlap). The average WTP for, for example, those bundles in which a lunchroom is included (€6.83) differs statistically significantly from the average WTP for bundles in which a day-care centre is included. Furthermore, we see that employees are willing to pay relatively high amounts for the use of a bundle of three facilities in which: (i) a day-care centre is included (€13.10), (ii) sports facilities are included (€10.80), or (iii) a museum is included (€10.20). The WTP for so-called public facilities is generally much lower. Perhaps people perceive access to facilities (such as an urban green or a railway station) as a right, which they are not willing to pay for.

4.2 Shopping facilities

As explained above, we asked the respondents about their percentage change of their total expenses (*E*) at the Zuidas on a specific type of shop, when (relative) prices would

Figure 3. Average WTP values for bundles in which indicated facility is included.

increase. Because we normalised prices and quantities and we have information only on budget shares, the data do not directly allow for a calculation of the WTP for the presence of a specific type of shop at the Zuidas. For this, we need an estimate of the average expenses in those types of shops. CBS (2004) provides data for the year 2000 for household expenses for different categories. Assuming that the average expenditure pattern of individuals in the Netherlands can be applied to employees at the Zuidas, we can calculate the WTP of employees to use these shopping facilities at the Zuidas as follows.

First, we assume that total expenses on each product group do not increase when workers gain access to facilities at the Zuidas. Furthermore, we have observations on four budget shares q_{ZA} at different relative price levels p_{ZA} . As already observed above, the area in figure 1 between the horizontal line $p_{ZA}^0 = 1$ and the demand curve fitted through the four observation points can then be interpreted as the employee's WTP for the presence of these shops at the Zuidas. To estimate the demand curve as consistently as possible, we fitted, by means of ordinary least squares regression, an average quadratic demand function $p(q_{ZA}^\pi) = a + bq_{ZA}^\pi + c(q_{ZA}^\pi)^2$, in which a , b , and c represent coefficients to be estimated. The curve in figure 1 represents this fitted demand function. Finally, using these estimates we are able to calculate the area beneath the demand function, and thus the WTP for a specific shopping facility.

5 Empirical specification and results

5.1 Correcting for self-selection in the choice of facilities

In our dataset, respondents first state their most preferred nonshopping facilities or most frequently visited shopping facilities and subsequently report their WTPs for those facilities. Thus, observed WTPs are most likely positively biased if taken to represent the sample average, and do not reflect the mean WTP for each facility for the whole sample. In the early 1950s Roy (1951) studied a similar problem where he described an elegant model dealing with the comparative productivity between hunters

and fishermen in a very simple (autarkic) community. We will follow Roy's train of thought and apply it to our specific problem.

Assume for ease of exposition that there are only two facilities at the Amsterdam Zuidas—for example, a restaurant and a sports facility—from which an employee has to value his or her most preferred one (we will generalise later on). Employee i will have a WTP of X_i for a restaurant and a WTP of Y_i for a sports facility. If employee i has to report his or her most preferred facility, he or she gives a WTP for a restaurant when $X_i \geq Y_i$ and for a sports facility when $X_i < Y_i$. Now, assume that (X, Y) is bivariate normally distributed, with expectation (μ_X, μ_Y) and covariance matrix:⁽⁵⁾

$$\begin{bmatrix} \sigma_X^2 & \sigma_{XY} \\ \sigma_{XY} & \sigma_Y^2 \end{bmatrix}.$$

Thus, the WTPs for a restaurant and a sports facility are allowed to be correlated. For example, it may well be that workers who frequently visit restaurants have a higher preference for sports facilities as well. Or, those workers who like to play sport may very well dislike visiting restaurants. Note that we are interested in the unconditional distributions of X and Y ; namely, the average value that all workers at the Amsterdam Zuidas attach to these facilities.

Now, define the residuals as follows (see for an elaboration Maddala, 1983, pages 257–258),

$$u_X = X - \mu_X, \quad u_Y = Y - \mu_Y,$$

and define the variance of the difference between the two residuals as follows:

$$\sigma^2 = \text{var}(u_X - u_Y),$$

and finally define the standardised values:

$$Z = \frac{\mu_X - \mu_Y}{\sigma}, \quad u = \frac{u_Y - u_X}{\sigma},$$

where Z denotes the standardised difference in the WTPs between restaurants and sports facilities, and u the standardised difference in deviations from the mean. Note that both Z and u are standard normally distributed. The condition $X > Y$ now implies $u < Z$, because, for those individuals who indicated that they prefer a restaurant, the following expectation must hold:

$$E(X|X > Y) = E\left(X \mid \frac{\mu_X + u_X}{\sigma} > \frac{\mu_Y + u_Y}{\sigma}\right) = E(X|u < Z),$$

which simplifies to (see also Greene, 1993; Maddala, 1983):⁽⁶⁾

$$E(X|u < Z) = \mu_X - \sigma_{u_X} \frac{\phi(Z)}{\Phi(Z)}, \quad (1)$$

with

$$\sigma_{u_X} = \text{cov}(u_X, u) = \frac{\sigma_{XY} - \sigma_X^2}{\sigma},$$

⁽⁵⁾ Roy's model critically depends on the normality assumption and has therefore been criticised (for further analysis, see Heckman and Honoré, 1990).

⁽⁶⁾ Here we use the following property of the first moment of the truncated bivariate normal distribution (see also Greene, 1993, page 707):

$$E(X|u < Z) = \frac{f(X)}{\text{pr}(u < Z)} = \mu_X - \sigma_{u_X} \frac{\phi(\alpha_u)}{\Phi(\alpha_u)}, \quad \text{with } \alpha_u = \frac{Z - E(u)}{(\text{var } u)^{1/2}} = Z.$$

The case for $u > Z$ can be derived completely analogously.

and $\phi(\cdot)$ and $\Phi(\cdot)$ the density and cumulative distribution function, respectively, of the standard normal distribution. So, when there is a nonzero correlation between u_X and the standardised difference between u_X and u_Y , then the expectation is not only dependent upon the expectation of u_X , but also upon an additional term. This term, $-\phi(\cdot)/\Phi(\cdot)$, is also called the inverse Mills ratio, and depicts the probability that Z is larger than u .⁽⁷⁾ Analogous to equation (1), the following expectation yields for those who indicated that they preferred a sports facility:

$$E(Y|X < Y) = E(Y|u > Z) = \mu_Y + \sigma_{u_Y} \frac{\phi(Z)}{1 - \Phi(Z)}, \tag{2}$$

with

$$\sigma_{u_Y} = \text{cov}(u_Y, u) = \frac{\sigma_Y^2 - \sigma_{XY}}{\sigma}.$$

It is crucial to note that, when $\sigma_{u_Y} \neq 0$, or $\sigma_{u_Y} \neq 0$, linear regression on the observed WTP values of both facilities using dummies for the choice for a particular type of facility yields biased results. Therefore, two-stage least squares or maximum-likelihood methods have to be used.

Up until now we have looked into a structure with only two facilities. To generalise equations (1) and (2) to J facilities, we use the following useful property of the normal distribution; namely, assume that the WTPs of J facilities are multivariate normally distributed, with μ the vector of expectations and Σ the covariance matrix. Then for each subset, y_1 , of J the following holds:

$$y_1 \sim N(\mu_1, \Sigma_{11}).$$

This means that each set of WTPs (and correspondingly, each single WTP) again has a normal distribution. Assume now that individuals first choose a facility of j , which they subsequently value, then the following holds for the valuation y_j of facility j :

$$E(y_j|y_j \geq y_k, \forall k \neq j) = \mu_j - \sum_{k \neq j} \frac{\sigma_{jk} - \sigma_j^2}{\sigma} \frac{\phi(Z)}{\Phi(Z)},$$

with σ and Z defined as above for each pair of facilities z and z' . For our purpose, however, individuals first choose m (ordered) facilities, after which they will value them (separately for shopping facilities and in aggregate for nonshopping facilities). Thus, if facilities k are lower valued and facilities l are higher valued than facility j , then the following must hold for facility j :

$$\begin{aligned} E(y_j|y_j \geq y_k \wedge y_j \leq y_l, \forall k, l \neq j) &= E(y_j|\xi_j) \\ &= \mu_j - \sum_{k \neq j} \frac{\sigma_{jk} - \sigma_j^2}{\sigma} \frac{\phi(Z)}{\Phi(Z)} + \sum_{k \neq j} \frac{\sigma_l^2 - \sigma_{jl}}{\sigma} \frac{\phi(Z)}{1 - \Phi(Z)}, \end{aligned} \tag{3}$$

where ξ_j is a convenient shorthand notation for the ordering structure in the choices for the various facilities. Specification (3) now enables us to estimate the WTP correctly for both shopping and nonshopping facilities.

5.2 The WTP for nonshopping facilities

As explained above, respondents first had to rank their three most preferred facilities (from most to least preferred), after which they had to value this bundle of facilities.

⁽⁷⁾ Note that—unlike ordinary selection models—the standardised difference between the error terms is used here. This follows from the fact that both $X > Y$ and $X < Y$ may denote a selection process.

We indicate these three most preferred facilities as j , k , and l . The expected value of the bundle $E(y_{j,k,l})$ for individual i may then be denoted as:⁽⁸⁾

$$E(y_{j,k,l} | \xi_j, \xi_k, \xi_l) = E(y_j | \xi_j) + E(y_k | \xi_k) + E(y_l | \xi_l),$$

where ξ_z ($z \in \{j, k, l\}$) denotes the rank individual i attributes to facility z . Assuming that (i) each valuation of facility j follows an $N(\mu_j, \sigma_j^2)$ distribution and that (ii) the level of total WTP for the three most preferred facilities j , k , and l ($y_{j,k,l}$) depends additively on a set of individual characteristics $\mathbf{Z}$ leaves us with:

$$y_{j,k,l} | \xi_j, \xi_k, \xi_l = E(y_j | \xi_j) + E(y_k | \xi_k) + E(y_l | \xi_l) + \mathbf{Z}\beta + \varepsilon_{j,k,l}, \quad (4)$$

with $\varepsilon_{j,k,l} \sim N(0, \sigma_{j,k,l}^2)$, and

$$\sigma_{j,k,l}^2 = \sigma_j^2 + \sigma_k^2 + \sigma_l^2 + 2\sigma_{jk} + 2\sigma_{jl} + 2\sigma_{kl},$$

where $\sigma_{zz'}$ denotes the covariance between the value attached to facility z and facility z' ($z' \in \{j, k, l\} \wedge z' \neq z$). As already noted above, 49% of all observations are zeros, implying that our sample is censored. Thus, we have to apply the following standard tobit specification to equation (4):

$$y_{j,k,l}^* | \xi_j, \xi_k, \xi_l = \begin{cases} y_{j,k,l} | \xi_j, \xi_k, \xi_l, & \text{if } y_{j,k,l} | \xi_j, \xi_k, \xi_l \geq 0, \\ 0, & \text{otherwise,} \end{cases} \quad (5)$$

where y^* denotes the observed (censored) variable.

Because we have 17 nonshopping facilities, this would mean that we have to estimate 170 variables (17 means, 17 variances, and 136 covariances), and that is without including individual characteristics in the model. Because of this computational complexity, we merge the nonshopping facilities into 6 more or less homogeneous groups of facilities, which leaves us with only 27 variables (6 means, 6 variances, and 15 covariances) to be estimated. The groups of nonshopping facilities encompass:

public transport: bus station, railway station, metro station, bicycle stand;

restaurants: pub, lunchroom, restaurant, snackbar;

luxury transport: high-speed-train station, taxi stand;

day-care centre: day-care centre;

sports: sports centre;

public/reception: library, museum, video shop, post office, park/green.

Table 2 presents the estimation results of specification (5) which are to be interpreted as shifts in the expected value⁽⁹⁾ of the *latent* distribution for the *bundle* of shopping facilities. Because of the structure of the model, the coefficients reflect the marginal effects on the latent distribution and can therefore be interpreted in only relative terms. Thus, age does not seem to have a large impact on the WTP for nonshopping facilities. Employees who work four or five days a week at the Zuidas, however, have a higher WTP for nonshopping facilities compared with workers who travel less to the Zuidas. This result is not surprising, since these workers are expected to use these facilities more often, as they spend most time at the Amsterdam Zuidas. The income measures do not show statistical significance, nor do they show any clear pattern. Travel time characteristics display an intriguing behaviour. It appears that the WTP conditional on travel time follows an inverse U-shape pattern, indicating that workers living very close by or far from the Zuidas have a relatively low WTP for nonshopping facilities. A possible explanation might be that employees living close by

⁽⁸⁾ For ease of notation, we leave out the individual subscript i .

⁽⁹⁾ Note that the expected value of the latent distribution ($y_{j,k,l}^*$) is simply

$E(y_j | \xi_j) + E(y_k | \xi_k) + E(y_l | \xi_l) + \mathbf{Z}\beta$.

Table 2. Estimation results for nonshopping facilities (at 5% significant in bold).

Variable	Coefficient	Standard error
Age (base ≤ 30)		
31–40	1.73	1.97
≥ 41	0.42	2.40
missing	−2.55	1.73
Travel days (base = 1–3)		
4	7.32	0.29
5	6.66	0.45
Income, € (base ≤ 1500)		
unknown (5.1%)	5.46	1.26
1500–2000	0.02	3.56
2000–3000	0.53	1.70
> 3000	0.00	15.48
Travel time (mins) (base = 10)		
10–20	1.47	0.84
20–30	1.43	0.93
30–45	5.69	0.80
45–60	3.83	1.17
> 60	− 2.04	0.56
Transport mode (base = car)		
train	3.39	1.35
tram/bus	3.42	1.43
walk/bike	−1.01	2.03
other transport means	−0.45	0.93
Gender (base = male)		
female	4.05	2.15
Urbanisation at place of residence (base = < 500 addressees per km ²)		
500–1000	5.90	1.25
1000–1500	−0.78	1.02
1500–2500	−0.05	2.42
≥ 2500	−0.27	8.52
missing	4.04	0.75
Distribution parameters		
μ _{public transport}	− 5.51	1.10
μ _{restaurants}	− 7.94	1.59
μ _{luxury transport}	− 1.56	1.49
μ _{day-care centre}	0.21	1.91
μ _{sports centre}	−2.04	1.89
μ _{public/recreation} ^a	− 2.01	0.86
σ _{public transport} ^a	7.32	
σ _{restaurants}	6.82	
σ _{luxury transport}	6.58	
σ _{day-care centre}	7.76	
σ _{sports centre}	7.12	
σ _{public/recreation}	4.62	
Number of observations	1518	
Mean log-likelihood	0.49	

^a Due to a reparametrisation of the (co)variance parameters using a Choleski decomposition, standard errors of the σs cannot be provided (Greene, 1993).

may also use their own facilities at home while employees living far from the Zuidas might leave early because of higher commuting time and may therefore use nonshopping facilities relatively less. Perhaps related, employees commuting with bus, train, or tram seem to be willing to spend most on nonshopping facilities compared with workers who come by car or bike. Females have on average also a higher WTP and finally, employees coming from

less densely urbanised regions are also willing to spend more. The latter is probably due to the fact that there are fewer nonshopping facilities in sparsely populated areas, so that every improvement in the accessibility to facilities would be appreciated.

The distribution parameters of the WTP for each nonshopping facility are difficult to interpret directly, because relative changes between the WTP for facilities not only depend upon the expectations but also depend upon the standard errors. To clarify this point, figure 4 offers the (latent) distribution of the WTP for each nonshopping facility. Figure 4 and table 2 clearly show that day-care centres have the highest WTP expectation and restaurants the lowest. However, because we are only interested in the *observed* WTP values, we should restrict our attention to the areas below the distributions to the right of the vertical axis. This means, for example, that, although expected latent WTPs for public/recreation facilities are higher than for sports centres, expected observed WTPs are lower. This is because the latent expected means of the distribution are negative, due to the large number of zero observations. Moreover, the parameters of these distributions are only valid for the base case—in this case we are looking at a sample of young car-driving males, who work less than four days per week at the Zuidas, who are low earners and live in very sparsely populated municipalities.

Figure 4. Estimated normal density functions of latent WTP values for nonshopping facilities at the Amsterdam Zuidas.

Because we are interested in the expected observed WTP values for the full sample as well, we transform the latent WTP expectation into the observed WTP for each employee and for each facility (for example, see Maddala, 1983).⁽¹⁰⁾ These WTP expectations are given in table 3. The results in table 3 clearly show that day-care centres, public transport facilities, and restaurants are valued most highly among the nonshopping facilities (to be) present at the Amsterdam Zuidas. Public and recreation facilities are valued least by employees. Note that, for reasons of comparability, the sum of all WTP values is the sum again of all seventeen nonshopping facilities and not of the six composite variables. Thus, for example, public transport was composed of four facilities and its WTP should therefore be multiplied by four to calculate total WTP for all public transport facilities combined. To facilitate the interpretation

⁽¹⁰⁾ Basically, this means that all negative latent observations are set at zero.

Table 3. Expected WTP for nonshopping facilities.

Facility	Expected WTP (€)	Implied equivalent time savings (hour per month)		
		using car	using train	using bus/tram
Public transport	2.56	0.44	0.49	0.52
Restaurants	2.15	0.37	0.41	0.43
Luxury transport	1.59	0.28	0.31	0.32
Day-care centre	2.46	0.43	0.47	0.50
Sports centre	1.96	0.34	0.38	0.40
Public/recreation	0.59	0.10	0.11	0.12
Total WTP	29.39	5.08	5.66	5.92

Note: Value of time is defined as how people value travel time for noncommuting purposes.

of these WTP values, we present the value of time savings as well using the value of time for noncommuting purposes (such as shopping, leisure activities, and sports). Thus, it seems that employees expect that these new facilities do not result in time savings of more than half an hour per month per facility. However, the time savings for all of these facilities combined result in a significant value of time saving of five to six hours per month, where workers especially expected improvements in public transport facilities to save them time. Assuming 20 working days per month, this corresponds with 15–20 minutes per day. This appears to be on the high side, suggesting that there are other reasons than time gains alone that make employees value the presence of facilities near the work location.

5.3 The WTP for shopping facilities

In the questionnaire six shop types were distinguished: supermarkets, drugstores, hairdressers, dry cleaners, flower shops, and book shops. Each individual was first asked to indicate his or her two most frequently visited shops and subsequently to indicate his or her change in expenditure level for both shops when prices were 0%, 10%, 25%, and 50% higher. Although the two variables ‘most frequently visited shop’ and ‘most preferred shop’ are not identical, the same type of self-selection bias as before is likely to occur. Each respondent had to indicate a preference ranking of shops as well, so that for each individual we are able to construct a ranking structure ξ_s for each facility s . Normalising the prices (p_{ZA}^0) at one enables us to specify the relation between quantities (q_{ZA}^π) and prices levels (p_{ZA}^π) for shopping facility s as follows:

$$q_{ZA}^\pi | \xi_s = \mathbf{D} \gamma | \xi_s + \mathbf{Z} \beta | \xi_s + \varepsilon_s,$$

(6)

where $\mathbf{D}$ is a matrix of dummies for price levels at the Zuidas (p_{ZA}^π) with 24 columns—four relative price levels π ($\pi \in \{1.0, 1.1, 1.25, 1.5\}$) for each of the six shopping facilities—and $\mathbf{Z}$ is the same set of individual characteristics as used for the non-shopping facilities. Table 4 offers the estimation results of specification (6). Table 4 focuses especially on the impact of individual characteristics on the WTP for shopping facilities at the Amsterdam Zuidas. Although the individual characteristics directly influence expenditure shares in shopping facilities at the Zuidas—and the corresponding quantities—direct inference on the level of WTP values is not feasible because information on individual variation in monthly household expenditures is not available. However, we are able to interpret the sign of the coefficients as the direction in which WTP values change due to the impact of individual characteristics.

Almost all coefficients are statistically significant. First, young employees seem to have a higher preference for shopping facilities than older employees, which may indicate that

Table 4. Estimation results for shopping facilities (at 5% significance in bold).

Variable	Coefficient	Standard error
Age (years) (base ≤ 30)		
31–40	– 0.043	0.005
≥ 41	– 0.075	0.006
missing	– 0.059	0.011
Travel days (base = 1–3)		
4	0.024	0.005
5	0.025	0.006
Income, € (base ≤ 1500)		
unknown (5.1%)	0.043	0.009
1500–2000	0.013	0.006
2000–3000	0.028	0.006
> 3000	0.016	0.006
Travel time (mins) (base = 10)		
10–20	– 0.044	0.007
20–30	– 0.072	0.007
30–45	– 0.087	0.007
45–60	– 0.104	0.007
> 60	– 0.105	0.008
Transport mode (base = car)		
train	– 0.017	0.006
tram/bus	0.042	0.006
walk/bike	– 0.036	0.006
other transport means	– 0.023	0.010
Gender (base = male)		
female	0.025	0.004
Urbanisation at place of residence (base = < 500 addressees per km ²)		
500 < 1000	– 0.017	0.005
1000 < 1500	–0.011	0.007
1500 < 2500	– 0.023	0.008
≥ 2500	0.044	0.010
missing	– 0.033	0.007
Price dummies for supermarket		
$p_{ZA} = 1.0$	0.362	0.010
$p_{ZA} = 1.1$	0.241	0.011
$p_{ZA} = 1.25$	0.154	0.009
$p_{ZA} = 1.5$	0.114	0.009
Price dummies for drugstore		
$p_{ZA} = 1.0$	0.487	0.013
$p_{ZA} = 1.1$	0.334	0.014
$p_{ZA} = 1.25$	0.193	0.014
$p_{ZA} = 1.5$	0.114	0.012
Price dummies for dry cleaners		
$p_{ZA} = 1.0$	0.632	0.024
$p_{ZA} = 1.1$	0.412	0.026
$p_{ZA} = 1.25$	0.098	0.025
$p_{ZA} = 1.5$	– 0.080	0.023
Price dummies for bookshop		
$p_{ZA} = 1.0$	0.493	0.015
$p_{ZA} = 1.1$	0.309	0.015
$p_{ZA} = 1.25$	0.140	0.017
$p_{ZA} = 1.5$	0.045	0.022

Table 4 (continued).

Variable	Coefficient	Standard error
Price dummies for flower shop		
$p_{ZA} = 1.0$	0.463	0.019
$p_{ZA} = 1.1$	0.334	0.018
$p_{ZA} = 1.25$	0.138	0.019
$p_{ZA} = 1.5$	0.018	0.021
Price dummies for hairdresser		
$p_{ZA} = 1.0$	0.362	0.028
$p_{ZA} = 1.1$	0.207	0.035
$p_{ZA} = 1.25$	-0.079	0.032
$p_{ZA} = 1.5$	-0.232	0.033
Number of observations	11212	
Mean log-likelihood	0.21	

they are less tied to local shops around their place of residence. As could be expected, workers who work more at the Zuidas are also willing to pay more for the presence of shops, as the likelihood also increases that they will actually use these facilities. The income parameters point to the—theoretically justifiable—pattern that workers with a higher income have a higher WTP as well. Opposite to the estimates for non-shopping facilities, those workers with lowest travel time also have the highest WTP for shopping facilities. A possible explanation might be that these workers expect not only to use these shops during working hours, but also during nonworking hours (eg the weekends), as well as these shops are close to their place of residence. Workers who walk or cycle to work have a lower WTP for shopping facilities and workers who use the car and especially bus or tram have a higher WTP. This might be correlated with the ease of carrying the purchases made at the shops home. Just as for nonshopping facilities, women seem to have a higher WTP for shopping facilities as well. And finally, both workers who live in very densely populated areas and workers who live in very sparsely populated areas have a high preference for shops at the Zuidas. This is probably due to two effects. First, workers who live in rather rural areas value better access to shops anyway, irrespective of whether they are present at the place of residence or at the place of work. On the other hand, workers who live in very densely populated areas probably live in residential areas with few shopping facilities and hence value better access to shopping facilities as well.

Note that the coefficients for the price dummies in table 4 directly give the effect of prices on quantities for a very specific sample: namely for young car-driving males, who work less than four days per week at the Zuidas, who are low earners and live in very sparsely populated municipalities. However, we make a few general comments before looking at the total sample. For all shop types, the analyses result in vertical intercepts within the range 0.36–0.63, implying that the employee belonging to the sample as described above is prepared to spend 36% to 63% of his or her total expenditure on shops at the Zuidas when prices remain the same. For hairdressers and dry cleaners, table 4 shows that workers will be actually spending less at the Zuidas compared with their normal expenditure pattern when prices increase too much at the Zuidas.

We use the approach as explained in subsection 4.2 to calculate sample average WTP values for all shopping facilities. We use the estimates provided by CBS (2004) for the average monthly household expenditures at supermarkets (€260), drugstores (€35), hairdressers (€13), dry cleaners (€1.40), flower shops (€11.40), and at bookshops

(€26.70). Now, the second column in table 5 shows the share of an employees' average monthly expenses in a specific type of shop he or she is willing to spend extra for the use of that type of shop in the Zuidas area. The third column shows the conversion into corresponding WTP values. Table 5 shows that the WTP values for almost all shops are much lower than for supermarkets, which is primarily due to the fact that average monthly household expenses for nonsupermarket shops are much lower than for supermarkets. If we, however, look at the WTP for the use of different types of shops in a multifunctionally designed area as a share of average monthly expenditures, we see that the relative WTP is more or less equal for all kind of shops, except for hairdressers. This is most likely due to the very low amount of actual observations on hairdressers, which lies around 1% of the total sample (the R^2 of the fitted demand functions was also considerably lower than the R^2 s of the other demand functions).

Table 5. Expenditure share and expected WTP values for shopping facilities at the Zuidas.

Facility	Expected share (%)	Expected WTP (€)	Implied equivalent time savings (hour per month)		
			using car	using train	using bus/tram
Supermarket	5.85	15.20	2.63	2.93	3.06
Drugstore	5.41	1.89	0.33	0.36	0.38
Dry cleaners	3.49	0.05	0.01	0.01	0.01
Bookshop	3.59	0.96	0.17	0.19	0.19
Flower shop	3.44	0.39	0.07	0.07	0.09
Hairdresser	54.02	6.89	1.19	1.33	1.39
Total WTP		25.38	4.39	4.89	5.12

Note: Value of time is defined as how people value travel time for noncommuting purposes.

Again, for ease of interpretation, we included implied values of time savings. Obviously, employees consider access to a supermarket as most valuable in terms of time savings, followed by hairdressers and drugstores. In total, workers expect access to these shops to result in value of time savings of about 5 hours, corresponding to another 15 minutes per average day. Again, this appears to show that there must be other reasons than time gains alone that make employees value the presence of shops near their workplace.

6 Conclusion

Larger railway stations often attract, and benefit from, various types of economic activities. This makes the planning of stations and areas around them a complicated task, for which it is crucial to have a clear understanding of the benefits and costs associated with different types of designs. This paper studied this question empirically in the context of a multifunctional design of the area around the Amsterdam Zuid-WTC train–tram–metro station, focusing on the valuation by local employees of various hypothetical shopping and nonshopping facilities. To that end, a stated preference survey was held, in which employees at the Amsterdam Zuidas were asked to indicate their WTP for their most preferred or visited facilities—ranging from public transport facilities and restaurants to various types of shops. To assess the true average WTP for each individual facility, we had to control for censoring and selection effects.

With regard to nonshopping facilities, employees have a low WTP for public and recreation facilities. Probably, workers expect these facilities such as post offices and greenery to be present anyway, and are not used to think in terms of paying for them. Moreover, workers seem to have a higher preference for public transport facilities than for more luxury types of transport facilities. Obviously, the first type is used more

often by a large share of the employees at the Zuidas. Only a small percentage of the employees at the Zuidas will make use of taxis and high speed train on a regular basis.

As for shopping facilities, employees at the Zuidas have a high absolute WTP for supermarkets, but only because they spend a large part of their budget at supermarkets anyway. Looking at WTP relative to current expenditures reveals that, for the availability of most shopping facilities at the Zuidas, employees are willing to pay 3% to 5% of current expenditure.

The analysis of the average WTP of employees for the total bundle of nonshopping and shopping facilities reveals a value of €54.77 per month for the average employee, for the full set of facilities considered. Moreover, the analysis reveals that most WTPs for facilities are positively correlated with each other. This indicates that there are unobserved factors present that—although corrected for—influence the WTP that employees have for facilities at the Zuidas. These unobserved factors may be related to personal characteristics—for example, lifestyle and personality—or may be work related—for example, ambition and type of workplace. The WTP of €54.77 would correspond to an equivalent time gain of around 10 hours per month when valued at nonwork value of time or 30 minutes per working day. This is so high that it seems safe to conclude that there are other factors, apart from sheer time gains, that make employees value the presence of shops and other facilities near their workplace.

Ideosyncratic factors that we are able to control for directly show that the WTP for facilities at the Zuidas depends significantly on individual characteristics. Moreover, it appears that the type of facility (shopping versus nonshopping) seems to appeal to different groups of employees. For example, employees aged less than 30 years have a strong preference for shopping facilities, while employees between 30 and 40 seem to prefer nonshopping facilities, which may be related to child care. However, the largest difference can be found in travel time, where workers living close to their workplace have a high preference for shopping facilities and workers living further away have a higher preference for nonshopping facilities. This indicates a significant difference in behaviour between these two types of employees. If present, workers who live further away are willing to spend time and money on nonshopping facilities at the place of work, while workers who live close to work seem to be more indifferent to the presence of these types of facilities. However, the latter group is willing to spend more at shopping facilities close to work. The latter point underlines that functions present at a multifunctional land use may often be strongly related to each other, implying that the presence of other functions may be a critical success factor.

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