Analysis of demand characteristics for transport and communication in Spain from 1980 to 2015

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Abstract

This paper investigates the characteristics of the demand for transport and communication in Spain in a period of 36 years. The period considered covers relevant events, such as the starting of democracy and the recent crisis in 2008. Transport and communication demand is a significant indicator of the development and welfare of a society. The evolution of demand is analysed with the direct characterization of the data available. Besides, different models for representation of consumer preferences are checked in order to determine the relationship between the different products considered. The study includes the results of the different elasticities obtained with the model that best fit with the data.

Palabras clave: Transport and communication, Spain, Demand Systems.

JEL Classification: D12, D13

1. Introduction

The consumption of households related to transport and communications are one of the expenditures more sensitive to economic conditions in the society (García, 2018; García and Molina, 2017; Molina, 2011). Therefore, the analysis of its evolution in a period where the society traverse significant events is a well indicator of its development. In the period considered for this study there are relevant differences in different sub-periods. Thus, the whole period 1980-2015 can be divided in the following sub-periods: 1980-1987, 1988-1993, 1994-2007, 2008-2012 and 2013-2015. As explained in García (2018), these sub-periods are characterized for different social and economic scenarios. The first one is determined by the starting of democracy in Spain after a long period of dictatorship. The agreements between the political parties led to the entry of Spain in the European Economic Community in 1986. This was a period of growth due mainly to the opening of economy. This growth was followed by a slowing period determined by a global financial collapse that made Spain enter into recession in the year 1992. The last of this period was characterized by dramatic increases in unemployment. In the period 1994-2007, Spain economy recovered, unemployment decreased and there was privatization of public companies. Spain entered into the Economic Monetary Union and the Euro replaced the peseta in 2002. The growth, low interest rate and stability led to a period of speculation and under controlled of private indebtedness that finally concluded in the crisis of 2008. This meant a significant increase of unemployment and lack of fulfillment of mortgages with an over valuation of real-state sector. There were several decreases in GDP during this period. The last period, starting in 2013 represents starting of recovery with economic growth, with a recovery in the unemployment but with an internal devaluation caused by the decrease in salaries.

In this scenario, it is interesting to evaluate characteristics of demand for transport and communication as good indicator of household economy health. The analysis of data and representation with microeconomic models will help to understand the relationships and determinants of the household expenditures. In fact, there are studies that analyse complementary and substitution relationship between transport and communication goods (Choo and Mokhatarian, 2007, Lee and Mokhatarian, 2008, Choo, Lee and Mokhatarian, 2008). These studies analyse US demands for industry and customers in different periods, covering from 1947 to 2002. In Choo, Lee and Mokhatarian, the auhors use the Almost Ideal Demand System (AIDS) for the period between 1984 and 2002, with disaggregate categories for transport and communications (nine and five respectively). The model results indicate substitution and complementary relationships between transport and communication, often not symmetric. The influence of communications on transportation shows a dominant complementary effect.

2. Evolution of demand

In this chapter, the consumption in real terms and prices are analysed. Different categories for transport and communication are considered. The reference year for the study is 2010. The categories considered are the following: vehicles, equipment and

transport services for transport, and postal services, communication equipment and communication services for communication. A particularity in relation to communication expenditure is that the first data for communication equipment are from year 1995, whereas for communication service are from year 1987. Thus, the consumption rate and price evolution take into account this fact to calculate evolution in the sub-periods considered.

The table 2.1 shows the consumption in real terms with the base of year 2010 for the categories considered. Table 2.2 shows the budget share for every category. Both consider the whole period of study.

Table 2.1. Consumption in real terms (base year 2010, millions of Euros)

	Mean	Std. Dev.	Min	Max
Vehicles	15493,0	3713,1	10697,9	22724,0
Equipment	29024,8	8871,6	15400,7	42182,7
Transport services	9930,4	1549,7	7125,8	12018,1
Postal services	447,6	199,5	87,1	674,6
Communication equipment	384,8	460,8	118,6	1927,0
Communication services	8840,4	6226,4	81,9	16837,5

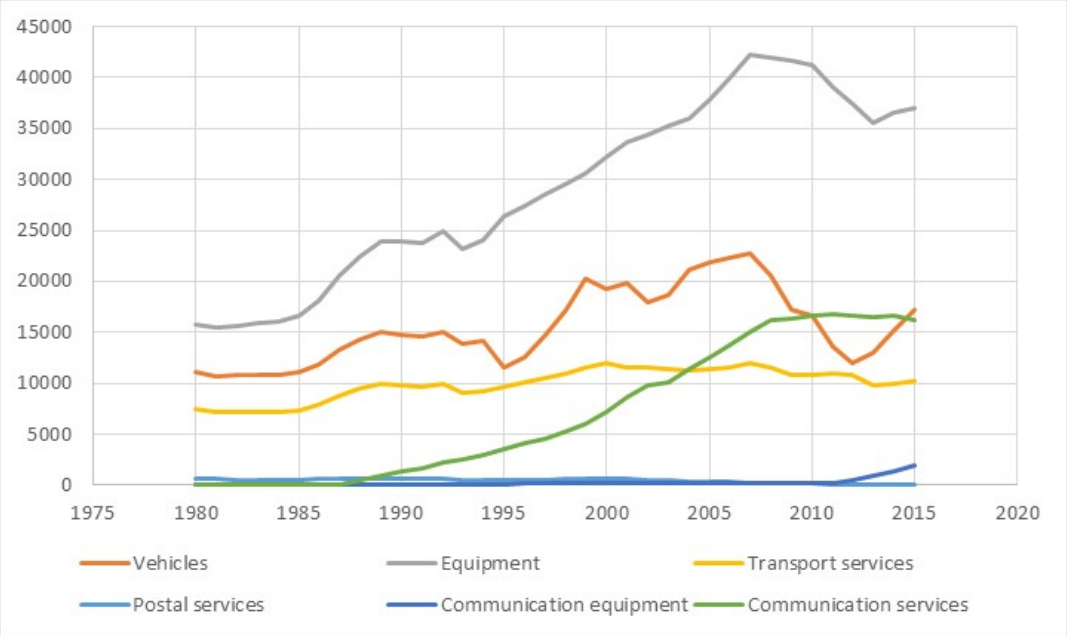
Table 2.2. Budget shares

PERCENTAGE	Mean (%)	Std. Dev.	Min (%)	Max (%)
Vehicles	25,97	0,0471037	15,5	31,8
Equipment	46,72	0,0146279	44,2	50,9
Transport services	16,89	0,0315491	12,4	21,2
Postal services	0,88	0,0054463	0,1	1,7
Communication equipment	0,29	0,0049037	0,0	2,3
Communication services	9,25	0,0773124	0,0	21,7

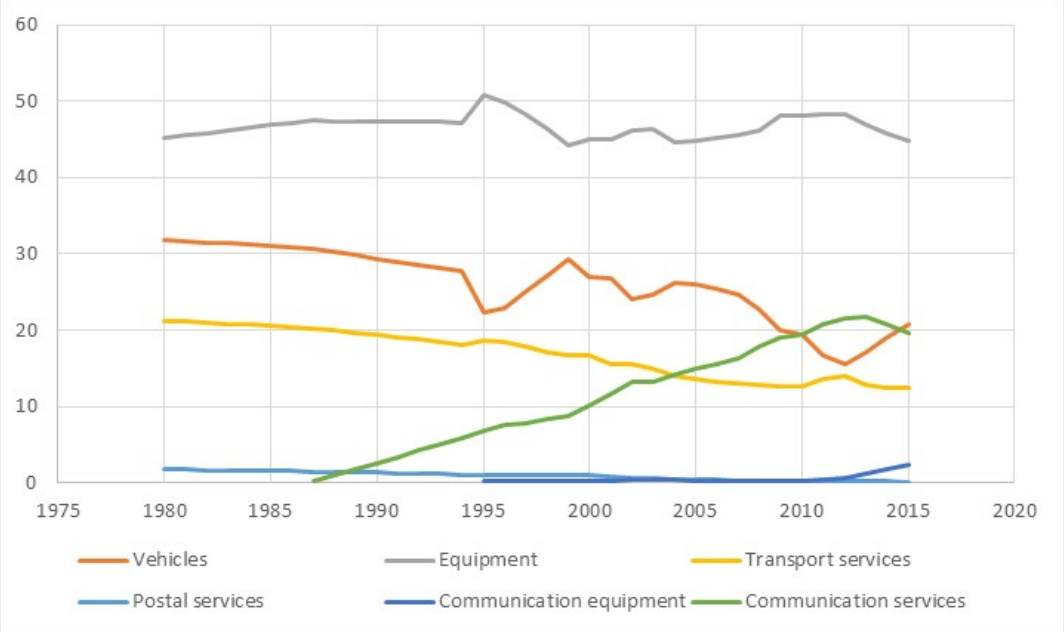
From the information analysed in García, 2018, the transport and communications group represents the 12,76% of total budget share in the whole period considered, with a standard deviation of 0.010. Thus, the variation is not reaching the highest level of other consumption groups, such as food, that attains 0.029. However, the variation inside the different categories of the transport and communications group is far away from this value of 0.010. From the data in Table 2.1 and Table 2.2, it is observed that the highest consumption is equipment, followed by the category vehicles. The highest

variability is reached for vehicles and equipment in relation to transport, and in the communication services in relation to communication consumption, that achieves a value of 0.077. It reflects the boom of consumption in communication that followed the mobile and connectivity networks after year 1985. The evolution of consumption and variability are well observed in the graphs that show both consumption value (Graph 2.1) and budget share (Graph 2.2).

Graph 2.1. Consumption of transport and communication (constant prices 2010)



Graph 2.2. Budget shares



The observations in the graphs shows the variability that has occurred for the different periods. The variability in numbers is also shown in the Table 2.3. Generally speaking, the consumption has followed a raising trend. This trend has been broken in periods of

economical crisis, mainly for transport goods and in the crisis of 2008. The categories with a higher impact of consumption decay are vehicles and equipment. Vehicles reaches a value of -41,81% in the period 2008-2012, showing the sensitivity of consumption in this good, that could also be analyzed by its origin (Molina, 1997). The significant decay of postal services is likely to be caused by the significant increase of communication services. In fact, communication equipment and services show not to be sensitive to crisis, and both figures of consumption show a significant increase. It is especially remarkable for communication services, since it overcomes the budget share of transport services and reaches almost the value of transport equipment in the year 2015.

Table 2.3. Evolution of consumption in real terms (%, base year 2010)

	1980-87	1988-93	1994-2007	2008-12	2013-15	1980-2015
Vehicles	19,53	-3,48	60,53	-41,81	31,95	**54,36**
Equipment	30,14	3,30	74,88	-10,84	4,24	**133,99**
Transport services	18,55	-4,18	29,69	-6,74	4,75	**38,11**
Postal services	4,68	-15,73	-54,11	-47,77	-11,90	**-85,40**
Communication equipment	NA	NA	81,87	110,46	126,75	**1525,23**
Communication services	NA	425,18	409,68	2,76	-1,33	**19727,44**

The specific characteristics of the group communication and transport in relation to the consumption rate in all goods (extracted from García, 2018) are characterized in the Graph 2.3. The values for consumption of communication goods are significant in relation to the general trend. It is also observed that the consumption rate of the whole group transport and communications do not differ significantly from transport, since the three categories included in this group are the highest budget share inside the whole group (from the Table 2.2, it can be seen that communication consumption represents a value slightly above 10% in the whole period).

As for the prices, the Table 2.4 shows the mean value and variability for the whole period, whereas Table 2.5 represents the evolution of prices in the different sub-periods. When compared with standard deviations for groups of whole consumption (García, 2018), it results in general a value higher for transport good different from vehicles. Vehicles are inside general range between 0.22 and 0.29. The variability is higher for the categories of equipment and transport services. As for communication goods (apart from postal services), the difference is very high. It comes from the fact that these are goods that have appeared in the period analysed, and the prices have been decreasing according to massive use and technology evolution. It is indicated in the Table 2.5, where the evolution of prices in percentages is registered.

Graph 2.3. Consumption rates of all goods / transport and communications

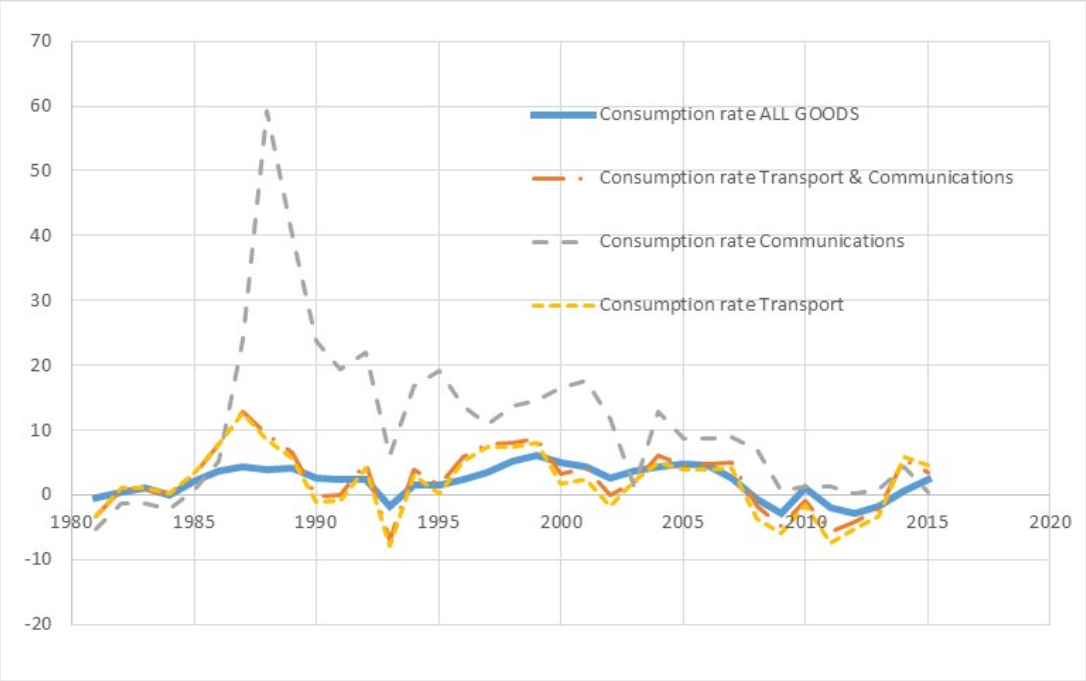


Table 2.4. Prices (base year 2010)

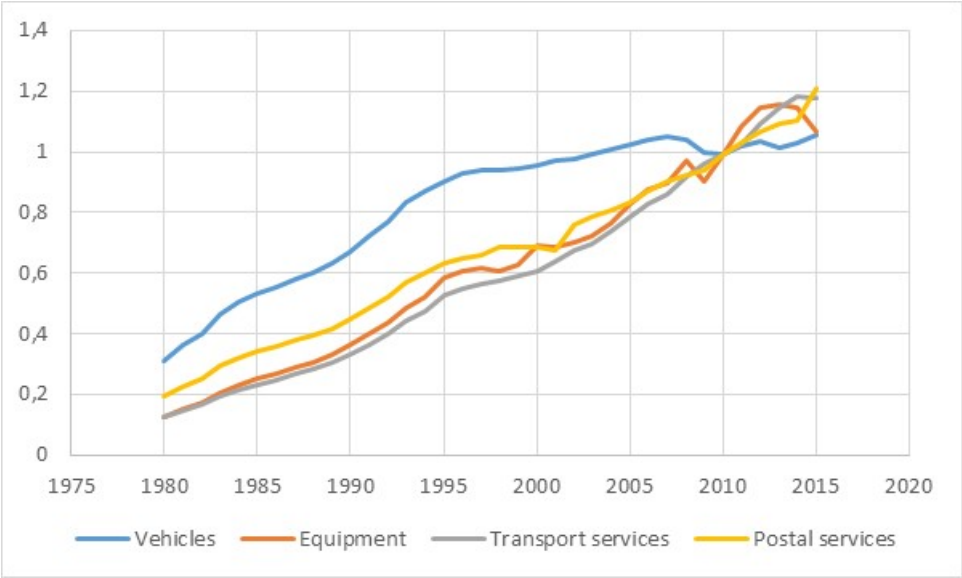
	Mean	Std. Dev.	Min	Max
Vehicles	0,82413	0,23089	0,31120	1,05724
Equipment	0,61633	0,31790	0,12735	1,15554
Transport services	0,59193	0,32374	0,12297	1,18051
Postal services	0,66051	0,28010	0,19351	1,20682
Communication equipment	2,04131	0,83823	0,69882	2,91055
Communication services	2,08863	4,03181	0,84361	22,66647

Table 2.5. Evolution of prices

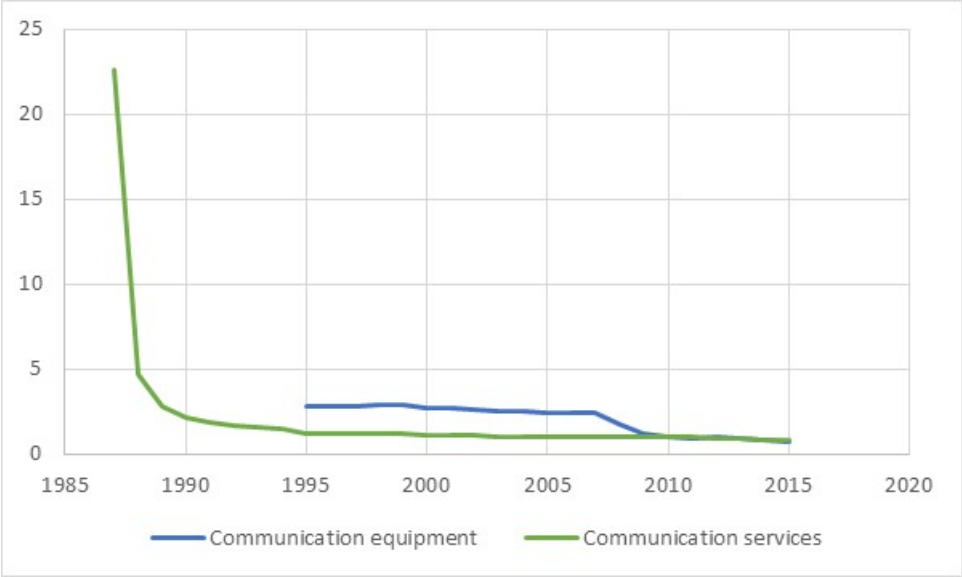
	1980-87	1988-93	1994-2007	2008-12	2013-15	1980-2015
Vehicles	86,49	38,88	20,75	-0,86	4,50	**239,73**
Equipment	125,95	58,68	72,36	17,59	-7,90	**735,76**
Transport services	116,61	57,21	80,57	19,05	2,81	**857,21**
Postal services	95,04	44,83	50,08	15,54	10,63	**523,66**
Communication equipment	NA	NA	-15,00	-44,00	-26,09	**-75,29**
Communication services	NA	-66,80	-31,52	-4,55	-7,13	**-96,28**

In the Graph 2.4 and the Graph 2.5, it is shown separately the prices that follow the general trend for other consumption groups and the communication equipment and services that show a significant decrease, as explained previously.

Graph 2.4. Prices for categories that follow general trend (food) (base year 2010)



Graph 2.5. Prices for categories: communication equipment and services (base year 2010)



3. Microeconomic study

The methodology followed for gathering the data is to maintain the consumption in the categories well established for the whole period, and to convert the data in a common base. In this case, it has been done for year 2010 (Molina, 1994, 1995, 1997).

The categories inside the group communication and transport have been selected to consider the welfare and development of the country.

In order to analyse demand characteristics, two different models have been used: AIDS (Almost Ideal Demand System) (Deaton and Muellbauer, 1980; Molina, 1994) and Rotterdam. These models, that are consumer unitary models, have been used in their static and dynamic versions. For the latter up to three lags have been checked. The objective is to find the model that best fits with the data considered and calculate the elasticities (Gimenez-Nadal and Molina). It provides the information on the characteristics of demand and can explain the specific conditions for every category inside the group taken into account. Different tests have been used to verify the compliance with the econometric properties. First, it must be ensured that there is no autocorrelation in the system. For that purpose, Harvey test (1982) and the statistic ρ- have been used. The homogeneity and symmetry conditions have been also checked. As for homogeneity, it means that when the available income increase similarly to prices, the quantity demanded does not increase. As for symmetry, it means that the crossed effects are equal.

The models used are explained in detail in García, 2018. In this working paper, the main equations are presented together with the calculation of elasticities (the equations are also shown in the appendix with the formula used in the calculation model). Only the static models are presented in this chapter. In the calculation model, the dynamic version is also used with a given number of lags (Molina, 1995).

AIDS (Almost Ideal Demand System)

The expenditure function is taken with PIGLOG preferences.

$$\log c(p, u) = (1 - u) \log a(p) + u \log b(p)$$

Where the terms are expressed in terms of prices (p) and utility (u).

$$\log a(\mathbf{p}) = \alpha_0 + \sum_k^n \alpha_k \log p_k + \frac{1}{2}\sum_k^n \sum_j^n \gamma_{kj}^* \log p_k \log p_j$$

$$\log b(\mathbf{p}) = \log a(\mathbf{p}) + \beta_0 \prod_k p_k^{\beta_k}$$

By applying the Hotelling's Theorem, making derivatives in the equation and assuming that all the income is spent by the rational agent, we arrive at the system of equations in function of budget share for every good, such as follows:

$$w_1 = \alpha_1 + \gamma_{11}\log p_1 + \gamma_{12}\log p_2 + \ldots + \gamma_{1n}\log p_n + \beta_1 \log\left(\frac{y}{P}\right)$$

$$w_2 = \alpha_2 + \gamma_{21}\log p_1 + \gamma_{22}\log p_2 + \ldots + \gamma_{2n}\log p_n + \beta_2 \log\left(\frac{y}{P}\right)$$

...

$$w_n = \alpha_n + \gamma_{n1}\log p_1 + \gamma_{n2}\log p_2 + \ldots + \gamma_{nn}\log p_n + \beta_n \log\left(\frac{y}{P}\right)$$

The elasticities of the model can be calculated from the parameters of the models as follows:

- Income elasticity:

$$e_i = \frac{\partial \log q_i}{\partial \log y} = 1 + \frac{\partial \log w_i}{\partial \log y} = 1 + \frac{\beta_i}{w_i}$$

- Marshallian price elasticity:

$$e_{ij}^{\ y} = -\delta_{ij} + \frac{\partial \log w_i}{\partial \log p_j} = -\delta_{ij} + \frac{\partial w_i}{\partial \log p_j}\frac{1}{w_i} = -\delta_{ij}\left[\gamma_{ij} - \beta_i \frac{\partial \log P}{\partial \log p_j}\right]\frac{1}{w_i}$$

$$\frac{\partial \log P}{\partial \log p_j} = \alpha_j + \sum_k^n \gamma_{kj} \log p_k$$

- Hicksian price elasticity:

$$e_{ij}^{u} = e_{ij}^{y} + e_i w_j$$

The Hicksian price elasticity isolates the effect of income in the relationship of price and demand (Molina, 1998).

<u>Rotterdam model</u>

This model comes from a generic demand system approximated by its logarithmic differentiation:

$$d\log q_i = \frac{\partial \log q_i}{\partial \log p_1} d\log p_1 + \ldots + \frac{\partial \log q_i}{\partial \log p_n} d\log p_n + \frac{\partial \log q_i}{\partial \log y} d\log y = \sum_j^n \frac{\partial \log q_i}{\partial \log p_j} d\log p_j + \frac{\partial \log q_i}{\partial \log y} d\log y$$

In this model, the income elasticity and Marshallian price elasticity appears in the general equation, since the latter equation can be expressed as:

$$d\log q_i = \sum_j^n e_{ij}^{y} d\log p_j + e_i d\log y$$

The Slutsky equation is used, introducing also the budget share, and the income is expressed relative to prices. Thus, the complete system of Rotterdam demands is given by the following equations:

$$w_1 d\log q_1 = \theta_{11}^* d\log p_1 + \ldots + \theta_{1n}^* d\log p_n + \mu_1 d\log \bar{y}$$
$$w_2 d\log q_2 = \theta_{21}^* d\log p_1 + \ldots + \theta_{2n}^* d\log p_n + \mu_2 d\log \bar{y}$$
$$\ldots$$
$$w_n d\log q_n = \theta_{n1}^* d\log p_1 + \ldots + \theta_{nn}^* d\log p_n + \mu_n d\log \bar{y}$$

In this case, the elasticities are calculated as:

- Income elasticity:

$$e_i = \frac{\mu_i}{w_i}$$

- Marshallian price elasticity:

$$e_{ij}^{y} = e_{ij}^{u} - w_j e_i$$

- Hicksian price elasticity:

$$e_{ij}^{u} = \frac{\theta_{ij}^{*}}{w_i}$$

4. Results

As explained before, different tests are applied in order to check the validity of the models. In order to check the absence of auto-correlation, the ρ-value has been considered. Given a significance level of 5%, the value is accepted for the Rotterdam model with one lag. The symmetry conditions is also accepted, but the homogeneity is not accepted. As this is the model with better adjustment, it is used to calculate elasticities and therefore to characterize demand.

First, the income-elasticities are presented in the table 4.1.

Table 4.1. Average Income- Elasticities and their evolution

	Mean	1980	1990	2000	2010	2015
Vehicles	**2,0842**	1,7018	1,8417	2,0045	2,7843	2,6079
Equipment	**0,6908**	0,7130	0,6813	0,7164	0,6714	0,7208
Transport services	**0,2761**	0,2198	0,2408	0,2790	0,3677	0,3764
Postal services	**0,2341**	0,1202	0,1598	0,2294	1,3586	1,9488
Communication equipment	**12,2517**	--		12,2352	13,7992	1,5082
Communication services	**0,5621**	--	2,0121	0,5179	0,2681	0,2648

The income elasticity value represents the variation in demand of a given category due to a change in the income available for the consumer. The value is the percentage of variation of the quantity of the good that a 1% of change in the income causes. For normal goods, the value of elasticity is always positive, as it is the case for our case of study. A value of the elasticity lower than 1 means that the good is a “necessary good”, so variations in the income do not differ significantly the quantity of the good demanded. When the elasticity is equal to 1, the elasticity is unitary, and when the elasticity is higher than 1, it is assumed that this is a luxury good.

If the mean values are observed, the luxury goods for the group of communications and transport are the vehicles and the communication equipment. The category of vehicles shows an elasticity around 2 as mean value. It is significant that the value of the elasticity increases after the 2008. Thus, the value before year 2000 is 2 or lower, and it becomes up to 2,78 for the year 2010. As for the communication equipment, it is

relevant to observe that the value is showing that the relationship with the income has varied significantly. Up to the year 2010, the elasticity was about 12-13, but then decreases significantly up to 1,5. Apart from a new need created in the consumer, that is related to the generalized use of communication in the society (Rohlfs, 1974), it also corresponds to the decrease in prices shown in graph 2.5. The rest of categories are in mean value classified as "necessary goods". However, there has been interesting evolution through the years. The equipment has remained stable, but both postal services and communication services have had significant changes. For postal services, the mean value reflects the fact that the weight of first years is more significant, since the consumption is drastically reduced with the massive entry of communication services. Thus, it starts to be a luxury good in the year 2005 and beyond. The communication services have followed the opposite trend. They started being a luxury good in 1990 with an elasticity around 2, and then passed to be "necessary goods". In fact, from year 2010 they show the lowest value of elasticity. That is to say, from that year there is low sensitivity of the consumption in communication services in relation to the income availability.

After income-elasticities, an evaluation of price elasticities is presented. The price elasticity is defined as the variations in the quantity demanded of a good with variations in the price. They can be direct (variation of one determined good with its price) and crossed (variation of one good demand with the price of other goods). The Marshallian and Hicksian price-elasticities are considered. The Marshallian elasticity considers both income and substitution effect, whereas the Hicksian elasticity considers only substitution effect (it considers that once a price has changed, the income of the consumer also changes to compensate the price, thus isolating the impact of purchasing power.

Table 4.2. Marshallian price-elasticities

	Vehicles	Equipment	Transport services	Postal services	Communication equipment	Communication services
Vehicles	-2,206	0,376	-1,233	-0,728	-0,277	0,218
Equipment	0,382	-1,020	0,345	0,141	-0,133	-0,209
Transport services	0,448	0,227	-1,673	0,070	-0,023	0,192
Postal services	-1,540	0,325	-2,469	-1,314	0,200	0,413
Communication equipment	-3,653	-6,612	-15,691	-2,898	-0,356	-20,731
Communication services	0,698	-3,369	2,179	-0,178	-0,060	-1,772

The values in the diagonal represents the direct-price elasticities. That is, the impact on the quantity demanded in function of its own price. A normal demand implies that the value of direct-price elasticity is a negative value, so an increase in the price gives rise to a decrease in the consumption. When the absolute value is lower than 1, the demand is inelastic, unitary when the value is 1 and elastic when the absolute value is higher than 1. From the table 4.2 it is observed that most of the products in the

transport and communication group have an elasticity absolute value higher than 1, showing that families will vary its consumption significantly if there is an increase in price. The most sensitive category to the price is the one of vehicles, with a value of -2,206. Only one category shows an absolute value lower than 1, this being the communication equipment. It means that families are not modifying their expenditure in this good significantly if the price increases. It shows the generalization need of connectivity, whatever the price and in spite of the fact that this good has shown until year 2010 a high value of income elasticity, as explained before.

The values out of the diagonal are the crossed-price elasticities. These values represent the impact of quantity demanded in function of the price of other goods. The value can be higher, lower or equal to 0. If the value is higher than 0, it means than the goods are substitutive (the increase of the price of one of them makes the other good consumption increase). Whereas if the value is lower than 0, the goods are said to be complementary (the increase in the price of one of them means that the consumption of the other decreases).

For example, it is shown that equipment and vehicles are substitutive goods. A decrease in the consumption of equipment because of price of 1% leads to an increase in the demand of vehicles of 0,37%. The effect of income is included in this relationship. The highest value are in the category of communication equipment. The communication services are complementary goods of communication equipment. So, a decrease in consumption of communication services due to price will provoke a 20,7% of decrease in communication equipment. This is due to the fact that if the use of communication services decreases due to cost, there will less need to own communication equipment. However, the relationship between communication equipment and communication services is a very low value, meaning that the consumption of communication services is not very sensitive to communication equipment demand. Transport services and communication equipment are also complementary goods with a value of elasticity of -15,7%, so it means that their use is connected. A significant value is the cross-price elasticity of vehicles with communication equipment. As far as the demand of vehicles decreases due to an increase in price, the demand of communication equipment also decreases (cross-priced elasticity -3,6%). However, vehicles demand shows substitution effects with communication services. Another effect also shows that transport services demand has substitutive effect on communication services, showing the competence between these two services.

The Table 4.3 shows the Hicksian price-elasticities. The elasticity in this case shows the direct impact of prices in the demand, leaving apart the effect of the income. In this case, the relationship of the crossed-price elasticities is similar to the previous one, but in the case of the complementary and substitution effects are net. The values of direct-price elasticities are very similar to Marshallian values, but it shows a lower value for vehicles, equipment and communication services. It means that the demands is more inelastic in relation to prices if the income effect is not considered. So, as far the

income is maintained, the impact on demand will be less important. This is significant for equipment, that pass from a value of elastic demand (slightly higher than 1 in absolute value) to a value of 0,69, classified as inelastic demand. Most of the values maintain it sign, thus meaning that the complementary and substitution relationships are maintained, with the exception of the impact of demand and prices of communication equipment in vehicles consumption and the impact of equipment on communication services. In the first case, as example, the demand of communication equipment due a variation in its price shows a relationship of complementary effect, but Hicksian elasticity shows a net substitution effect. That is, the increase in price in communication equipment is related to an increase in consumption of vehicles. The values that differ much between Marshallian and Hicksian effects show the influence of income, such us the impact of equipment demand on communication equipment expenditure. It goes from a value of -6,6 for Marshallian to a value of -0,8 for Hicksian crossed-price elasticity. The most significant relationship must be considered with similar levels of consumption. Communication services has reached a level that is in the level of transport goods (when considering vehicles, equipment and transport services). In this case, it shows substitutive relationship with these transport goods, while it shows a complementary effect with communication equipment.

Table 4.3. Hicksian price-elasticities

	Vehicles	Equipment	Transport services	Postal services	Communication equipment	Communication services
Vehicles	-1,664	0,918	-0,692	-0,187	0,263	0,759
Equipment	0,561	-0,697	0,461	0,147	-0,131	-0,145
Transport services	0,519	0,356	-1,626	0,073	-0,023	0,217
Postal services	-1,479	0,434	-2,429	-1,312	0,201	0,435
Communication equipment	-0,471	-0,887	-13,622	-2,791	-0,321	-19,597
Communication services	1,042	0,281	3,234	-0,141	-0,043	-1,230

5. Conclusions

Different models of demand have been used with the six categories of the consumption of transport and communications goods for Spain between the years 1980 and 2015. The estimations with the AIDS and Rotterdam model have been done for static and dynamic simulations. The model selected as most representative for this demand is the Rotterdam model with one lag. It fulfils the condition of no autocorrelation and symmetry, though the homogeneity condition is not valid.

The most remarkable conclusion from the data analyzed is the growing importance of communication goods consumption, both for communication equipment and services. These two categories show significant evolutions in demand, prices and elasticities

throughout the period analyzed. In fact, communication services have reached similar level than traditional goods such as vehicles and transport services. The transport categories, however, have shown not meaningful variations, maintaining the equipment expenditure as the highest for the whole period. The most significant decreases is postal services that has become almost insignificant consumption when compared with the rest of categories. This is due to replacement of this way of communication by other type of connectivity goods (classified in the categories as communication services and equipment). From the data, it is also relevant to observe the decrease in prices for these latter goods that is especially important for communication equipment since its appearance around year 1995, when it is introduced in the group analyzed.

As for the econometric results concerning income elasticity, there are interesting remarks that differ from categories inside transport and communication. Whereas equipment and transport services show low variation, vehicles show a meaningful trend in the income elasticity in the years analyzed. Vehicles are classified as luxury good, since they have income elasticity higher than one, and this value has been increasing from 1,7 to 2,6 between the years of analysis, showing that the consumption in the good is every time more sensitive to income availability. As for communication, the most significant data show the contrary effect. Communication services have decreases its elasticity from 2 to 0,26 and communication equipment from around 12 to 1,5. Thus, these expenditures are much less sensitive to the income availability for households. In the other type of communication, postal services have decreases significantly the demand and also this category has become to classification as luxury good instead of necessary good.

As for the elasticity of consumption in relation to price, both considering Marshallian (that includes income effect) and Hicksian elasticities, the highest value for transport is vehicle and for communication group it is communication services (leaving apart postal service due to its low weight in consumption). Communication equipment shows the lowest value that it is not depending much on income effect. From the crossed-price effect, the complementary effects are stronger between goods related to communication than for transport, where there are alternatively complementary and substitution effects. In transport, vehicles and equipment show substitution effects and transport services shows complementary relationship with vehicles but substitution effect with equipment and. The highest complementary effect is the influence of communication services price in the communication equipment, shown both when income is considered and not (Marshallian and Hicksian elasticities). The differences in price of transport goods (Hicksian elasticity) shows substitution effect with communication services, but complementary effect with communication equipment. This can be due to the fact that society development imposes use of both goods. Singularly, equipment demand has a complementary effect with communication services if income is included (Marshallian elasticity), but it changes to substitution effect when income considered (Hicksian elasticity).

As a summary, the importance of communication and connectivity in society is highly increasing. The study shows the rising expenditure of household in equipment and services that are considered more and more as essential goods. Household expenditure is thus related to the evolution of society and new approaches to business and production.

Also it is relevant the evolution in vehicles that given its high cost per unit is being more and more sensitive to income, giving rise to a potential evolution where ownership of cars will not be a priority in household expenditure decisions.

For continuation of the work, it could be interesting to study communication and transport goods relationship from year where prices have become stable, for example, 2010. If the effects of the introduction of communication expenditure are stabilized, the conclusions can be more profitable to determine evolution of society development pattern and therefore to define strategies for public organisms. What is relevant is that communication is being more and more significant, and transport will be at the same time contributor and replaced. For next studies, the inclusion of more categories could result in better characterization to isolate effects.

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