Shadow-tolls in Portugal: How we got here and what were the impacts of introducing real tolls

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1. INTRODUCTION

Road transportation continues to be the main form of travel to respond to the worldwide increasing transportation demand. It plays a key role in economic growth, both through the direct effects of higher mobility for citizens and goods, as through the indirect benefits that result from the process of building the road infrastructures. At EU scale, the policy emphasis on the development of trans-European Networks assumes that improvements in accessibility will lead to economic development and, by implication, to greater cohesion (ERF, 2007).

In view of the growth in traffic between EU member States, expected to double by 2020, the investment required to complete and modernize a well-performing trans-European network is substantial. The EU comprises 5,000,000 km of paved roads, out of which 65,100 km are motorways. The total investment on transport infrastructure during the period 2000-2006 was €859 billion (Gleave, 2009). For the period of 2010-2030, the cost of EU infrastructure development is estimated to at over €1.5 trillion. Given the scale of the investment required, it is necessary to strengthen the coordination dimension of network planning and development at European level, in close collaboration with national governments.

At the national level, the necessity to deliver a transportation infrastructure that keeps up with the social and economical present requirements, as lead the member states to invest in their transportation networks. Moreover, for peripheral countries like Portugal, investments in road infrastructure were also a strategy for promoting territorial cohesion and to get close to central Europe. For most of these countries this policy has become a heavy financial burden both for the national and the local governments. This fact has lead to an increase in the collaboration between public and private sectors for the development and operation of road infrastructures, among others areas. Thus the public-private partnership (PPP) agreements have been driven by limitations of public funds to cover the necessary investments, but also efforts to increase quality and efficiency of public services in a faster way.

PPPs are a recent extension of what has now become well known as the “new public management” agenda for changes in the way public services are provided. PPPs

involve organizations whose affiliations lie in respectively the public and private sectors working together in partnership to provide public services (Broadbent and Laughlin, 2003). The private sector undertakes the commitment to provide the government, or the community, with a certain utility measured by the operation and maintenance of an infrastructure designed, financed and built by him. In exchange, the private operator can explore the infrastructure for a certain number of years and collect benefits or a periodic performance-based fee is paid by the government. The four main rules for the private sector in a PPP scheme are to provide additional capital, provide alternative management capabilities and implementation, add value to consumers and the general public and to improve the identification of needs and value for money.

There is certainly a large quantity of money at stake in today's PPPs, especially in Long-term Infrastructure Contracts, (LTIC) (Hodge and Greve, 2011). For instance, report for LTIC-type PPPs alone, from 1992-2007, Europe has seen more than a thousand contracts at a capital value of almost €138 billion, mainly of macroeconomic and systemic importance in the UK (with 76.2% of projects), Spain (at 8.6%) and Portugal (at 2.3%). These projects have involved deals totaling between €10,935 million and €19,978 million each year since 2000 (Blanc-Brude et al, 2007).

In this study, we focus on the case of 'shadow-tolls' motorways in Portugal, a particular case of PPP contracts implemented in Portugal in the late 1990's. Contrary to general road investment PPP contracts, this scheme does not involve the direct collection of tolls on the roads. Instead, the national government is committed to pay an annual rent based on the traffic flows in the roads. The money for these rents comes taxes collected from the taxpayers, even from those not using the concession roads.

This paper is divided in six chapters. After this introduction chapter, we give a brief input on the Portuguese road network, specifically on how it was designed, built, operated and financed. On the preceding section we address the "shadow-tolls" scheme used in Portugal, the so-called SCUTs (standing for "no costs for the users"). In particular, it is explained the evolution of this approach, why and in which assumptions it was considered, and why it was rethought and tolls were recently implement in these roads. In the fifth chapter we discuss the impact that the introduction of real tolls had in the travel demand on those roads. Final, in the last section, some conclusions are drawn.

2. PORTUGUESE ROAD INVESTMENT HISTORY

An efficient road network is a paramount for promoting a countries' economical and social growth. Portugal lagged considerably behind in the standard of its roads with respect to most European countries when it joined the EU in 1986. It has been trying to reduce that difference, investing considerable amounts of money, partly from European Regional Development and Cohesion Funds (Fernandes and Viegas, 1998). In 2005, the freeway density per km^2, and per inhabitant, where both higher than the EU average (Figure 1) (Gleave, 2009).

The positive evolution of the national road infrastructure relied on many studies, plans and financial investments, during a time period of decades. In 1945 the first Portuguese national road plan was elaborated. This document consisted of the classification of

public roads, technical features they should address, and was meant to be a starting point for structuring a poor road network.

A comprehensive investment plan did not exist before Portugal joined the EU. In fact, the first official plan came only in 1985 (DR, 1985). This road network plan became known as the *Plano Rodoviário Nacional,* or simply PRN85*.* An important aspect of the PRN85 was that it distinguished roads as belonging to one of two hierarchical categories: main road network (*Itnerários Principais* - IP) and complementary road network (*Itnerários Complementares* - IC).

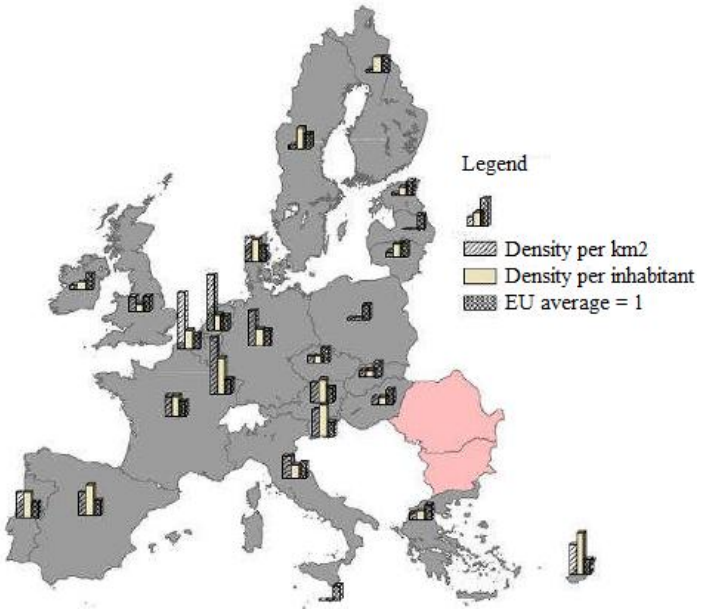

Figure 1 - Freeway network relative surface and population densities in 2005 (Gleave, 2009)

The main road network consisted of the roads connecting all major cities (district capitals), ports, airports and key border connections. The complimentary road network, as the name indicates, complimented the main network establishing regional connections with small and medium urban centers. Combining the main and complementary road networks the PRN85 was composed of 9,900 km.

In 1998, the first revision of PRN85 was made, becoming known as PRN2000, that is still in effect today (DR, 1998). Among the main differences, the plan was extended to 11,350 km of new routes (Figure 2). In this manner, the national road network grew 65%, from 9,900 km to 16,500 km. Another imperative feature of the PRN2000 was the creation of the national freeway network (AE), consisting of 3,378 km of more than half of the IP and IC networks.

According to the Portuguese Government, in 2010, 78% of the PRN2000 was complete. The construction of the AE network was at 80% of the design. The complementary network is the one in the lowest state of conception, being only 42% complete.

2.1. Financing the Portuguese Road Infrastructure

There is obviously a cost for financing and maintaining such an ambitious road infrastructure plan. Ever since the first national road plan was elaborated, several approaches have been made to respond to these needs. Two distinct models have been followed in Portugal: direct public investment and public-private investment, through PPP contracts.

According to the direct public investment model, the first and until today the most common, the responsibility for the construction and maintenance of the road infrastructure is inputted to the state. This was the case of most IC roads already built. These roads have been managed directly by the state. But in 2007, *Estradas de Portugal SA* (*EP*), a public limited company whose capital stock is owned entirely by the Portuguese state, was formed through the extinction of a former national road agency to operate these roads. *EP* is the main investor in the road network through a concession contract signed with the government. Despite the IC network, in terms of the AE network, *EP* has only 2,4% contracted (EP, n.d.).

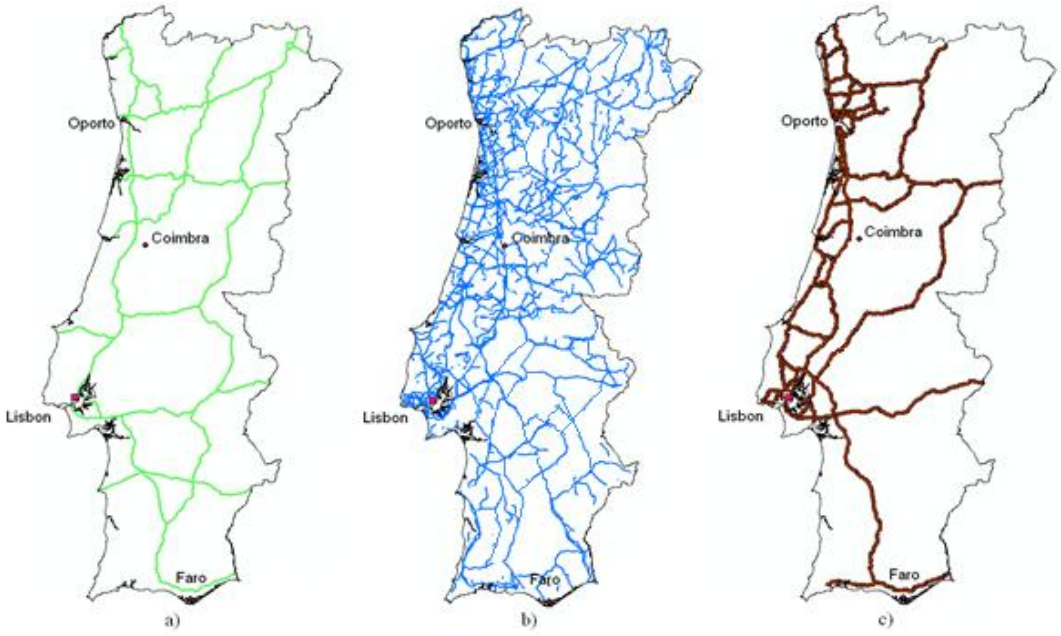

Figure 2 - PRN2000: a) IP road network; b) IC road network; c) AE road network

To build the AE network, the Portuguese government created *Brisa*, a public limited company founded with the objective of building, managing and operating this infrastructure through the collection of tolls. The first motorway to be built was the A1, which connects the two main Portuguese cities – Lisbon and Oporto. After this, *Brisa* built other segments of the AE network. Nevertheless, in the 1990's, there was already the idea that completing the AE network plan in this kind of model would involve a large financial burden for the state. Thus, the Portuguese government decided to call the participation of private companies on this process. It partially privatized *Brisa* and negotiated a PPP contract with the new company for managing and operating the

existing AE network. Since then, the PPP scheme was used to build the new motorways, by *Brisa* or any other private company. According to this scheme, a private consortium is issued by the state to design, construct, finance and operate on the road infrastructure, according to the *EP* technical requirements. Concessions are obtained in a tender and, usually, the duration of a given concession ranges from 25 to 30 years, sometimes even longer. Under this model approach, the ownership of all assets remains in the public sector domain. Part of the construction investment is obtained from the government budget (e.g., 20% in the case of A1 motorway), while the remaining investment comes from private investment and bank loans. In general, the private consortium would financially benefit from the tolls collected on the road and from a state paid rent.

The origins of the PPPs in Portugal was based on design, build, finance, operate and maintain policy (DBFO) schemes implemented in the United Kingdom after 1993 (Highway Agency, n.d.). In this model, the private sector can be seen as an additional source of funding, allowing more public funds to be transferred to areas that were less attractive to the private sector. One other benefit to take into account with private financing is that it involved private discipline that, in some sense, can lead to greater efficiencies. To the private sector, this kind of model allows new opportunities to execute projects that would otherwise be carried out by the public sector, assuming all the risks associated with this kind of projects.

In fact, the majority of the Portuguese AE network (70,6%) was, and still is, financed through these PPP schemes. However, for some cases, these traditional PPP schemes are limited by financial, technical and political reasons:

- Financial reasons because private investment decisions are based on uncertainty on traffic levels forecast and there is the consequent risk of not recover the investment made;
- Technical issue is grounded on the requirement, on behalf of the Portuguese law, that each time a tolled motorway road is built, the state must ensure the existence of an alternative road of free access. This becomes troublesome in cases when parts of the new freeway must to be built by improving existing roads;
- Political restrictions are related with the aim of promoting territorial cohesion, leading to the development of more deprived regions of the country where lower levels of traffic flows are predicted.

3. SCUTS

In 1997, a new concept of PPP scheme was introduced in Portugal. Also base in the British experience, in this new scheme, users would not pay tolls. Instead, the concessionaires receive a rent directly paid by the state as a function of the number of vehicles using the road and the number of days per year in each the road is operated according to *EP* standards. The money for the rent would come from all taxpayers, users and non-users of these roads. The main goal of this scheme was to compensate the private sector for investing in a not so business appealing road investments, while

promoting free-access to the AE network in social and economic deprived areas of the country. It was also a way to accelerate and help finance the completion of the PRN2000, mainly the AE network. This model is known as 'shadow toll' payment and the Portuguese government named it as SCUT roads, the Portuguese acronym for "no cost for users".

Of the 3,378 km of the Portuguese AE network, 27% (914 km) are under this model. In total there are seven different SCUT concessions in Portugal. The seven concessions under this model are present in Figure 3.

3.1. Evaluation of the costs

Although the SCUT scheme application can be justified in some circumstances, the program eventually gave rise to financial constraints. By allowing a rapid motorway construction, with low initial financial costs, in a short period of time these costs originated a large financial expenditure for the next 25 years. One decade after the first SCUT, the SCUT program has already generated additional costs evaluated around €1.5 billion. Much of this burden comes from the right of the concessionaires to claim for financial rebalancing for a general set of unforeseen events that could lead to escalation of construction or operation cost.

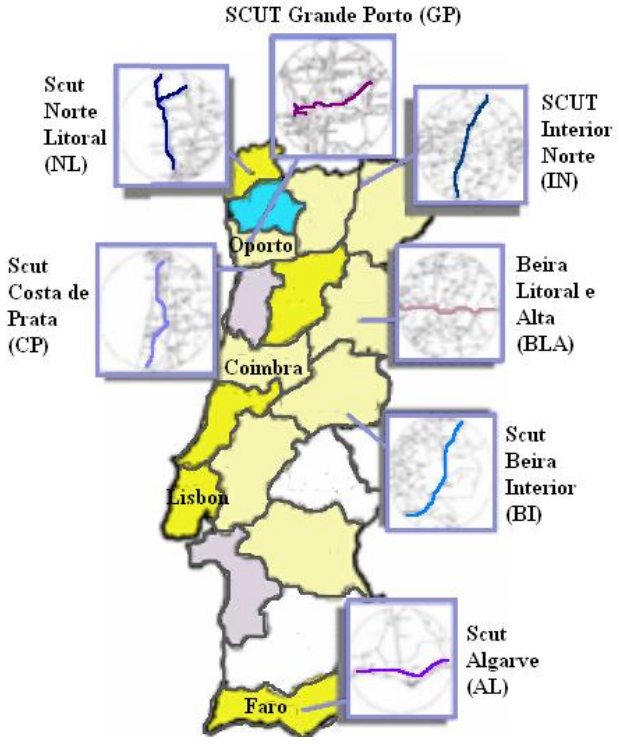

Figure 3 - Seven Portuguese SCUT concessions (source: Government of Portugal)

Table 1 shows the deviations concerning construction costs of each one of the SCUT concessions. Among the seven SCUTS, there are two that the costs more than doubled (NL and AL). The lowest difference was around 32% for IN concession.

Table 1 – Construction costs deviation for SCUTs in Portugal (DGTF, 2008)

SCUT	Length (km)	Construction Cost Estimated in 2004 (M€)	Construction Cost Evaluated in 2008 (M€)	Difference (%)
Beiras Litoral e Alta (BLA)	166	702	1.135	+ 61,7%
Beira Interior (BI)	177	576	925	+ 60,6%
Grande Porto (GP)	64	545	733	+ 34,5%
Interior Norte (IN)	155	488	645	+ 32,2%
Norte Litoral (NL)	121	306	656	+ 114,4%
Costa de Prata (CP)	102	299	531	+ 77,6%
Algarve (AL)	129	218	570	+ 161,5%
Total	914	3.134	5.195	+ 65,8%

In 2010, SCUT concessions costs reached €724 million, when the forecast was of €607 million, representing a difference of €106 million (DGTF, 2008). Between 2007 and 2023, the average value of annual rent is expected to be €700 million, in contrast with the €545 million that EP was received from the state budget in 2010 (Figure 4) (EP, 2010). EP has been obliged to take on bank loans to be able to cover these cost differences, turning the SCUT scheme unsustainable in the medium-term.

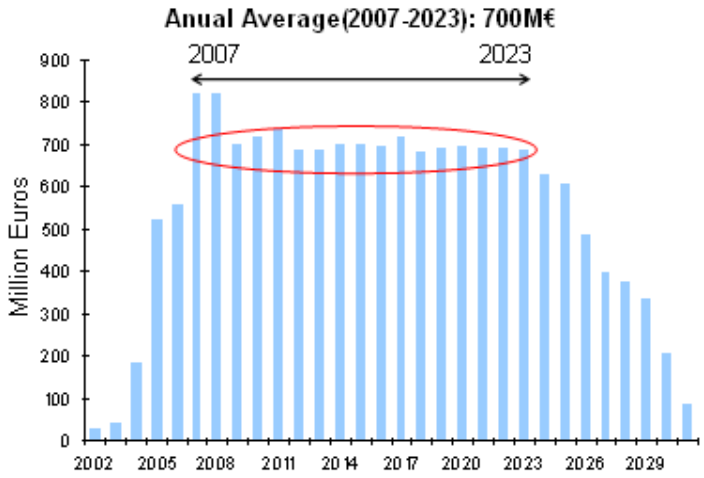

Figure 4 - Estimated expenses with SCUT roads until 2030 (source: Government of Portugal)

3.2. SCUT Program reevaluation

In this way, in 2007, the Portuguese government decided to reevaluate the SCUT program (MOPTC, 2006). In this context, it was decided to evaluate each of the seven SCUTs and in the cases it was justified, convert them into user toll roads. Greater equity

and social justice would be ensured with an increase of funds, available to other key areas of road infrastructure, such as maintenance and security, as well as improving the road network and concluding PRN 2000. This governmental program was to assess whether the maintenance of the SCUT scheme was necessary. Given three indictors, three criteria were assumed for this decision process. A SCUT would be converted into user toll road if it met all three criteria:

Criterion 1 - Regional gross domestic product per capita disparity

In line with the EU index for the identification of less developed regions, the Portuguese government considered by less developed regions those that are characterized by having a GDP per capita less than 80% of the average EU GDP. The indicator considered for the reevaluation of SCUT schemes was based on the weighted average of GDP per capita of NUTS III regions, located in the SCUTs' area of influence.

Criterion 2 – Municipal Purchasing Power Index

The municipal purchasing power index (PPI) is an indicator published by the National Statistic Institute (INE), deduced from a set of 18 variables, and that characterizes the Portuguese municipalities in terms of the residents' purchasing power. The chosen indicator corresponds to the average municipal PPI, weighted by the number of inhabitants of each municipality in the SCUTs' area of influence. In terms of PPI, a limit of 90% the national average was also assumed to establish the limit from which user tolls are introduced on the road infrastructure.

Criterion 3 – Travel time on alternative routes

This criterion has taken into account the travel time associated with each of SCUTs, relating it to the travel time of alternative routes. According to this criterion, the introduction of toll was only considered in SCUT roads that have an alternative route that has a travel time that is no greater than 30% the travel time of the SCUT road.

In conclusion, the Portuguese government decided to convert three SCUT roads into toll roads: the NL section belonging to the Oporto metropolitan area, the GP and the CP. The other SCUT roads were kept. For the case of NL in Minho-Lima, IN, BLA, and BI, for a matter of economic development of the regions in the influence area of the concession, it was not considered the implementation of tolls. In the case of the AL, its maintenance is justified due to the lack of viable alternative routes.

Based on this study, on October 15 of 2010, user tolls began being charged on the three motorways that did not meet all three criteria requirements. Nevertheless, for particular municipalities served by these motorways with lower economic development, temporary positive discrimination measures were implemented, in which each household could use a set of free rides per month in their local old SCUT (usually, around 30 to 35 trips per month).

Table 2 - Criteria analysis in the SCUT roads reevaluation

Concession	Criterion 1	Criterion 2	Criterion 3	Considered for tolls introduction?
	PIB per capita[1]	PPI[2]	Travel time	
	≥80	≥90	AltR≤1,3SCUT[3]	
Interior Norte (IN)	57	67	1,0	No
Costa de Prata (CP)	96	105	1,0	Yes
Beira Litoral e Alta (BLA)	77	77	0,9	No
Beira Interior (BI)	81	74	1,2	No
Grande Oporto (GP)	84	96	1,3	Yes
Algarve (AL)	106	109	1,4	No
Norte Litoral (NL):				
- Oporto Metro Area	91	104	0,9	Yes
- Minho-Lima	64	68	0,9	No

[1]100 refers to the national average;

[2]Weighted by the municipal populations. 100 refers to the national average;

[3]Indicator based on the travel times (AltR: time on the alternative route; SCUT: time on the SCUT road);

3.3. The end of SCUT schemes

One year after the conversion of the first three SCUT roads into tolled roads, the economic crises in Portugal pushed the government to reconsider again the inclusion of tolls in the still existing SCUT roads. In a pure financial-based approach, the government decided to introduce real tolls in all SCUT roads, despite not verifying some of the economical and travel time criteria previously considered.

The tolls were introduced in December 8, 2011. Again, some temporary positive discrimination measures were contemplated.

4. DEMAND FLEXIBILITY

The introduction of real tolls in former SCUT roads has changed the demand on those roads. In some cases there was a traffic reduction of about 30 to 60 percent. Thus, to analyze this huge variation in traffic demand we considered the concept of short-run demand elasticity. Short-run elasticity refers to the effect that tolls, or any other travel cost component, has on traffic demand within one year after the travel cost variation. For this analysis, we considered the concept of short-run demand elasticity. For this matter, we used a simple empirical approach to calculate elasticity, commonly used in transportation studies (e.g., Burris, 2003):

$$e = \frac{(f_{2011} - f_{2010})/f_{2010}}{(C_{2011} - C_{2010})/C_{2010}} \quad (1)$$

in which, e is the short-run demand elasticity; f_{2011} is the average annual daily traffic (AADT) observed in 2010; f_{2010} is the AADT observed in 2010; C_{2011} is the general travel cost, per kilometer, in 2011 (after the introduction of tolls); and C_{2010} is general travel cost, per kilometer, in 2010 (before the introduction of tolls).

The traffic flows volume for each year was computed with base on the traffic data made available by the current Portuguese road manager agency (InIR, 2011). For the estimation of the equivalent AADT we considered the traffic using the roads between July and September of each year. For the computation of the general travel costs, we considered the work presented by Santos for one of the former SCUT roads (Santos, 2007). In this work, Santos derives formulations to calculate the operational costs of vehicles, the costs associated with accidents, and the costs of travel time for each road class (private vehicles, light duty vehicles, trucks, and coaches). The general costs were computed by adding the three previous cost components with the toll costs per kilometer. Given the lack of information of the fleet composing in both periods considered, we used the proportion of vehicles per class constant and equal to 2006, the last year for each this detail information is available for each of the motorway sections analyzed.

The traffic volumes, general costs per section and the elasticity results for the motorway sections in which tolls were implemented are provided in Table 3. We can conclude that, given this empirical analysis, traffic demand was elastic to the introduction of tolls. On average, the short-run elastic along these motorways was -0.88. This means that for each 1 percent increase on the general travel, there was a decrease on traffic of 0.88 percent. The maximum elasticity value obtain was -0.44, while the minimum value was -1.94.

The elasticity values, when compared with previous studies (such as, Burris, 2003 – ranging from -0.02 to -0.36 – or Odeck and Brathen, 2008 – ranging from -0.03 to 2.26, with an average of -0.56) are somewhat higher. For instance, when compared with the results obtained by Odeck and Brathen (2008), the average value that we obtained in this study is higher. However, when we compare the variability of the short-run elasticity obtain for the different sections, they are much lower. The possible explanation for this can be location of these motorway sections. Most of these motorways are located in the metropolitan area of Oporto or in the surroundings of this metropolitan area but still in dense semi-urban areas. This means that the neighboring network to these motorways is usually very dense, providing many alternatives to those drivers that want to avoid the tolled roads.

It can be forecasted that for the SCUT motorways that recently have tolls, the impacts were even higher. No traffic data is still available to evaluate this. However, these motorways are located in regions with less dense road networks. Alternative roads are rarer than in the case of the SCUT roads previously analyzed. Therefore, less detoured trips exist and few drivers have the option to avoid tolled roads. The result should be an increase in costs associated to road users who continue using the recently tolled road.

Table 3 - Arc elasticity for motorway sections of former SCUT roads

Motorway	Section	Extension (km)	AADT (vehicles/day)		General travel cost (€/km)		Short-run elasticity
			2010	2011	2010	2011	
A17	Mira PV – Ponte de Vagos	5.7	17207	9827	0.335	0.571	-0.61
	Vagos – Ilhavo	4.3	22416	12477	0.309	0.458	-0.92
	Aveiro Sul – S. Bernardo	5.4	27940	13742	0.314	0.469	-1.03
A29	Salreu - Estarreja	5.0	38214	13628	0.309	0.564	-0.78
	Estarreja - Ovar	9.2	38593	14723	0.356	0.469	-1.94
	Arada - Maceda	4.1	46756	17555	0.332	0.571	-0.87
	Granja - Miramar	2.7	78084	47906	0.310	0.526	-0.55
A41	A28/Perafita - Aeroporto	3.0	53576	25172	0.278	0.360	-1.81
	Lipor - EN13	1.7	48965	24649	0.274	0.444	-0.80
	EN13 - EN14	2.2	50225	26703	0.278	0.362	-1.55
	EN14 - EN107	2.0	51677	26250	0.278	0.545	-0.51
	Maia - Alfena	2.5	57067	32658	0.270	0.362	-1.27
	Alfena - Santo Tirso	5.1	39036	18318	0.266	0.399	-1.07
	Ermida - A41/A42	1.1	33744	16758	0.498	0.656	-1.58
A42	Paços de Ferreira Este - EN106 (Sul)	2.5	26590	11488	0.269	0.510	-0.63
	EN106 (Norte) - Lousada	6.0	17608	8666	0.257	0.369	-1.16
A4	Custóias – Via Norte	2.7	61831	34434	0.255	0.355	-1.12
	Via Norte – Ponte da Pedra	1.1	56937	31980	0.259	0.516	-0.44
						Average	-0.88
						Minimum	-1.94
						Maximum	-0.44

5. CONCLUSION

In 1990's, the Portuguese government introduced the design, build, finance, operate and maintain (DBFO) model in the fulfillment of the AE network plan. The main goals were to expedite the development plan and to transfer the initial investment and associated risks of the motorways operation to the private sector. However, for some regions of the country this financial scheme was not appealing enough to involve the private sector. Therefore, the Portuguese government adopted a different PPP approach in which the payment to private companies was made directly from the state with base on traffic flows and service days per year. In this manner, all Portuguese taxpayers finance the infrastructure, instead of the road users through the payment of tolls.

This shadow-tolls scheme sooner proved to be financially unsustainable for the Portuguese government. Through time, it became clear that the initial suppositions were far from accurate. The consortiums had the right to solicit payment rebalances from the government when "not foreseen situations" happen, leading to a considerable amount of extra costs, paid with taxpayers' money. In addition, the construction of the motorways over the existing roads was also proved to be a wrong decision. By introducing tolls on these roads without having in consideration the significance its impact would have on the accessibility of the served regions, turned out to be negative.

In fact, this was what happened when the state felt the financial need to introduce tolls in these shadow-toll roads. Less than 20 years after the first DBFO contract under a

SCUT scheme, the Portuguese government canceled this scheme and now allows concessionaires to charge the road users. The impacts on travel demand were enormous, with traffic volume reductions going up to almost 65 percent in some motorway sections. The elasticity of the demand with the introduction of tolls varied from around -0.45 to around -2.00, showing the negative impacts of this policy on the mobility on these regions.

The Portuguese case is a good lesson that must be learnt for future financial schemes of this type. PPP schemes should be based on the share of investment and risks. By reducing the risks for the private side, and by allowing relaxed contract terms for coping with unforeseen situations, the public partner can put itself in an unstable situation. The result of this may be the increase of state expenses and the decrease of accessibility (or the increase of travel costs) for road users.

This work still needs to be extended for a better understanding of the evolution and impact of these road investment policies in Portugal. A more comprehensive demand elasticity approach should be used to understand if the high elasticity of travel demand in regard the introduction of tolls was just simply a result of trip retouring or if also involved the reduction of the number of trips or the change to a different transport mode. Furthermore, the impact of other factors, such as fuel price or income reduction can be also tested for a larger scope analysis. Finally, in the next years, this study can be extended by considering long-run elasticity and by analyzing the possible impact of people's activities relocation.

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