RETHINKING THE DEATH OF RAILWAYS IN THE PORTUGUESE COUNTRYSIDE

Paulo Rui Anciaes
Independent scholar
p.r.anciaes@gmail.com

ABSTRACT

Two waves of line closures (1988-92 and 2008-12) have left the Portuguese countryside largely deprived of railway services. This paper assesses rail accessibility and potential demand in the areas served by the lines closed. The study contributes to existing literature by taking into account the availability of rail services and public transport access to stations, considering separate types of destinations, trip frequencies and departure times for different population segments. The population potentially served by rail is first mapped at the level of the civil parish and aggregated to rail stations. In a second stage, the effects of providing extra rail connections and bus feeder routes are estimated, identifying the parts of the country and railway network with the highest potential improvements. The findings show that despite low levels of demand in absolute terms, rail services still had the potential for serving a significant part of the population in the areas around some of the lines closed.

1 INTRODUCTION

The restructuring of national rail networks often involves the withdrawal of some passenger services in the rural areas, with potential effects on local economic, social and demographic conditions [1]. While these policies are sometimes justified with technical or geographical reasons, their main determinant is economic, as the services affected tend to have low demand. Major waves of closures have in fact responded to specific economic objectives, such as the renewal of ageing infrastructure (England and Wales, 1960s) [2], rationalization of resources in dispersed areas (Australia, 1980s) [3] and overall economic restructuring (Eastern Europe, post 1990s) [4].

Although passenger service withdrawals are often subject to public discussion, the information used by railway companies, governments, and groups of activists is usually specific to each line and does not consider network effects and overall losses in accessibility and demand. In addition, academic studies approaching this question tend to focus on complete closures of railway lines. However, rail accessibility and demand are also affected by measures such as closures of individual stations, reduction in the availability and frequency of connections, and withdrawal of public transport access to stations. In practice, the services in the lines closed may no longer be considered by the population as a viable transport alternative. The study of this question can then benefit from the use of general measures of rail accessibility (such as time to nearest station [5] or number of connections [6] at each place) but of detailed information on the extent to which rail services meet the mobility needs of the populations. A few studies have looked at factors such as departure times [7] and frequency of bus services [8], but there is still little knowledge on their role in rail accessibility.

This paper contributes to this literature by mapping the services provided by railways in the periods before line closures, taking into account actual rail schedules and local public transport options to access the stations. The services are matched with the destinations, trip frequencies and departure times of different segments of the population. The objectives are to study the geographic distribution of levels of rail accessibility and potential demand and to evaluate the benefits of policies such as the creation of new rail connections and new bus feeder routes.

The analysis focuses on two major waves of railway closures in Portugal. The next section is an overview of the evolution of the Portuguese passenger rail network. Section 3 maps rail accessibility and potential demand before the two waves of closures and Section 4 estimates the benefits of additional connections and bus feeder routes. Section 5 sums up the results and suggests points for discussion.

2 THE TWO WAVES OF RAILWAY CLOSURES IN PORTUGAL

Figure 1 shows the railway lines in operation and the lines closed to passenger services in Portugal, revealing two major periods of closures: 1988-1993 and 2008-2013.

The first wave of closures occurred within a period of relatively high economic growth and influx of funds from the European Union. The restructuring of the railway sector was laid out in the 1988-1994 Railways Modernisation Plan [9]. The objective of this plan was to make "selective investments" [10], giving priority to suburban passenger transport in the two main cities (Lisbon and Porto), medium and long distance transport in the Lisbon-Porto axis, international links and freight transport. The lines classified as "secondary network" (29% of the network length) received only 0.13 % of the investment. The emphasis was therefore on the economic viability of the railway sector, supported on the belief that railways are not a "means to transport almost everything almost everywhere" [10, p.147]. As a result, 790 km of railway lines were closed, mainly in the most isolated parts of the Portuguese hinterland: the Northeast (*Trás-os-Montes*) and South (*Alentejo*) regions. The largest city in the central part of the hinterland provinces (*Viseu*) was also deprived of all rail connections. Some lines were replaced by bus services, which were also withdrawn a few years later.

Despite the efforts of economic rationalization and the separation from the infrastructure provider in 1997, the financial results of the Portuguese Railways company did not improve. After a steady reduction of rail services, the ongoing economic crisis triggered a new wave of line closures, justified in the Strategic Plan for the Transport Sector [11] as an essential part of the restructuring of the Portuguese public sector. Since 2009, a total of 490km of railway were closed, including most of the remaining lines in the Northeast and Southern regions and all the remaining narrow-gauge lines in other parts of the country. While some lines were initially closed for refurbishment and replaced by bus services, plans for reactivation of the lines were later abandoned and eventually, bus services were also withdrawn. The future of a few other lines remains uncertain and projects for new infrastructure such as the high-speed rail and light urban railways have also been shelved.

In 2013, the Portuguese railway network includes only a third of the stations that once served the hinterland provinces, and reach only 11 of the 44 cities and towns in these provinces. The reduction of accessibility in this region is of special social and political concern, given its traditionally lagging economy and rapidly ageing population.

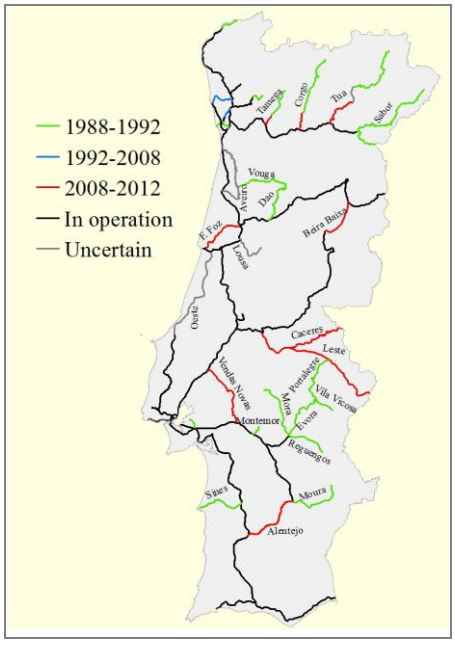

Figure 1: Railway lines in operation and lines closed in Portugal, by period of closure

3 ACCESSIBILITY AND POTENTIAL DEMAND BEFORE THE CLOSURES

This section analyses rail accessibility and potential demand in the period immediately before each wave of railway closures in Portugal, that is, in 1987 and 2007. The analysis is conducted at the level of the 4037 civil parishes in continental Portugal and assumes that individuals potentially travel to the capitals of one of the 278 municipalities. The calculations are relative to the central points of both types of areas, given by the Portuguese official administrative map. The population is segmented in two groups (workers/students and remaining population) who have distinct mobility needs, requiring daily or weekly round trips to specific destinations and imposing certain restrictions on departure and arrival times, possibility and time to access stations by public transport and total travel time. The main hypothesis is that rail is only considered as an option if these needs are met by the origins, destinations, frequency of trains and trip duration of existing rail services and by the public transport options to access rail stations at both origins and destinations.

The analysis is based on the official rail schedules for each year and includes all inter-city, inter-regional and regional rail services but not international services. The services of private railway operators and underground, light railways and buses and ferries connecting stations in Lisbon and Porto are also included. A small number of bus feeder routes provided by the railway company in 1987 are treated as a part of the railway network itself and not of public transport access to stations.

The estimation of accessibility of workers and students considers their place of residence and work, given by census data. The census results used are 1991 (for 1987) and 2001 (for 2007) and give the number of people living in each civil parish and working in the same civil parish and in each municipality in the country. It is assumed that the first of these groups walk to work, and the second group works at municipal capitals. People living in the municipal capital and working in the same municipality also walk to work. The remaining workers and students travels daily or weekly by motorised transport to their places of work.

Rail services are identified as a possible option for daily return trips of workers and students if they allow the possibility to arrive at the place of work or study between 8:00 and 9:30 and leave between 17:30 and 19:30 in any given weekday, restricting the rail section of the trip to a maximum of 1 hour. The place of work or study is accessed from the nearest station by walking or by bus, restricting this section of the trip to a maximum of 15 minutes. The existence of connecting bus services is identified for each station, based on the existence of local bus networks operating in the relevant municipality. It is assumed that at the places of residence, connecting bus services only exist in the case of municipal capitals. In the other civil parishes, stations are accessed only by walking. In practical terms, this assumption means that rail services at a given station serve only the population in the village around or near that station.

Weekly return trips to places of work and study are possible if the rail schedules allow individuals to depart from the place of work on Friday after 17:30 and arrive at the place of residence before 24:00, returning on Sunday after 14:00. A restriction of a maximum 30 minutes is put on the waiting time at any intermediate station within the best route. This restriction is imposed in order to account for the hypothesis that individuals will choose to take alternative public transport options (such as coach) if the rail alternative implies long waiting times. The same restrictions regarding access bus access to stations made for daily trips also apply.

It is assumed that the remaining (non-working or studying) population needs to access a set of services and facilities located in municipal capitals (such as shops and public offices) and that individuals make daily return trips to these places on a weekly basis. In each civil parish, the set of possible places is the one including municipal capitals at a maximum of 90 minutes time, measured on the road network. Each place is assessed with a probability proportional to the population working in that place, which is obtained by aggregating the census data described above. This assumption means that the level of employment is a proxy for the location of services and facilities.

Rail services are an option for day trips of non-working people if they allow for the possibility to arrive at the destination between 8:00 and 14:00 and return between 14:00 and 19:30 in any weekday, allowing a minimum of 2 hours at the destination. Restrictions on bus access also apply.

The following maps show the proportion of the population resident in each civil parish in 1987 and 2007 potentially served by rail services for each type of trip frequency. Figure 2 gives the proportion of workers and students served by rail for daily trips in relation to the total number of workers and students travelling from each civil parish to destinations within 90 minutes distance, measured on the road network. Figure 3 gives the proportion of workers and students served by rail for weekend return trips in relation to total number of workers and students travelling to destinations more than 90 minutes distant. Figure 4 gives the proportion of non-workers served by rail for daily return trips to destinations within 90 minutes distance.

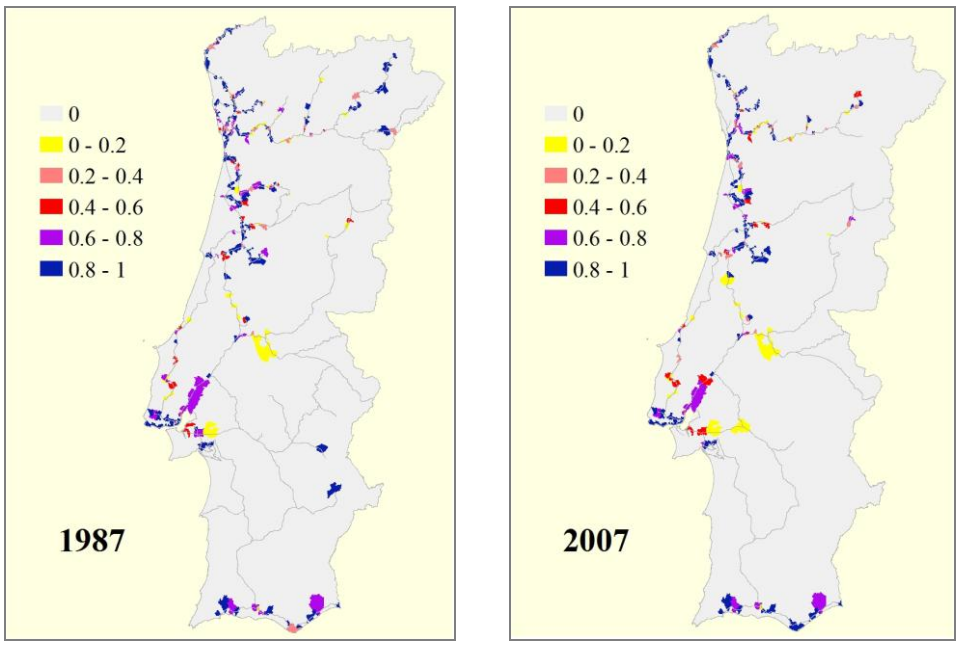

Figure 2: Proportion of workers and students served by rail (daily trips)

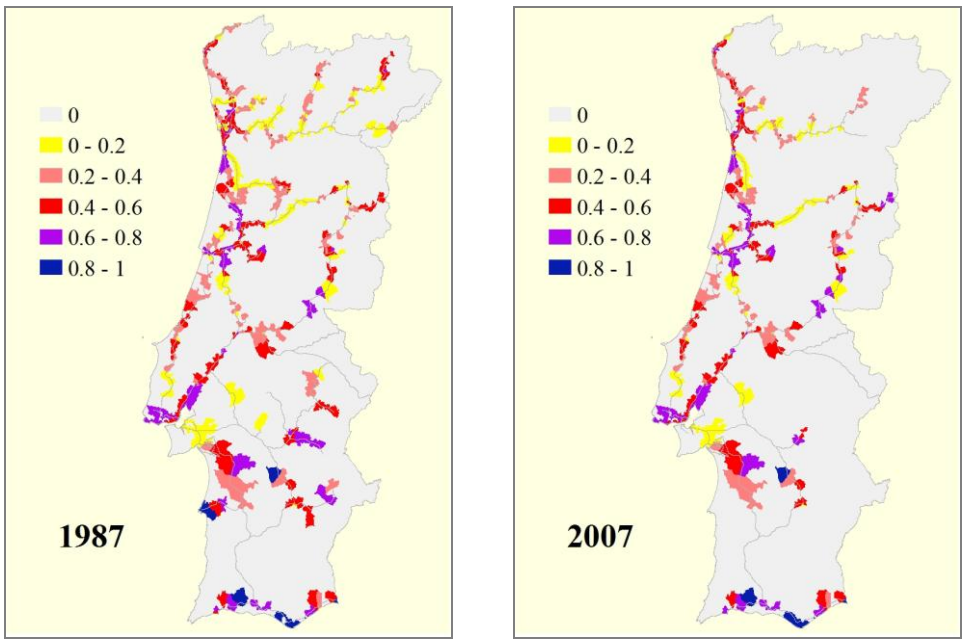

Figure 3: Proportion of workers and students served by rail (weekly trips)

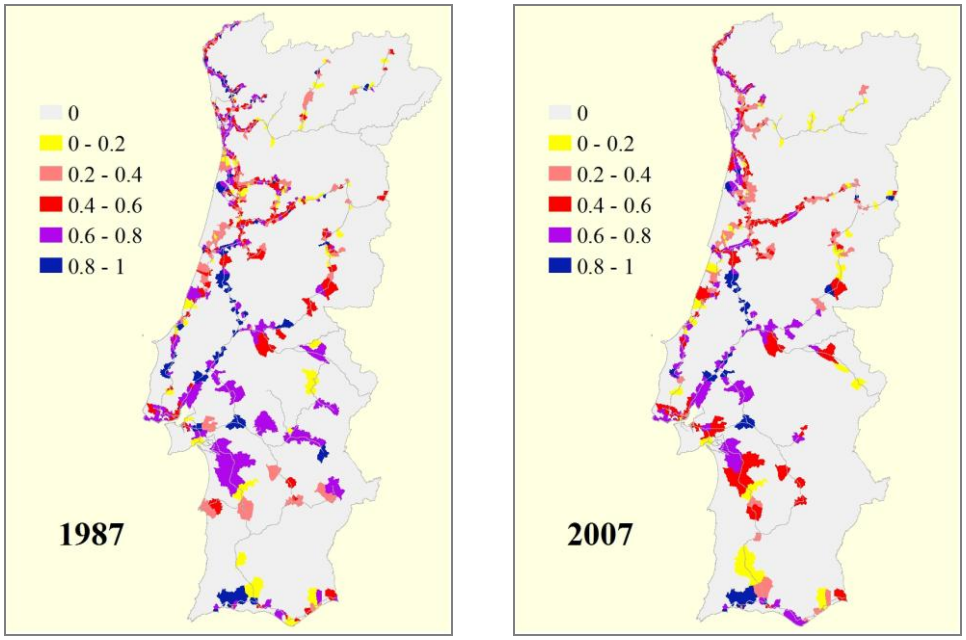

Figure 4: Proportion of non-workers and students served by rail

The analysis of the distribution of the proportion of daily trips of workers and students show that a substantial part of the areas around the railway network were not served by suitable rail services either in 1987 or 2007 (proportion=0). These areas include almost all the civil parishes in the central and southern hinterland provinces, both those located around the lines that were subsequently closed and the ones locates around the lines that were not closed. In contrast, the majority of the areas in the strip between Lisbon and Porto and in the south coast have proportions above 80%. Only one line in these regions was not served by railway (*Linha do Oeste*). This line is also planned to close in the future. The most important result is however the evidence that some of the lines closed in the period 1988-2003 in the hinterland provinces served relatively high proportions of workers and students, including one of the lines in the Northeast (*Linha do Tua*) and one part of the line in the central part of the country (*Linha do Vouga*). All the lines closed in the period 2008-2013 served very small proportions of workers and students. Finally, proportions tend to be stable from 1987 to 2007 in the areas around the lines which did not close.

The proportion of weekly trips of workers and students potentially served by rail is more evenly distributed across the country than in the previous case, with most areas showing a value between 0.2 and 0.6 in both years. Proportions also tend to be stable from 1987 to 2007 in the areas around the lines which did not close. Only a few sections of the some lines in the Northeast and Southern provinces had a proportion of 0. However, some of these lines are not in the set that was subsequently closed. Many of the lines closed show proportions of population served that are comparable with the remaining lines, both in the hinterland and in the coastal parts of the country. There is also a higher variability within each line than in the previous case, with higher proportions usually found in the areas around major cities. It is worth noticing that in some of the cases where only a section of the line was closed, this section was the one with higher proportions of workers and students served. This is the case of two of the lines in the Northeast in 1987.

The proportions of non-workers and students served ranges from 0.2 to 0.8 in most areas. When comparing with the two previous cases, a larger number of areas were served by rail in the Southern regions and a smaller number were served in the northeast regions. However, some lines and sections lines in both regions show proportions equal to 0. There is no clear relationship between the set of lines closed and the proportions of population served in the period before the closures. In particular, the lines closed in the central part of the country (*Linha do Vouga* and *Linha do Dão*) in 1983 serve

relatively high proportions of the populations living along their whole extensions. As in the previous cases, proportions remain stable in the two years of analysis.

The aggregation of the population potentially served by rail in each civil parish can be used to estimate the potential demand for the rail services offered at each station in the network in each of the years of analysis, given the schedules of services in those years. This is done by assigning the population making the three types of trips to the stations used at the origins and summing the results for each station.

Figure 5 gives the potential demand for trips starting at each station in 1987 and 2007, measured by the number of trips per week. The maps show that despite the relatively high proportions of population served by some lines in the hinterland provinces, the demand for rail services tends to be concentrated in the coastal strip linking Lisbon and Porto and in the south coast. In fact, the large majority of the stations in the hinterland have a potential demand of less than 1000 trips per week. The only exceptions correspond to some of the largest cities and towns in this region. In contrast, all the stations in the metropolitan areas of Lisbon and Porto have a potential demand of more than 10000 trips per week. The only lines in the coastal region with a small potential demand are the ones that are were closed in the 2008-2013 period or are probably closing in the near future (*Linha da Figueira da Foz* and *Linha do Oeste)*. In the case of the latter, the demand is small in the whole extension of the line, including the sections of the line that will not close, despite the fact that these sections are within a potential commuting zone to Lisbon.

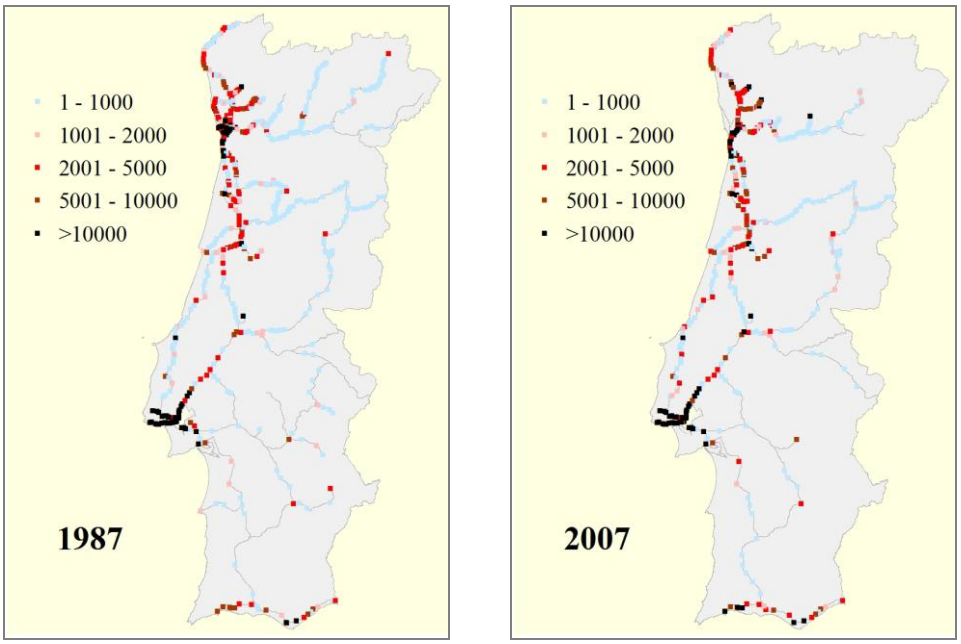

Figure 5: Number of weekly potential rail trips starting at each station

3 THE BENEFITS OF NEW RAIL CONNECTIONS AND BUS FEEDER LINES

The arguments stated in the Strategic Plan for the Transport Sector for closing railway lines in the Portuguese countryside have not been universally accepted and academics and activists have proposed solutions for increasing the attractiveness of services in these lines and generate the demand needed to ensure their economic viability.

Changes in origins and destinations of trains are one of these solutions. The hypothesis advanced by its proponents is that existing services are outdated and incompatible with current geographic patterns of residence and work of the population living around the stations closed. That is

especially the case of the above mentioned *Linha do Oeste*, which crosses a densely populated areas but where train services do not directly link these areas with major centres of employment either in the central part of the country and Lisbon [12].

An alternative solution is to increase the number of places connected by the rail network. This involves the creation of new rail branch lines or the provision of a greater supply of public transport options (such as bus feeder lines) to access stations, in order to connect existing stations with major towns. Some authors suggest that the implementation of these measures could provide the base for a successful re-operation of most of the lines closed in the Southern provinces [13].

This section analyses these two proposals in the case of the current wave of railway closures (2008-2013), focusing on daily return trips of workers and students. The method used is to re-estimate the two variables described in the last section (proportion of population served and potential demand at each station) based on hypothetical improvements leading to the creation of new connections between origins and destinations, that is, changes in rail schedules creating new connections on the existing rail network and provision of new bus connections to the network itself. The objective is to determine the size of the potential gains from this measure and identify the parts of the country and the stations receiving the highest gain.

The provision of new rail connections is modelled by assuming that all destinations within 90 minutes time on the road network from an origin are attained using rail services, considering the existing conditions regarding availability of public transport from and to stations. In other words, the restrictions applied in the previous section to the time of departure and arrival of trips no longer apply, but the restrictions to the existence of public transport to access the stations at origins and destinations still apply. The provision of new bus feeder lines is modelled by assuming that all destinations within 90 minutes on the road network from an origin have bus connections from the nearest station, considering the existing conditions regarding the availability of rail connections between the stations at the origin and at the destination.

Figure 6 shows the changes in the proportion of workers and students served by rail in each civil parish in 2003, considering daily return trips.

The changes associated with the provision of rail connections are extensive, especially in the lines crossing the central part of the country, where the gains are above 50% in many civil parishes. There are also considerable gains in some sections of the lines crossing the Southern region. However, the areas covered by the lines which have subsequently closed show only minimal potential gains, including all the lines in the Northeast and in the Southern regions and the section of *Linha Beira Baixa* in the central region. . The section of the *Linha do Oeste* scheduled to close in the future also does not show many potential benefits. The same can be said of the other lines scheduled to close. This result suggests that the provision of new rail connections is not a viable solution for the increase of attractiveness of rail services in these areas as the increase in the population served by rail services is minimal.

The changes associated with the provision of new bus feeder routes are smaller, with improvements limited to small sections of some lines. Some of these sections also belong to the set of sections with the highest potential improvements following the provision of new rail connections (especially in the central part of the country), while one of the sections belongs to the set of sections closed in the period 2008-2013 (*Linha da Beira Baixa*).

Figure 7 maps the changes in potential demand for rail services starting at each station following the two types of hypothetical improvements.

In the case of new rail connections, changes in demand are relatively widespread throughout the network. The highest increases (above 2000 additional trips per week) occur in the metropolitan areas of Lisbon and Porto, reflecting the high population densities in these regions. However, the stations in some sections of the lines crossing the central part of the country also derive substantial benefits from the improvement in rail connections. There are also benefits in some stations in the Southern provinces. In contrast, the increases in potential demand in stations in the Northeast are in almost all cases below 100.

In the case of new bus feeder routes, gains are relatively modest but also evenly dispersed among several lines. The highest gains seem to be on the southern part of the *Linha do Oeste* and on the lines serving the south coast and the southern corridors of access to Lisbon. None of these sections are in the set of lines and sections closed in the period 2008-2013 or scheduled to close in the near future.

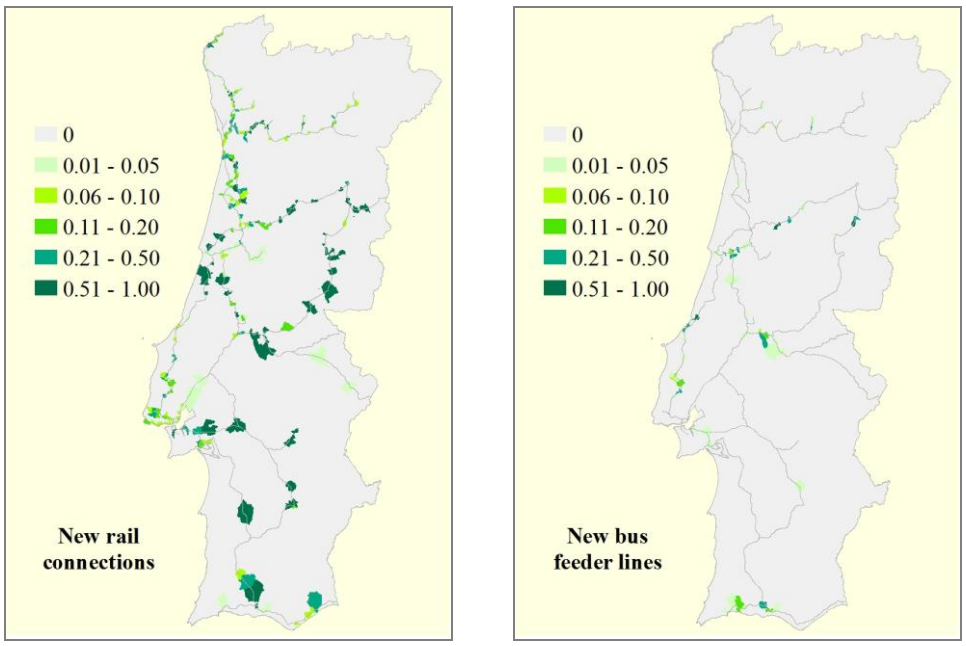

Figure 6: Changes in the proportion of workers and students served by rail (daily trips)

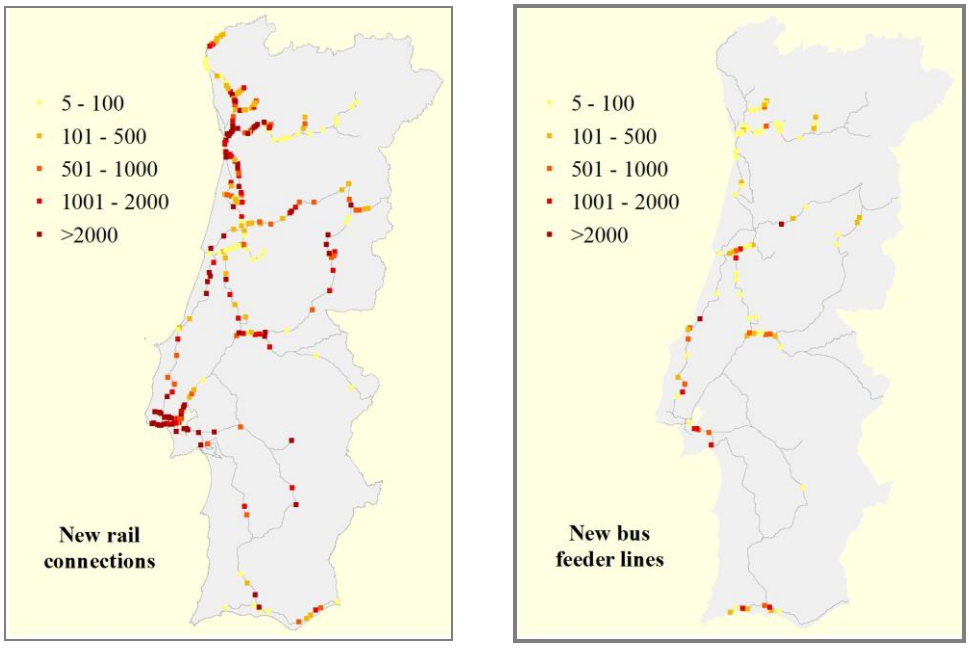

Figure 7: Changes in the number of weekly potential rail trips starting at each station

4 DISCUSSION AND CONCLUSIONS

The results of this paper suggest that instead of focusing public discussion and academic research exclusively on the consequences of the closure of whole lines, more attention should be given to the insufficiencies in rail scheduling and local access to stations before the closure. Improvements in these factors can increase the economic viability of parts of the lines closed, while simultaneously addressing the accessibility of the local populations, especially in the most peripheral areas.

Looking at the problem in purely economic terms, the closure of some lines seems unavoidable nevertheless, as the investment needed to improve the service in these lines is too high comparing with a small and shrinking demand. In fact, Portugal is the only country in Western Europe that lost railway passengers in the last decades, with a reduction of 1 million trips (43%) from 1988 and 2009 [14]. The reduction is not only related to insufficiencies in the service provided by rail but also to the priority given to public investment in the road and motorway infrastructure throughout the country. The share of railways in passenger travel decreased from 66% to 4.4% between 1990 and 2008 [14]. This study showed that some of the lines closed still had the potential to attract a fair share of the market, especially when more rail connections and bus feeder routes are created. However, previous experiences of reopening of lines have always failed (cases of *Linha de Vendas Novas*, *Linha de Leixões* and *Metro de Mirandela*). Bus replacements to lines closed have proved to be short-lived, and recent projects for reconverting some of the lines for tourism have also been cancelled. The possibility of salvaging some lines is also undermined by the poor financial situation of the Portuguese Railways and the fact that only the metropolitan areas of Lisbon and Porto provide realistic market opportunities for private operators or local governments.

The importance of the closed railway lines only becomes clear when considering societal objectives such as equity and regional cohesion. The analysis in this paper shows that some of the lines closed in the countryside served a potentially high proportion of the local populations, despite their small number in absolute terms. The withdrawal of rail services is socially and politically relevant as it can increase social and economic exclusion in a region where population is ageing at a faster rate than in the rest of the country. The provision of public transport alternatives for this population or the decentralization of some services and facilities can compensate the loss in mobility associated with rail service withdrawal.

The measurement of the opportunity costs in the lines closed and the identification of the lines with highest potential for reopening also supports the idea that line closures should be reversible and that the removal of services from existing lines should not imply the physical removal of the infrastructure, which has been the case of most of the lines closed in Portugal.

A few extensions to the analysis could also bring further insights into the study of rail passenger service withdrawal. The attractiveness of the rail service in the closed lines depends for example on further aspects of the schedules, such as the number of different possibilities for daily or weekly round trips, while the competitiveness of rail versus alternative modes (coach or private car) is dependent on the total time and financial costs of the journey. The withdrawal of services from some individual stations could also create faster services and decreasing the time disadvantage of rail travel in some lines. While this study provides an overview of rail accessibility and demand in the closed lines in comparison with the remaining network, an assessment of the accessibility and demand of specific lines requires further and more detailed analysis, provided for example by surveys to the population living and working in the areas surrounding the line. In overall terms, the effects of the disinvestment in the rail network are also wider than the lost accessibility and demand in the lines closed, as regional feeder lines provide a relevant part of the demand of the main lines. In addition, services are often reduced in some of the lines that are not closed, contributing to the overall loss in attractiveness of the network. Finally, the decisions for closing lines and withdrawing services are political, and may diverge from economic or social equity principles [15, 16].

REFERENCES

[1] Whitelegg, J., 1987. Rural railways and disinvestment in rural areas. Regional Studies 21(1), 55-63.

[2] Patmore, J. A., 1966. The contraction of the network of railway passenger services in England and Wales, 1836-1962. Transactions of the Institute of British Geographers 38, 105-118.

[3] Parolin, B. P., 1996 Effects of rationalization of rural passenger services on travel activity patterns. Transportation Research Record 1557, 48-57.

[4] Taylor, Z., 2006. Railway closures to passenger traffic in Poland and their social consequences. Journal of Transport Geography 14(2), 135-151.

[5] Kotavaara, O., Antikainen, H., Rusanen, J., 2011. Population change and accessibility by road and rail networks: GIS and statistical approach to Finland 1970-2007. Journal of Transport Geography 19(4), 926-935.

[6] Koopmans, C., Rietveld, P., Huijg, A., 2012. An accessibility approach to railways and municipal population growth, 1840, 1930. Journal of Transport Geography 25, 98-104.

[7] Ochojna, A.D., Brownlee, A.T., 1977. Simple indices for diagnosing rural public transport problems. Traffic Engineering and Control 18, 482-485.

[8] Nutley, S. D., 1985. Planning options for the improvement of rural accessibility: use of the time-space approach. Regional Studies 19(1), 37-50.

[9] Governo de Portugal - Ministério das Obras Públicas, Transportes e Comunicações., 1987. Reconverter e Modernizar o Caminho-de-Ferro. Lisboa: MOPTC.

[10] Martins, J M O., 1996. A Questão Ferroviária - Estudos Ferroviários I. Lisboa: Caminhos de Ferro Portugueses.

[11] Governo de Portugal - Minstério da Economia e do Emprego (2011) Plano Estratégico dos Transportes - Mobilidade Sustentável, http://www.portugal.gov.pt/media/152472/pet_mobilidade_sustentavel_rcm.pdf

[12] Oliveira, N R., 2011, Linha do Oeste: diagnóstico e propostas para a sua viabilidade. Unpublished study. Presented at the "O Futuro da Linha do Oeste" (The Future of Linha do Oeste) conference, São Martinho do Porto, Portugal, 14 January 2011. Presentation available at http://www.cm-peniche.pt/_uploads/PDF_Noticias/LinhadoOeste_EngNelsonOliveira.pdf

[13] Tão, M M., 2010. O exemplo alemão - Subsídios para um novo caminho-de-ferro na região do Alentejo. Transportes em Revista 8(90), 40-69.

[14] Portugal perdeu 43% dos passengeiros de comboio em 20 anos, Público, 2 February 2011. Available at http://www.publico.pt/economia/noticia/portugal-perdeu-43-dos-passageiros-de-comboio-em-20-anos_1478215

[15] Brent, R J., 1979. Imputing weights behind past railway closure decisions within a cost-benefit framework. Applied Economics 11(2), 157-700.

[16] Dodgson, J. S., 1984. Railway costs and closures. Journal of Transport Economics and Policy 18(3), 219-235.