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Accounting quality in railway companies during the nineteenth and twentieth centuries: the case of Spanish NORTE and MZA

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Prior literature studying railway accounting during the nineteenth and twentieth centuries defends the thesis of lack of reliability of accounting figures. This prior research, which mainly studies the cases of the United Kingdom and the United States, offers mixed views on the causes, or simply accepts this thesis without providing conclusive evidence, as is the case of historical research in Spain. We provide novel evidence on the quality of railway accounting and contribute to this prior debate by (1) analysing the accounting for two material accruals: depreciation and prior period adjustments; (2) studying the persistence of earnings and its components, and (3) analysing how accrual accounting affects persistence. These analyses are conducted for the period 1856–1939 for the two major Spanish railway companies (MZA and NORTE). The reported evidence suggests that earnings are highly persistent. However, we show that there are significant differences across firms and that these differences are particularly obvious when analysing the adjustments for prior period earnings. Overall, our evidence does not support the thesis that accounting was underdeveloped, but rather, that managerial accounting choices lowered accounting quality.

Keywords: accounting history; accounting quality; railway accounting; earnings persistence; Spanish railways

1. Introduction

We study accounting quality in railway companies during the nineteenth and early twentieth centuries. Prior literature provides evidence of low accounting quality, driven both by managerial opportunism (Edwards 1985, 1989) as well as by the overall underdevelopment of the accounting

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information system (Pollins 1956, Lee 1975) both in theory (e.g. because of the lack of conceptual frameworks) and in practice (e.g. because of the lack of experience of managers in accounting issues). Prior studies examining railroad accounting suggest that both elements are present (e.g. Glynn 1984, Arnold and McCartney 2002). We build on this literature and study the Spanish railway industry and, in particular, we analyse the case of MZA and NORTE,¹ the two largest Spanish railway firms of the nineteenth and twentieth centuries.

To contribute to this prior work, we first provide a detailed description of railway accounting in Spain during the period, as well as review the historical context, to assess the degree of underdevelopment of the accounting system throughout the period and show the similarities between MZA and NORTE. They operated in the same business, under the same regulation and shared a common contextual accounting knowledge and institutions. Second, we study, for these two firms, the accounting for specific accruals. This permits understanding the extent to which, despite the similarities underpinning their business models and context, these firms may have developed accounting systems that led to heterogeneous firm-level choices. Finally, we study whether these choices contributed significantly towards differences in accounting quality across these firms, by studying if the earnings reported by railway companies exhibit evidence of differential persistence, which we associate with a uniform and consistent application of accounting criteria.

For our analyses, we manually collect all available data from NORTE and MZA for the period 1856–1939, i.e. from the time these firms were first established until the end of the Spanish Civil War. Using these data, we study accrual accounting and earnings persistence. Our analyses permit comparing accounting practices across both companies and thus, understanding to what extent the shared historical context (i.e. the aforementioned underdevelopment of the accounting system, which would have affected both firms equally), as well as firm-specific characteristics, influence accounting. To separate these effects, we propose the study of accrual accounting using a long-time series of data, and focusing on two key accruals: depreciation and a singular and novel element of Spanish railway accounting not studied in detail in prior work: the use of ‘prior period adjustment’ accruals (*Ejercicios Cerrados*). These adjustments reflect revenues and expenses from prior period(s), accounted for during the current period. We use these adjustments, which were material in size (around 4% of earnings on average) to identify accounting policies which we suggest may help differentiate between the underdevelopment of the accounting system versus managerial opportunism. Our underlying assumption is that to the extent that these adjustments reflect the lack of timely channels to communicate and measure economic events, they should not reflect any systematic biases. Bias in the accounting for these adjustments would lead us to conclude that the use of accounting was opportunistic.

Our analyses provide the following key evidence. We find that, overall, earnings are persistent, which can be interpreted as indicating a consistent and uniform application of accounting criteria, and thus, as high accounting quality on average. Second, we find differences between MZA and NORTE in their earnings persistence levels and in their accrual accounting practices. In particular, they used the prior period adjustments differently: whilst MZA adjustments are consistently negative (income-decreasing), they are persistently positive (income-increasing) in the case of NORTE. Indeed, when we remove the adjustments from NORTE, the persistence of earnings significantly decreases. This could be evidence of opportunistic accounting practices, as NORTE may have used the adjustments to increase earnings and report a more sustainable and stable pattern. In addition, when studying depreciation, we also find evidence of different accounting practices, which again suggests managerial choice as an important explanatory factor underpinning differences in quality across firms, rather than overall lack of knowledge and accounting underdevelopment. Of course, an alternative explanation to these differences in depreciation practices could be, as noted in McCartney and Arnold (2003, p. 845) that it ‘took time for railway

managers and directors to become sufficiently familiar with the new technologies as to be able to make the forecasts of asset life that “smoothed” depreciation accounting requires.’ However, because we study these firms for a period of eight decades, that spans their full life cycles and reaches the 1930s, the observed patterns of accounting for depreciation do not seem to indicate that this explanation holds in our setting, at least for the full period.

Our paper makes a number of contributions. First, we contribute to the debate in the international literature by providing novel insights on the lack of reliability of railway accounting. Specifically, we analyse two material accruals: depreciation and prior period adjustments to understand firm-specific accounting choices. We also examine the persistence of accounting earnings in a historical context and how accrual accounting affects persistence. The study of earnings persistence places our study close to the work of Sivakumar and Waymire (2003), who study US railway companies’ accounting in the twentieth century by looking at related properties of accounting earnings: income smoothing and conservatism. Finally, we contribute to prior literature by studying Spain. Prior studies suggest low accounting quality in Spanish railway companies (e.g. Villacorta Hernández 2014), often without supporting their claims with evidence. We question this view, as our analyses provide evidence that persistence was high on average, which we interpret as indicating that reliability was high. In addition, prior research does not generally focus on opportunism as a factor explaining the low accounting quality of railway companies, and it often focuses on limited time periods, instead of looking at a long-time series of data that span the full life of railway companies. Such analyses permit uncovering patterns that cannot be identified by looking at shorter windows of time. Indeed, to the best of our knowledge, only Villacorta Hernández (2014) attempts to examine the reliability of Spanish railway accounting, looking at six accounting practices implemented by NORTE from 1900 to 1923, and providing mixed evidence.

The remainder of the paper is structured as follows. Section 2 reviews the prior literature. Section 3 presents the historical context. Section 4 explains the method and predictions and Section 5 discusses the sample and presents the main results. Finally, Section 6 concludes.

2. Literature review

Railway companies played a pioneering role in the history of accounting. These companies faced varied challenges in developing their accounting practices related to the valuation of fixed assets, the calculation of periodic profit, the separation of capital expenditures from revenue expenditures, and even the development of financial statements both in terms of content and form (Edwards 1985). The level of investment required meant a particular focus on how to value long-lived assets (May 1936, Edwards 1989). Railway companies had to develop accounting principles as they became aware of economic events, which they discovered in running their day-to-day operations. The overall finding in prior studies is that railway companies reported unreliable accounting figures during the nineteenth and twentieth centuries. However, prior literature provides mixed views on why. A stream of research argues that low accounting quality was driven by the lack of knowledge (i.e. accounting knowledge was underdeveloped), whilst another stream of research argues that there existed deliberate manipulation of accounting.

Among the authors who justify the unreliability of accounting figures by the conceptual and normative underdevelopment in accounting measurement, we can cite Pollins (1956), Gourvish (1970), Lee (1975), and McCartney and Arnold (2003). Keynes refers to the ‘precariousness of the basis of knowledge’ as one of the factors that might explain the error or bias in profit calculations during the nineteenth century, and specifically, to conceptual errors due to ‘the failure to systematically distinguish between capital and revenue expenditures and the failure to periodically allocate the original cost of fixed assets to expense’ (Keynes 1936, pp. 149–50, quoted

in Brief 1965, pp. 13–4). Indeed, many historians recognise the early and middle decades of the nineteenth century as ‘the heyday of laissez-faire’ for railway companies (Glynn 1984, p. 103). This unregulated period led to the development of different accounting practices and disclosure levels among companies and over time (Glynn 1984, Bryer 1991, Previts and Samson 2000). For example, McCartney and Arnold (2003, p. 833) point out the failure of governmental legislation in providing guidance to calculate legally distributable income. Similarly, Brief (1965, pp. 23–24) affirms that ‘since the standards of financial disclosure were ill-defined, financial reports from the period are at best ambiguous and at worst unreliable.’ This does not mean that the accounting profession at the time was not self-aware. For example, an accountant affirmed that ‘... a mere merchant or tradesman ... would find great difficulty ... to ascertain at once the real results of Railway accounts, even supposing them to be truly kept’ (Monteagle 1949, p. 221, quoted in Bryer 1991, pp. 461–2). The ambiguity was oftentimes caused by the absence of a precise nomenclature. Indeed, it is difficult to find clear statements of how railway companies accounted for their fixed assets in the nineteenth century (Edwards 1986). Glynn (1984) concludes that it took British accounting over 80 years to produce a standard presentation of accounts and financial reporting for railway companies.

The lack of managerial experience may have also caused low accounting quality, particularly in depreciation calculations to account for capital consumption (Mason 1933, Pollins 1952a,b, 1956, Pollard 1965, Gourvish 1970, Perelman 1997, Arnold and McCartney 2002, Toms and Shepherd 2013). Indeed, Grinyer (1987, p. 43) described depreciation as ‘one of the most intractable problems of accruals accounting’ (quoted in Arnold and McCartney 2002, p. 195). *The Accountant* claimed in 1887 that ‘much confusion and uncertainty exist in property and machinery accounts by reason of the way in which wear and tear and renewals are treated’ (quoted in Brief 1965, p. 28). In the late 1830s and early 1840s, British railway companies began to depreciate the rolling stock, but not the permanent way (the railway track), which began in the 1850s (Edwards 1986, Arnold and McCartney 2002).² The evidence suggests that managers and shareholders did not welcome attempts to improve existing legislation (Edwards 1985, p. 42). This, together with the conceptual underdevelopment, led to the non-existence of an accounting standards framework. In the UK, the financial disaster of the mid-1860s revived the interest of the Government in the financial reporting system, imposing statutory audits in 1867 and standardised accounts in 1868 (Edwards 1985, p. 42). The Regulation of Railways Act of 1868 allowed but did not require depreciation, and the Railway Companies Act of 1911 first regulated depreciation in the general balance sheet (Edwards 1986). As noted in Glynn (1984, p. 113), although the 1868 Act already imposed half-yearly accounts under a prescribed form, the information required in pro forma accounts was still ‘extremely meagre,’ and did not clarify what items had to be recorded under each heading.

Whilst a number of these studies suggest managerial intervention in accounting, via opposition to legislation, some studies directly suggest a deliberate manipulation of the figures: ‘Many nineteenth century writers argued that railway accounts were not merely badly drawn up, incomplete, and incomprehensible but that directors, either individually or in collusion, deliberately sought to distort presentation to investors and other interested parties’ (Glynn 1984, p. 109). It has been argued that railway companies manipulated the accounts to hide deficiencies and/or to prevent comparisons among them (Gourvish 1972). In fact, it was common to refer to financial statements as *cooked accounts* at shareholders’ meetings in the mid-1840s, which included, among others, ‘manipulated figures, partial statements, and delusive representations’ (Wang 1918, pp. 155–6, quoted in Edwards 1985, p. 26).

The lack of a regulatory framework left discretion to the companies, and rendered financial statements ‘incapable of comparison but in many instances led to charges of deliberate deception’ (Glynn 1984, p. 109). Many authors at the time agreed that accounting error did exist but they

differed on whether this error led to an overstatement or understatement of assets (Brief 1965, p. 30). Even *The Accountant* stated in 1885 that

the [accounting] practice of railway companies [is] as vicious and as full of temptation to managers and directors to manipulate accounts for their own ends and purposes as can well be imagined. It is little short of an inducement to fraud. (quoted in Brief 1965, p. 19)

The early British railway companies showed irregularities particularly with respect to depreciation that appears to have been driven by economic self-interest (Arnold and McCartney 2002). During the British railway-mania (1845–1847)³ and subsequently, railway companies abandoned depreciation accounting (Edwards 1986), and also, the reserve funds for rolling stock to show higher profits, according to Gourvish (1970), because it was considered that rolling stock could be properly maintained out of revenue, but, according to Pollins (1956), it was more likely because of ‘the desire to maintain dividends when results deteriorated in the depression of 1846–8’ (quoted in Edwards 1985, p. 26). Edwards (1989, p. 167) also identifies the pressure by shareholders to receive dividends as a key element driving the manipulation of financial reports. Bryer (1991) defends a more specific thesis: the ‘swindle hypothesis’ (p. 439), and argues that high-class investors manipulated the figures deliberately to swindle middle-class investors, and that railway companies understated the true cost of capital consumption, inflating profitability. However, McCartney and Arnold (2003) criticise this view and explain the unreliability of early financial statements by the lack of legal requirements to recognise fixed assets consumption and, in general, by the embryonic development of income measurement.

Therefore, despite the overall agreement that accounting was of low quality, a debate exists surrounding the thesis of whether these practices were applied wittingly or not. For example, Arnold and McCartney (2002) claim that there was manipulation by stating that most of the depreciation funds of British railway companies from 1830 to 1850 worked as devices for smoothing replacement expenditure in the profit and loss account. Edwards (1985, p. 26) had already noted that, in the mid-1840s, railway companies ‘employ[ed] valuation procedures designed principally to produce a pattern of reported profit sufficient to justify the desired level of distribution – the aim was profit smoothing on a large scale.’ As proof of such deliberate manipulation, there is evidence of managerial opportunism and fraud. This is, for instance, the case studied by McCartney and Arnold (2000) of George Hudson, known as the ‘railway king,’ who, in the mid-1850s, was unmasked as ‘doctoring the books’ to improve balance sheets, and, also to have made contracts in his private capacity to his personal profit (Glynn 1984, p. 107).

Finally, a number of authors, whilst not making such strong claims, suggest that railway managers made opportunistic decisions without the intention of distorting accounts, but taking advantage of the lack of a regulated accounting framework. Some authors offer a defence that there were omissions – or non-compliance – of proceedings (or customs) (McCartney and Arnold 2003). However, this argument is difficult to reconcile with the knowledge that by the end of the 1830s, many British railway companies had begun to depreciate their rolling stock (Pollins 1956), and in the 1840s the railway industry knew that the rolling stock and permanent way were not indestructible. Thus, the concept of depreciation was known, and different accounting treatments to recognise it existed (Edwards 1985, 1986, Bryer 1991, Arnold and McCartney 2002). According to Edwards (1985, 1989) railway companies published cash-based accounting statements in the 1840s to inflate reported profit, pay higher dividends and attract capital, by creating an appearance of greater profitability.

The Railway Times drew attention in 1841 to railway companies because they were running out of perishable assets and paying excessive dividends (Brief 1965, p. 16). Edwards (1986) identifies the lack of disclosure of general accounting policies as important in explaining why

managers reported profit without considering the depreciation of the assets, in response to pressures to pay dividends. In the last quarter of the nineteenth century, different authors⁴ recognised the failure of railway companies to depreciate fixed assets. Even during the early twentieth century, Hatfield affirmed that North American railway companies 'are still apt to look upon the charge for depreciation as being an act of grace rather than of necessity' (Brief 1965, p. 26).

It is not easy, from a current perspective, to correctly interpret historical events and accurately distinguish between deliberate manipulation and simple (or wilful) ignorance. *Herapath's Journal* (1850, p. 711) revealed the opinion of the Chairman of the London, Brighton and South Coast Railway about the 'cooked accounts,' and justified that Directors did not report these accounts 'from any deliberate dishonesty, but because Directors did not like to show a worse result than was anticipated' (quoted in Edwards 1985, p. 26), justifying perhaps an ignorance not of accounting, but of the consequences of low accounting quality, or alternatively, of the benefits of high quality accounting for optimal decision-making.

2.1. Evidence on accounting quality in Spanish railway companies

The literature reviewed focuses on the case of British railways,⁵ where much of the research has been conducted. Arnold and McCartney (2003) note that many well-known accusations of railway accounting manipulation are not supported by evidence or not duly referenced. The literature on Spanish railway companies also includes frequently repeated speculations about accounting manipulation. However, these studies (often from the field of economic history) are not focused on accounting reliability, as these authors are not concerned with how the figures were computed,⁶ and use accounting to support their theories and views, which include: (1) railway companies were accused by the public opinion of manipulating first establishment expenses to obtain more public funds and justify their requests for financial assistance, mainly during the construction phase (Cordero and Menéndez 1978, Mateo del Peral 1978, Tedde De Lorca 1978, Herránz-Loncán 2003); (2) accounting manipulation is more likely when institutional control by tax authorities is lax and concessioner railways' political power is higher, and both were characteristics of the Spanish railway sector (Martín Aceña and Comín 1994, p. 135); (3) there was a wide margin between legal rail fares and real fares that produced continuous profits to railway companies, which resulted in suspicion because railway companies demanded increases in rail fares to cover expenses (Menéndez Pidal 1984); or that (4) the Government remained sceptical towards the accounts reported by railways (Comín et al. 1998, pp. 289, 299–300).

This negative image comes from the 1920s, when suggestions and vituperative opinions from the Government, press, politicians and public opinion about the lack of reliability of railway accounts would lead to the establishment of inquiry committees in 1923, to analyse the reported accounts. Villacorta Hernández and Müller (2014, pp. 153–4) argue that these committees did not find evidence of manipulation and only noted that different accounting criteria were being applied. Nuñez Romero-Balmas and Buendía Carrillo (2008) even suggest that railway companies were careful with accounting proceedings, because they had to return the assets to the State at the end of the concession. This argumentation would suggest a concern for high quality accounting among railway companies, and an attempt to best reflect the underlying economic phenomena.

3. The case of Spanish railway companies: historical context (1844–1941)

In the first half of the nineteenth century, Spain based its economic activity in traditional agriculture, and the characteristics of the context included significant political and economic instabilities,

depleted public funds, underdevelopment of the legal framework and institutions, high levels of corruption, narrow domestic markets, challenging geographic conditions to build public works, and technical backwardness (Comín et al. 1998). This led to a delay in the industrialisation process and, in particular, in the establishment and development of the railway sector. Lardner (1850) stated that Spain dawdled in political distractions. In 1847 there was not one railway mile in Spain whilst the railway miles were already substantial in other countries.⁷

After several unsuccessful attempts to establish a railway policy, the Royal Order of 1844 regulated the procedure to obtain railway concessions for the first time in Spain. This regulation did not have the status of Law and was provisional (Comín et al. 1998), but led to a proliferation of private initiatives to build railway infrastructure, forcing the State to pass the General Railway Law of 1855 to organise a process to grant the concessions, to simplify the administrative procedures and avoid speculation. Applications for concessions were usually backed by foreign investors (from England, France, and Belgium) together with traders, aristocrats and burghers⁸ settled in the regions crossed by projected railways (Wais San Martín 1943, Comín et al. 1998). The regulatory framework opted for a concessions system as a legal mechanism to build and operate railway lines. Administratively, the State owned the lines and granted the right of usufruct to the concessionary railway companies over a period not exceeding 99 years. Private companies were forced to return their assets to the State at the concession's expiration date. This was a hybrid model between pure private initiative (i.e. British case) and state planning (i.e. Belgian case), where public works were designed and managed by the Government (Mateo del Peral 1978). To obtain a concession, private railway companies had to justify the feasibility of the planned line and prove they had enough financial resources (Mateo del Peral 1978). Companies then had to build the rail network subject to an approved route and specific terms and conditions to protect the general public interest, whilst the State supported the companies financially through subsidies, financial aids and tax exemptions (Artola Gallego 1978).

Tedde De Lorca (1978) divides the history of the Spanish railway sector into five phases: *start-up* (1856–1874), *expansion* (1874–1900), *consolidation* (1900–1919), *institutionalisation* (1919–1935), and *nationalisation* (1939–1942). We briefly review each of these phases.

In the *start-up* phase, Spain saw the creation of its first railway companies, the first approval of concessions, the establishment of main railway lines, and the emergence of the first management challenges (Tedde De Lorca 1978). French capital drove economic development (Cameron 1961), mainly associated with the business expansion of the Rothschild family and the Pereire brothers (Parisian bankers) in Spain.⁹ The Rothschilds established MZA in 1856 and to operate in the north and north-west, the Pereires set up NORTE in 1858. Simultaneously, they created Credit Societies to finance them (Tedde De Lorca 1994, Comín et al. 1998). Ownership was concentrated in the hands of large investors (Perelman 1997), and it was common that members of the nobility and other businessmen contributed with domestic savings to co-finance these companies. Spain also imported from France qualified technical staff and¹⁰ consequently the management model,¹¹ which was designed upon the principles of centralisation, hierarchy, training, and specialisation (Comín et al. 1998). The Boards of Directors of MZA and NORTE were under the instructions of 'Committees of Paris' which were the de facto managers of railways. This influence of France was also evident in other aspects such as the legislative initiatives in the banking and railway sectors (Tortella Casares 1973). The State supported the sector financially through the duty exemption for railway stock,¹² and the payment of subsidies. These aids were justified by the underdeveloped nature of capital markets and the insecurity of institutions (Comín et al. 1998). Concurrently, the agricultural crisis (1864) turned into an economic crisis (1866) and, later, a political crisis (1868). This was the first financial crisis of Spanish capitalism and affected banks and railways. However, the interest of European investors did not dwindle. Concessionary

railway companies proliferated and built an extensive rail network as can be seen in Panel A of Figure 1. MZA and NORTE built their core railway lines during these years.

The *expansion* phase (1874–1900) coincided with the restoration of the Bourbon kings and the start of the industrialisation process. The second half of the nineteenth century was characterised by the alternation between liberal and conservative governments. The leading railway companies implemented policies of concentration through takeovers and signing commercial agreements with smaller companies, and of expansion through the construction of railway branches (Tedde De Lorca 1978), as can be seen in Figure 1 Panel B. These strategies aimed at generating economies of scale, to decrease costs and increase market shares. The takeovers changed the ownership of MZA and NORTE. Spanish shareholders began to represent around three-quarters of the capital, and French control started to weaken (Vidal and Ortúñez 2002). In the 1880s, railways suffered problems caused by agricultural transformations, harvest shortages, progressive decrease in the traffic of cereals due to imports from the US, Black Sea area and India, and the general crisis in Europe (Annual Report MZA 1889). In the 1890s, the commercial policy turned more protectionist partly as a response to the competition of US cereal producers. But Spain faced additional challenges: the insurrection of Cuba, currency depreciation, strong competition among railways that produced discounts in freight rates, etc. (Annual Report MZA 1896). Railway companies suffered because of exchange rates, breaks of trade agreements, and the depletion of Treasury funds due to wars in overseas territories (Annual Report MZA 1897).

The *consolidation* phase (1900–1919) presented a new scenario, where rail transport developed rapidly. The neutral position of Spain in the Great War, and its strategic localisation, contributed to a higher transport demand as a consequence of an increase in exports (Tedde De Lorca 1978). The financial returns grew and consolidated during the entire period, except for 1917–1918, and large railway companies had to renew and increase their transport capacity. The renewals that had started at the end of the 1890s were insufficient, and railways could not satisfy the demand or guarantee safe transportation services. Moreover, the general rise in prices in 1916, 1917, and 1918 caused riots and strikes by dissatisfied railway workers who demanded increases in salaries. As a result, labour costs of railway companies increased dramatically. This, together with the high cost of coal, diminished the positive results and eventually led to the nationalisation of private railway companies in later years (Menéndez Pidal 1984).

The *institutionalisation* phase (1919–1935) was characterised by wide state interventionism, particularly during the Spanish dictatorship of Primo de Rivera (1923–1930). Since then, the State assumed functions such as financing the modernisation of the railway system (Menéndez Pidal 1984), instituted the General Council of Railways (*Consejo Superior Ferroviario*) in 1922 as a link between the railway companies and the Government, and passed the Railway Statute in 1924. During the Great War, companies were interested in gaining state subsidies and permissions to increase rates (Vidal and Ortúñez 2002). Railway companies became increasingly indebted; as an example, the debt to equity ratio in NORTE evolved from 1.63 in 1913 to 5.41 in 1924, with banks ownership also increasing, up to about 49% of NORTE in the 1930s.¹³ During the 1920s, MZA and NORTE reported similar results to the previous decades. But, the world crisis of 1929 and the competition from road transport affected severely their profits during the 1930s. The recession in the 1930s brought to light the problems that had been mounting (Muñoz Rubio and Vidal Olivares 2006). The recession coupled with competition from road transport caused a reduction in rail traffic and the companies found themselves in trouble. The serious decapitalisation between 1929 and 1936 due to the fixed asset policies followed by the companies (including insufficient resources assigned to renewals or inadequate maintenance) worsened because of the Spanish Civil War (1936–1939) and created a railway incapable of taking on the transport



Figure 1. Spanish railway line. Panel A: Railway line in 1875 (Wais San Martín 1987, p. 186). Panel B: Railway line in 1900 (Wais San Martín 1987, p. 163)

needs of the time. The economic and political circumstances made it unattractive to continue investing in railways, and companies began the reversal of concessions before the expiration date (Menéndez Pidal 1984).

Finally, the *nationalisation* phase (1939–1942) started after the Spanish Civil War, which was a cataclysm to already ailing railway companies, because of the interruption of regular transportation. The Railway Act of 1941 nationalised the network and created the state-owned company RENFE (Red Nacional de los Ferrocarriles Españoles, National Network of Spanish Railways).

4. Accounting quality: definition and measurement

There are mixed evidence and theories on the historical quality of accounting practices in railway companies. We aim to contribute to this debate by studying the accounting information reported by Spanish railway companies in the nineteenth and early twentieth centuries. At the time, MZA and NORTE were the largest railway companies. Table 1 provides evidence on their relative size, as ranked within the top 50 Spanish firms. The relevance of these firms within the national economy justifies the development of accounting within that sector and the interest of the study of their accounting practices. Next, we describe the empirical challenges in measuring accounting quality and present our methods and arguments.

4.1. The challenge of measuring accounting quality in historical cases

Accounting quality is a dynamic concept, and different stakeholders value quality characteristics differently. Whilst this may appear a sufficiently broad consideration, qualitative characteristics of accounting information are even more difficult to pin down in historical cases, as the concept of quality has evolved over time. Thus, first of all, we review the Spanish railway accounting framework to identify the adjectives used in the nineteenth century and understand the attributes that were considered desirable in accounting information. These adjectives closely align with desirable qualitative characteristics of accounting, and thus, potentially, with accounting quality. Summarising this ample regulatory backdrop, accounting information should be complete and regular,¹⁴ legally binding,¹⁵ verified, publishable and communicated,¹⁶ clear,¹⁷ representative of the real business situation and precise.¹⁸ A close analysis of these characteristics reveals that despite not being jointly presented in a single conceptual framework, the overall concept of quality of accounting information in the nineteenth century was strikingly similar to the current one.

Turning to current research, there is no clear consensus on how to measure accounting quality. Recent literature reviews (e.g. DeFond 2010) show that usually, the focus is on the quality of earnings and its properties, such as persistence, accruals quality, timely loss recognition, or asymmetric opportunity (e.g. Gill-de-Albormoz and Rusanescu 2018, Bravo and Reguera-Alvarado 2018). This focus is justified because earnings is a key summary measure of performance that conditions the payment of dividends and many contractual outcomes, and thus, earnings is

Table 1. Ranking of MZA and NORTE among Spanish companies in the nineteenth century and early twentieth century.

Ranking of Spanish companies by ...	Position ^a	
	MZA	NORTE
Paid-in Capital in 1866–1867 terms	1/50	3/50
Capitalisation in 1913	3/25	2/25
Net Assets Value in 1917	2/50	1/50
Net Assets Value in 1930	1/50	2/50

Source: Based on data from Tafunell (2005, pp. 786–89).

^a n/N: where ‘n’ represents the position of MZA and NORTE in the rankings and N is the total number of companies that have been ranked (N = 50).

often the focus of managers and key stakeholders. The literature also suggests a historical relevance of earnings. Indeed, earnings were fundamental for dividend distributions, with prior research suggesting that accounts were managed in response to pressures to pay dividends (e.g. Edwards 1985, 1989). Also, possibly, there existed a certain governmental monitoring over earnings fluctuations, leading to political costs for railway companies if earnings became volatile and the government had to provide subsidies of mounting values. This setting may have led to pressures to artificially maintain stable and sustainable levels of dividends and earnings, i.e. to fabricate certain earnings persistence.

Against this backdrop, the study of earnings quality and its accrual components, and particularly, of earnings persistence, appears a promising avenue to study accounting quality.¹⁹ Earnings persistence captures earnings sustainability; persistent earnings are viewed as desirable as they are recurring (e.g. Francis et al. 2004, Penman and Zhang 2002) and may permit, for example, sustaining a certain level of dividends. Earnings persistence can be attained in two main ways (which may, of course, happen concurrently): (1) by operating a sustainable business, where earnings innovations stay in the earnings series; and (2) by managing earnings, using reporting accruals choices to reduce volatility in earnings. We propose to evaluate the existence of accounting quality by studying earnings persistence and a number of key accrual components in a temporal series. This is similar to the work of Sivakumar and Waymire (2003) who study the earnings properties of US railway firms in the early twentieth century by analysing income smoothing. This approach is, of course, not without criticism. Yet, a number of the criticisms of this quantitative technique turn into advantages when applied to historical cases. First, the analysis of persistence can be criticised on the basis that it focuses exclusively on earnings (Beest et al. 2009). However, in the nineteenth century, the historical context was characterised by a lack of accounting regulatory framework and limited development of accounting concepts and practices. This makes it nearly impossible to control for all the variables that may have affected accounting information and justifies a more focused analysis. Second, the analysis of persistence in historical cases can be effective, as it only requires bottom line earnings. Moreover, the technique shows a partial and generic approach to quality, which is appropriate in historical cases (instead of drawing restricted conclusions). Third, some quantitative models are not workable to measure quality in historical cases. For example, they may require non-existent information (railway companies were obliged to publish the Balance Sheet, but often did not comply (Bernal 2004)), or impose strong assumption on the working and efficiency of capital markets, which were historically not as developed as they are currently. Finally, earnings persistence could be criticised because it focuses on the utility for investors. But, precisely because railway companies' annual reports were formulated only to inform shareholders, some of whom were simultaneously members of the Board of Directors, this approach is useful.

4.2. *Earnings persistence and accrual accounting: main predictions and models*

Earnings persistence can be measured by earnings auto-correlation over time. The correlation quantifies the strength and direction in the linearity and proportionality of the relation. If there is earnings persistence, we expect that it may be suggestive of a uniform and subjacent application of accounting criteria, and evidence of high quality information. As noted above, earnings persistence reflects the sustainability of the underlying business, and as a measure of accounting quality, it depends on the implemented accounting system. In turn, the quality of an accounting system depends on (1) the ability of the accounting normative framework to capture value; and importantly (2) managerial choices within that accounting framework.

In our study, we focus on NORTE and MZA. By looking at persistence over a long period of time and across two different firms, we can focus on the endogenous elements of quality which

differ across both firms, such as managerial decision-making. In particular, to the extent that the underlying economics (as reviewed in Section 3) are shared by both firms, that the accounting common knowledge and regulatory frameworks and institutions at the time were also the same, and that we focus on the largest firms of a single sector, we would expect, in the absence of firm-specific differences and managerial discretionary accounting choices, similar earnings persistence in both firms, indicating these shared underlying conditions. In contrast, if different levels of persistence are found, it could mean that managerial decision-making within the accounting process drives, at least partly, those differences. In particular, the study of earnings persistence can help us to distinguish between biased accounting and mere lack of knowledge (errors). Given our long-time series, error is more likely to cancel out than bias.

To measure earnings persistence, we use the following simple model:

$$E_t = \beta_0 + \beta_1 E_{t-1} + \varepsilon_t, \quad (1)$$

where E is earnings and t is the time-series indicator. β_1 is the persistence coefficient and main coefficient of interest, which measures the auto-correlation between earnings in t and in $t-1$. A higher β_1 implies higher earnings persistence, suggesting a uniform and subjacent application of recognition and measurement criteria (i.e. higher accounting quality).

Even if firms show different levels of persistence, this could be due to differences in managerial style rather than to differences in managerial accounting choices. That is, underlying firm-specific circumstances may drive differences in cash flows that, in turn, determine earnings persistence. To circumvent this concern, we study the accounting process itself, i.e. accrual components of earnings. In particular, we study two accruals.

First, we analyse depreciation, which is an accrual that has been studied in prior historical research. Depreciation, if accounted for, leads to lower earnings. To increase earnings, and thus, for example, dividend payments to shareholders, managers may resort to failing to account for depreciation, or to reduce the annual charge (or even to discontinue it). To the extent that it was common knowledge that the permanent and rolling stock did not have an infinite useful life, observing either of these actions would reflect managerial purposeful decision-making. Second, we focus on an accrual which constitutes a novel element in railway accounting research: the annual adjustments to the earnings figure reflecting prior period events. These adjustments reflect earnings from prior periods that were not recorded in a timely manner and that are included as an adjustment in the current period. They refer to the immediate prior period, but also, to several prior periods and can be identified as '*Ejercicios Cerrados*' in annual reports. We denote them as prior-period earnings adjustments. As an example, Figures 2 and 3 show the *Ejercicios Cerrados* item in isolation and in context within an Operating Accounting. In both examples, the item appears under 'General Expenses' and as a line item before the bottom line calculation of the 'Total Expenses' (*Total general de los gastos*).

The adjustments, which modify current-period earnings, could simply reflect the accounting for events that become known after the fiscal year end if, for example, information was not available at the time of preparing the financial statements. We expect that this may have been a likely event, particularly in the nineteenth century, when communication and measurement of economic events were often significantly delayed because of the lack of timely communication channels and of strong internal controls. For example, the work of Chandler (1965, p. 16) notes that a challenge of early railway managers was to 'work out the basic methods of communication and control essential to the operations of the modern business corporation.' Indeed, given the difficulties of collecting information from the different operating units, these adjustments could reflect the intention of the management team to improve the quality of the accounting figures (i.e. reconcile the numbers as soon as the information was available). Conversely, these adjustments could be

SERVICIO DE MATERIAL Y TRACCION.		
Personal.....	076.503	86
Gastos diversos.....	121.501	79
Conduccion de máquinas.....	3.213.767	58
Consumo de id.....	9.309.638	85
Conservacion del material móvil.....	7.124.117	16
<i>Total servicio de Material y Traccion.....</i>	<i>20.445.619</i>	<i>24</i>
GASTOS GENERALES.		
Gastos generales por todos los servicios.....	4.143.929	46
Ejercicios cerrados.....	949.276	30
<i>Total gastos generales y ejercicios cerrados.....</i>	<i>5.093.205</i>	<i>76</i>

Figure 2. Expenses in the operating account (Annual Report, MZA 1876).

Notes: Translation (by authors): *Servicio de Material y Tracción* equals Traction and Rolling Stock Service, *Personal* equals Staff, *Gastos diversos* equals Sundry Costs, *Conducción de máquinas* equals Driving machines, *Consumo de máquinas* equals Machines consumption, *Conservación del material móvil* equals Maintenance of rolling stock, *Gastos generales* equals General Expenditures, *Gastos generales por todos los servicios* equals General Expenditures for all services, *Ejercicios cerrados* equals Closed financial years, *Total gastos generales y ejercicios cerrados* equals Total of General Expenditures and closed financial years.

used opportunistically to delay the recognition of expenses or to time revenues and expenses, including them in the period when management considers best.

If the adjustments are used opportunistically, they should lower accounting quality, and thus, influence earnings persistence. To understand whether prior period adjustments are used opportunistically, we first modify model (1), by including a variable that identifies cases where the adjustments serve to increase earnings (POS_ADJ). POS_ADJ takes the value of 1 if the firm reports an income-increasing adjustment; 0 otherwise. Second, we modify model (1), and run it using earnings before prior period adjustments (EBADJ) as our dependent variable. In our analyses, we also control for additional variables that capture the different phases of the evolution of the sector, which have been explained in Section 3, as well as run the models separately for NORTE and MZA. We study earnings increases and earnings persistence effects because the reviewed evidence suggests that railway firms were pressured to stay profitable and pay large dividends and, thus, had incentives to artificially inflate earnings (Edwards 1985, 1986). The work of Villacorta Hernández (2014) suggests that railway firms, particularly in the twentieth century, may also have had incentives to keep earnings at a level that would not draw the attention of the State, who may have stopped providing public funds if railway firms had reported large profits. Thus, these two incentives combine into a prediction that firms would try to report what could be labelled as ‘smooth high earnings,’ that is, to increase earnings to a level that was sufficient to justify the payment of dividends, but not so high as to reach the level where companies would lose public aid or be obliged to repay the State. This prediction would also be consistent with the work of Watts and Zimmerman (1986), who argued that companies at risk of political intervention are likely to manage their earnings downwards. We use prior period adjustments to provide novel insights into these two competing views of the drivers of accounting quality in early railway companies.

5. Sample and results

MZA and NORTE were the main railway companies in Spain for decades. Other smaller railway companies also operated, but their reduced dimensions and scope of operations make them difficult to compare with MZA and NORTE. As noted in Comín et al. (1998, pp. 83, 152, 147), in terms of stock capital, MZA and NORTE represented 36% of Spanish railways’ stock capital in 1865, and 52.5% in 1920. In terms of liabilities, jointly they represented 47.7% in 1867,

(a)

PRODUCTOS.

INGRESOS DEL TRAFICO.

Gran velocidad.....	{	Viajeros y trenes especiales..... Equipajes y perros..... Valores, encargos y comestibles..... Coches-correos en los trenes..... Carruajes, ganados y transportes fúnebres..... Diversos, almacenaje y repeso.....
		TOTAL, GRAN VELOCIDAD.....
Pequeña velocidad..	{	Mercancías y transportes de servicio..... Carruajes y ganados..... Diversos.....
		TOTAL, PEQUEÑA VELOCIDAD.....
		Total general del Tráfico.....
Subvencion Córdoba á Sevilla.....		
		Total general.....
INGRESOS FUERA DEL TRAFICO.		
Ingresos varios por alquileres y diversos.....		
		Total general de los productos (1)...
		TOTAL GENERAL DE LOS PRODUCTOS EN LA EXPLOTACION.....
		TOTAL GENERAL DE LOS GASTOS.....
		PRODUCTOS NETOS...
		Intereses sobre obligaciones y amortizacion de obligaciones.....
		Derechos de trasmision sobre acciones y gastos del servicio de pago
		Diferencias de cambio sobre remesas de fondos.....

Figure 3. Example of operating account and prior period adjustments ('Ejercicios Cerrados') (Annual Report, MZA 1878).

Notes: Translation (by authors): *Productos* equals Products, *Ingresos del tráfico* equals Income of traffic, *Gran velocidad* equals High speed, *Viajeros y trenes especiales* equals Travellers, *Equipajes y perros* equals Luggage and Dogs, *Valores, encargos y comestibles* equals Orders, *Coches-correos en los trenes* equals Mail, *Carruajes, ganados y transportes fúnebres* equals Stagecoaches, cattle and funeral transports, *Diversos, almacenaje y repeso* equals Sundry and storage, *Pequeña velocidad* equals Low speed, *Mercancías y transporte de servicios* equals Goods and transport services, *Total General del Tráfico* equals Total of Traffic, *Subvención Córdoba a Sevilla* equals Grant of Córdoba-Sevilla Railway, *Total General* equals General Total, *Ingresos fuera del*

(b) GASTOS.	
ADMINISTRACION CENTRAL Y DIRECCION.	
Consejo de Administracion en Madrid y en Paris.....	
Personal de Direccion y Secretarias, de Sanidad, de Almacenes y de Contabilidad general é Intervencion.....	
Gastos diversos de Direccion y Secretarias, de Sanidad, de Almacenes y de Contabilidad general é Intervencion.....	
SERVICIOS DE LA EXPLOTACION.	
TRÁFICO.	
Personal.....	
Gastos diversos.....	
MOVIMIENTO.	
Personal.....	
Gastos diversos.....	
TOTAL, ADMINISTRACION CENTRAL Y SERVICIOS DE LA EXPLOTACION.....	
SERVICIO DE VIA Y OBRAS.	
Personal facultativo y vigilancia.....	
Gastos diversos.....	
Conservacion de la via.....	
Idem de las explanaciones.....	
Idem de las obras de arte.....	
Idem de los edificios.....	
Idem del material fijo de la via.....	
Renovacion de la via.....	
SERVICIO DE MATERIAL Y TRACCION.	
Personal.....	
Gastos diversos.....	
Conduccion de máquinas.....	
Consumo de idem.....	
Conservacion del material móvil.....	
GASTOS GENERALES.	
Gastos generales por todos los servicios.....	
Ejercicios cerrados.....	
Gastos extraordinarios y complementarios (obras nuevas en las líneas).....	
Total general de los gastos.....	

Figure 3. Continued.

tráfico equals Non-traffic income, *Ingresos varios por alquileres y diversos* equals Non-traffic rents and sundry income, *Total general de los productos* equals Total General Products, *Intereses sobre obligaciones y amortización de obligaciones* equals Interests on bonds and reimbursements, *Derechos de transmisión sobre acciones y gastos del servicio de pago de cupones* equals costs of shares and other expenditures, *Diferencias de cambios sobre remesas de fondos* equals exchange rates differences. *Gastos* equals Expenditure, *Administración Central y Dirección* equals Administration and Management, *Consejo de Administración en Madrid y en París* equals Board of Directors of Madrid and Paris, *Personal de Dirección y Secretarías [...]* equals Management personnel and Administration staff, *Gastos diversos de Dirección y Secretaría [...]* equals Sundry costs of Management and Administration, *Servicios de la Explotación* equals Operating Services, *Tráfico* equals Traffic, *Personal* equals Staff, *Gastos diversos* equals Sundry costs, *Movimiento* equals Movement, *Total Administración Central y Servicios de la Explotación* equals Central Administration and Operating Services, *Servicio de Vía y Obras* equals Railway and Works Service, *Personal facultativo y vigilancia* equals Staff, *Conservación de la vía* equals Railway maintenance, *Conservación de las explanaciones* equals Maintenance of levellings, *Conservación de las obras de arte* equals Maintenance of infrastructures, *Conservación de los edificios* equals Maintenance of buildings, *Conservación del material fijo de la vía* equals Maintenance of fixed stock, *Renovación de la vía* equals Renewal of rails, *Servicio de material y tracción* equals Traction and Rolling Stock Service, *Conducción de máquinas* equals Driving of machines, *Consumo de máquinas* equals Machines consumption, *Conservación del material móvil* equals maintenance of workshop material, *Gastos Generales* equals General Expenditure, *Gastos generales por todos los servicios* equals General Expenditures for all services, *Ejercicios cerrados* equals Closed financial years, *Gastos extraordinarios y complementarios (obras nuevas en las líneas)* equals Extraordinary and supplementary expenses (new infrastructures in railway lines).

and 89% in 1900. In terms of permanent way, MZA and NORTE – individually – outnumbered the kilometres of the other three Spanish railway companies (*Andaluces, Madrid-Cáceres-Portugal* [MCP], and *Madrid-Zamora-Orense-Vigo* [MZOV]). Figure 4 provides a graphical representation of the profitability over time of NORTE and MZA.

We discuss Figure 4 in more detail below, but it is immediately obvious, in Panel A, that the earnings of NORTE and MZA follow a similar pattern. The graphs show parallel and almost overlapping trends during the 80-year period under study. These similarities provide preliminary evidence in line with our argumentation and early justification for the proposed analyses, which build on the idea of common underlying economics. An analysis of Panel A also reveals an increasing trend in the profitability of both firms. This contrasts with Villacorta Hernández (2014), who suggests that during the period 1900–1923 railroad companies were primarily interested in minimising earnings to receive higher subsidies from the State. The graph reveals that with the exception of 1917, and particularly, 1918 (when NORTE reported losses) the profitability of both firms in that period is on average higher than in the rest of the series. Panel B also reveals that the prior period adjustments were both income-increasing and income-decreasing. In the case of NORTE, the adjustments in the first few years of the century appear to suggest that they may have been used to smooth out fluctuations in earnings, but subsequently, they are mostly income-increasing and thus could not have been used to artificially deflate earnings. In the case of MZA, there are no adjustments reported in the period 1900–1923. Panel C provides a representation of the dividends paid. Again, the trends are similar and suggest a positive correlation between earnings and dividends. The data reveal that over the 60-year period 1875–1934, when both NORTE and MZA reported dividends and earnings, the correlation between the earnings reported and the dividends paid is 0.75 for both firms. MZA paid dividends in 52 of those years and NORTE in 40. Their ratios of dividend-to-earnings differed, with MZA having a mean (median) ratio of 0.69 (0.67) and NORTE of 1.32 (0.95), suggesting that NORTE used reserves throughout the period to pay dividends,²⁰ again emphasising the relevance of dividend payment. Indeed, NORTE set aside part of its earnings for ‘Contingency Reserves’ with the aim of ‘ensuring the stability of dividends’ (Annual Report NORTE 1910, p. 6).

Next, we describe the accounting practices of NORTE and MZA. To analyse them, we manually collect their financial statements (henceforth, annual reports) from the Railway Library of the Spanish Railway Foundation. We start our sample when these companies were first created and end it in 1939, after the Spanish Civil War and the *nationalisation* phase.

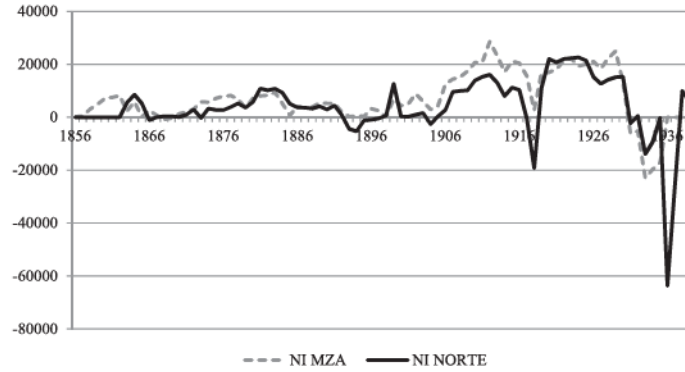
5.1. Accounting quality in MZA

MZA used replacement accounting, defined in Arnold and McCartney (2002, p. 195) as consisting in the recognition of fixed assets in the Capital Account at cost, and then, annually recognising in the Operating Account the expenses associated with repairs, improvements, replacements, etc. Replacement accounting is different from recording accounting depreciation. In analysing MZA historical documents, we have found references that could induce confusion on whether the company accounted for depreciation:

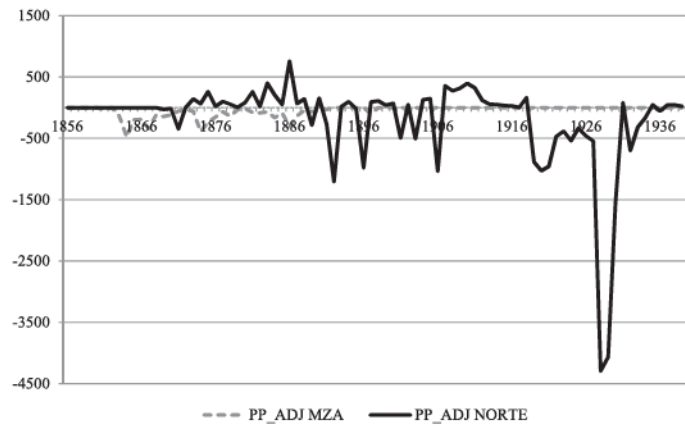
Regarding the inventory write-off of 13 service machines, this operation finalizes the liquidation of our rolling stock. [...] We expect to continue with a similar procedure and amortize these 13 machines through the Operating Account, distributing it over four periods. (Annual Report MZA 1887, p. 5)²¹

This could be evidence of an attempt to account for the depreciation of fixed assets, as it suggests that the write-off of machinery was distributed over time. However, it is difficult to evaluate this evidence, as no further evidence is available, and no entries have been retained. Beyond this

Panel A: Net Earnings/Income (NI) (MZA 1858-1935; NORTE 1860-1939)



Panel B: Prior period adjustments (PP_ADJ) (MZA 1858-1935; NORTE 1860-1939)



Panel C: Dividends (DIV) (MZA 1858-1935; NORTE 1960-1939)

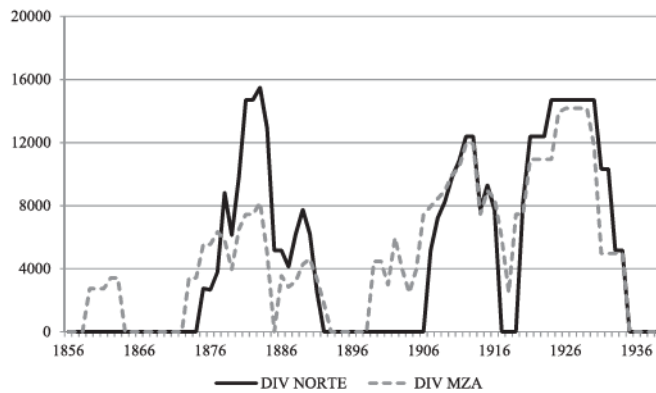


Figure 4. MZA & NORTE evolution. Panel A: Net Earnings/Income (NI) (MZA 1858-1935; NORTE 1860-1939). Panel B: Prior period adjustments (PP_ADJ) (MZA 1858-1935; NORTE 1860-1939). Panel C: Dividends (DIV) (MZA 1858-1935; NORTE 1960-1939). Note: All figures are in Thousand Pesetas.

3.º La Junta general acuerda que de la cuenta de «Ganancias y Pérdidas» se destine la cantidad de 5.600.000 pesetas á la amortización de material móvil, y que el saldo de la misma, previo pago de los impuestos, se aplique al «Fondo para obras de mejora».

Figure 5. Agreements (Annual Report, MZA 1910).

Notes: Translation (by authors): Agreements. 3.º The General Meeting agrees that from the 'Profits and Losses' account the amount of 5.600.000 pesetas is destined to the amortisation of rolling stock, and that the balance thereof, after payment of taxes, is applied to the «Fund for improvement works».

single comment, the common practice of MZA was to create an annual reserve 'for the depreciation of rolling stock' (see Figure 5, Annual Report MZA 1910). This practice existed from 1907 to 1923, except for 1918, when the low profit did not allow increasing the reserve. During these years, the reserve referred only to the rolling stock, with the exception of the Annual Report of 1911 (p. 15) that, in discussing profit distribution, refers not only to the annual 'depreciation reserve for rolling stock' but also to the 'depreciation reserve for permanent way.' This practice of annually increasing a reserve, and to charge against annual earnings the expenses associated with repairs, renewals, and replacements was common in UK railway companies during the 1830s and 1840s, but our evidence suggests that it continued in Spanish railway companies many decades later.

Rarely did the annual reports provide information about the final destination of those depreciation reserves, and thus, it is difficult to know if they constituted an early form of depreciation. When the destination is mentioned, the explanations seem to suggest these funds were used to cover expenses associated with track renovations, substitutions, bridge repairs, maintenance, etc., as evidenced in the Annual Report of 1912: 'in the old track, against the rolling stock depreciation reserve, we have undertaken 34.4 km of track renovations, substituting tracks of 30kg for others of 40kg per lineal metre, [...] and substituting the screws for bolts' (Annual Report MZA 1912, p. 8). Another practice that was also common was to provide information about the current state of the rolling stock, separating, among other, the material currently in use, from the one not in use because of poor conditions, or because the material was destroyed and not replaced (Annual Report MZA 1869, p. 23). In Britain, the Railway Act of 1868 made it mandatory for railway companies to include not only this type of information, but also to include engineering certificates in the annual reports. These certificates should confirm if the rolling stock and permanent way were in perfect state to function, and to provide information on any repairs conducted in the period (Edwards 1986, p. 258).

The above evidence is certainly not clear-cut, and could have different interpretations, but overall, we interpret it as suggesting that MZA did not account for the depreciation of its rolling stock or permanent way as expenses, and that serious doubts exist over the aforementioned depreciation accounting for rolling stock as an annual reserve during the period 1907–1923, given the evidence discussed that those amounts were allocated to a fund for improvement works. This is surprising given a number of reasons. First, NORTE did account for the depreciation of its fixed assets as we will show below. Second, given the French influence in the management of the company, one could expect to observe depreciation, as it was a common practice in France. Finally, depreciation (or at least a primitive form) was known in Spain, as there are news reports in the press dating back to 1884 that comment on the concept and its calculation (see Figure 6, where we provide an extract from the 1884 weekly publication *Gaceta de los Caminos de Hierro*). The Law of 1906 also evidences that accounting depreciation was already commonly known at that time (*Ley de Utilidades de 1906, Gaceta de Madrid, 266, 23 September*) because it established 5% as a maximum rate of depreciation. Subsequently, the

Aceptado, pues, el tipo de 1'00 pesetas para representar los gastos de explotación por kilómetro de tren, los del camino que hemos tomado como ejemplo, con el número de trenes que hemos supuesto lo recorrerían al día, ascenderán por año á

$$80 \times 4 \times 365 \times 1 \text{ pesetas} = 73.000 \text{ pesetas.}$$

ó sean 1'460 pesetas por kilómetro de vía.

Amortización del material.—Segun hemos visto antes, el material fijo representará aproximadamente un capital de 13.000 pesetas por kilómetro y el móvil y accesorio 4.000 ó sea en total 17.000 pesetas por kilómetro.

Adoptando barras-carriles de acero, con el poco tráfico que habrá en los ferro-carriles de que tratamos, puede suponerse, cuando menos, á los materiales de la vía una duración media de 30 años, tomando en consideración los resultados obtenidos en líneas de gran tráfico con carriles de dicha clase. Si del coste primitivo de la vía restamos una quinta parte para tener en cuenta el valor de los materiales de deshecho, su amortización representará una anualidad de 346 pesetas por kilómetro, prescindiendo del interés que puedan ir ganando estas sumas á medida que sean reservadas.

Figure 6. Annual depreciation calculation of Mallorca Railway Company (*Ferrocarril de los Caminos de Hierro de Mallorca*). Source: *Gaceta de los Caminos de Hierro*, Year XXIX, n° 51, 21-Dec (1884, p. 807). Notes: Translation (by authors): Accepted, then, the rate of 1'00 pesetas to represent the operating expenses for each kilometre of railway, those of the railway we are considering as an example, given the number of trains we have considered that would circulate per day, we would have, for the year: that is, 1'460 pesetas per kilometre of railway. *Depreciation of the stock*—As noted above, the fixed assets (stock) represents approximately a capital of 13,000 pesetas per kilometre, and the rolling assets (stock) 4,000, that is, a total of 17,000 pesetas per kilometre.

Adopting steel railroad ties, and given the limited traffic of the railways under consideration, we can suppose, at least, that the materials of the track may have an average duration of 30 years, taking into consideration the results obtained from railway lines with greater traffic and steel railroad ties. If we detract from the initial cost of the railway track a fifth of its value, to consider the value of unusable/waste materials, the depreciation would be 346 pesetas per kilometre, without considering any interest that may increase these amounts as they are accumulated.

Law of 1920 (*Gaceta de Madrid*, 121, 30 April) eliminated this maximum, allowing discretion in determining depreciation coefficients (Villacorta Hernández, 2014, p. 4).

With regard to the prior period adjustments, MZA records '*Ejercicios Cerrados*' within the expenses recorded in the Operating Account in the years 1861, 1863–1891 and 1897. Despite this being a common practice for many years, the annual reports did not provide any explanation about these accruals. This is of interest, as MZA did often provide further information on other line items, as can be seen in Figure 7, where we show three examples of disclosure surrounding errors, lack of information and use of judgment by MZA. This highlights the lack of transparency surrounding prior period adjustments. An important regularity of these adjustments is that throughout the period, they were always expenses, i.e. they debited income directly, and not

(a)

Bloqueado París hasta Febrero del corriente año é interrumpidas nuevamente las comunicaciones en Marzo, la ultimacion de las cuentas referentes al segundo semestre de 1870 no ha podido tener lugar en el corto espacio de tiempo aprovechable para este fin: de modo que para poder hoy someter á la Junta los ante expuestos resultados, hemos debido, para ciertas partidas variables, adoptar cálculos aproximados que, aunque sujetos á rectificaciones cuando llegue la rendicion de cuentas definitiva, no pueden, á nuestro juicio, experimentar alteraciones de importancia.

(b)

Intereses de 726.192 obligaciones (en nuestra anterior Memoria, dijimos por un error de cálculo:
726.095), á 57 reales. Rvn. 41.592.944
amortizacion de 1.950 obligaciones, á 1.900. 3.705.000

TOTAL. Rvn. 45.097.944

(c)

Total general de los Gastos..... 46.567.009 88

(f) NOTA. El gasto de la Pagaduría figura en este total, y el año anterior figuró en Direccion de la explotación.

Figure 7. Example of disclosure practices of errors and uncertainty, MZA. (a) Example A: MZA Annual Report (MZA 1871, p. 9), (b) Example B: MZA Annual Report (1868, p. 21), and (c) Example C: MZA Annual Report (1869, p. 37).

Notes: Translation (by authors): Example A: 'Blocked Paris until February of this year and interrupted anew the communications in March, the finalisation of the accounts of the second semester of 1870 has not taken place given the short space of time available: thus, to submit the results to the approval of today's General Assembly, we have to, for some accounts, adopt approximate calculations that, even though subject to rectifications on final reporting of the accounts, will not, in our judgment, experience significant changes.' Example B: 'Interests of 726,196 debt securities (in our previous Report, due to a mistake in calculations we reported: 726,095), of 57 reales each Rvn. 41,392,944, amortization of 1,950 debt securities, of 1,900 each ... 3,705,000. TOTAL Rvn. 45,097,944.' Example C: 'Total general Expenditure 46.567.009- 88. (1) NOTE. The "Pagaduria" ("Payment") expenditure is included in this total, while it was included in Operation Management the previous year.'

reserves. Figures 2 and 3 contain examples from the financial statements of MZA; in particular, they show the Operating Account of 1876 (Figure 2) and 1878 (Figure 3, where Figure 3(a) shows the revenues/profits and Figure 3(b) the expenses/losses). It can be seen that the prior period adjustments appear under General Expenses and before the bottom line ('Total general de los gastos' / Total expenditure).

5.2. Accounting quality in NORTE

Interestingly, we find that, for the case of NORTE, the accounting for depreciation and for prior period adjustments is very different from MZA, already suggesting that managerial choice may have played an important role in shaping accounting quality. In particular, the prior period adjustments appear every year, for varying amounts and with different signs, since first reported in 1869 (concurrently with their appearance in MZA) as 'balance of diverse revenues and expenses from

prior periods.' Even though we cannot always find details of the revenues and expenses considered, the evidence suggests that they were, indeed, of diverse nature. It also suggests that it recorded both accruals (such as write-offs of credits) as well as cash-based transactions (payments to the State).

For example, in the Annual Report of 1906 NORTE explains:

the credit balance of this account in 1906 results from recording the renting of stock from the Madrid-Zaragoza-Alicante Company during the period from August 1904 to the end of 1905, and also, from writing-off a number of debts which have been considered as uncollectable.

In the Annual Report of 1919–1926 and 1936 the explanations given are as follows: '[...] mainly reflects payments of prescribed coupons and titles whose owners justified the impossibility of timely perceiving the payments due to force majeure.' Whilst in the Annual Report of 1928, 1929, 1930, and 1935 this account reflects transactions with the State. In the first case, it is noted that 'it increased mainly because the State demanded the payment of rectifications from settlements of prior periods, and for the important sum we had to pay, as noted in the preamble to these statements, as down payments to employees.' Similarly, the lower balance in years 1929 and 1930 is justified '[...] by the lower payments made to the State for liquidations from prior periods.' In 1935 the balance decreases 'mainly because of lower payments of prior period liquidations of profits.' The last reference to this account appears in the Annual Report of 1937, where it is explained that 'the balance of this account reflects rectifications of employee payment transactions prior to 1932.'

To sum up, the amounts vary almost annually, but also the nature of the transactions accounted for under this concept. It would appear that this account was used to hide or dump expenses, which given the tone of the explanations provided by NORTE, appear to have been considered by management as extraordinary or non-recurrent at the time, and thus, are akin to early strategies of income-shifting of expenses. The origin of this account may be the 'expenses to classify' account (*gastos por clasificar*) which appeared in the Annual Reports of 1864, 1865 and 1866 listed among the assets in the Capital Account, without explaining its content. This account disappeared subsequently, which may indicate that it was a Suspense Account, although we have no means of verifying whether that was the case.

With respect to depreciation, NORTE did account for depreciation albeit not every year, and the terminology used varies, without real explanation as to the reason for these changes in amounts and concepts. Table 2 summarises the depreciation policy between 1858 and 1917, which is the last year when NORTE refers to it. The evidence suggests that managerial discretion influenced the depreciation policy, which, in turn, led to variation in the information reported on operating profits during the period. Concerns about the payment of dividends may have driven this behaviour, consistent with our above discussion. In particular, in 1917, NORTE reported losses, and from that moment forward the depreciation expense was no longer allocated, claiming that 'the results of the financial year did not permit it' (Annual Report NORTE 1917). In spite of the fact that during the period 1919–1930 the results were again profits, the company did not resume the depreciation practice, however, NORTE continued paying dividends until 1934, even in years of losses (1931 and 1934) and with increasing pay-out ratios.²²

The ever-changing depreciation policy did not go unnoticed. In 1927, the stock value of NORTE increased substantially. This led to a reaction from the Government when it became known that the price increase was driven by the intention of both firms (NORTE and MZA) to distribute dividends of 6% of stock nominal value. The Council of Ministers, in a note published in August of 1927, expressed its opposition to this measure.

Table 2. Accounting for depreciation (NORTE).

Year	Concept	Amount
1858–1877	–	–
1878–1881	Annuity for renovation of track and material	380.000 RV
1882–1885	Idem	95.000
1886–1887	Idem	190.000
1888	Idem	51.581.22
1889–1896	Annuity for the depreciation of reformed rolling stock	175.000
	Annuity for the renovation of track and permanent stock	51.581.22
1897	Annuity for the renovation of track and permanent stock	51.581.22
1898	Depreciation of rolling and traction stock	3.801.480.72
1899	–	–
1900	Wear and tear of material because of use	3.468.010.85
1901–1902	–	–
1903	Depreciation of 1% of engine and transportation materials	981.156.94
1904	–	–
1905	Depreciation of 0.4% of engine and transportation materials	410.490.4
1906	Depreciation of 5% of engine and transportation materials	5.169.296.83
1907	Depreciation of 5% of rolling and engine stock	5.346.527
1908	Depreciation of 5% of material	5.602.951.25
1909	Depreciation of 5% of material	5.931.068.42
1910	Depreciation of 5% of material	6.186.955.22
1911	Depreciation of 5% of material	6.512.956.56
1912	Depreciation of permanent stock 3.5% Depreciation of rolling stock 5%	11.459.766.2
1913	Depreciation of permanent stock 1.25% Depreciation of rolling stock 5%	9.340.360.77
1914	Depreciation of permanent stock 1.25% Deprec. Rolling St. 5%	5.901.344.53
1915	Depreciation Permanent St. 1.25% Depreciation Rolling St. 4%	8.909.327.14
1916	Deprec. Permanent St. 1% Deprec. Rolling St. 3%	6.501.378.67
1917	In page 8 of the Annual Report we find: ‘the credits amount to [...] without including any amount for depreciation as the profits of the period are insufficient to permit this charge.’	

Note: Unless otherwise indicated, amounts are in Spanish peseta. RV stands for Reales de Vellón.

Unless profits can justify it, they should first be used to pay the State, as the major creditor of large sums given as subsidies or down payments during the period when railway companies have been poorly managed or did not account for their real profits, continuously hounding the military government with their requests, that the previous government reduced and the current one has eliminated. (Peña and Pérez 1940, p. 109)

This also substantiates our arguments of government monitoring and general suspicion that managerial decision-making affected reported levels of earnings.

5.3. Analysis of earnings persistence

The sample used in the earnings persistence analyses comprises a maximum of 156 firm-year observations, albeit sample sizes vary for some tests. For MZA we have data from 1856 to 1935 (1936, 1937, 1938, and 1939 were published in a single Annual Report and cannot be annualised). For NORTE, we have data from 1860 to 1939, with the exception of 1867 (in that year, the Annual Report is a rebalancing plan).²³ To calculate model (1), we obtain MZA and NORTE’s annual earnings and prior period adjustments. Because MZA did not depreciate its fixed assets by recognising expenses, we cannot use depreciation in our persistence tests. Earnings are calculated as the difference between income and expenses (including both operating and

financial expenses). In other words, earnings are the distributable net result.²⁴ The net earnings are expressed in thousands of *Reales de Vellón* (Rs.Vn.) first, and later in *pesetas* (PTA). We use the official conversion rate to transform Rs.Vn. into PTA. In our models, we incorporate a dummy variable (VELLON) that takes the value of 1 if the numbers are originally expressed in Rs.Vn.; 0 otherwise.²⁵

Table 3 presents descriptive evidence of sample variables. Both MZA and NORTE were profitable firms during the period considered (see also Figure 4, Panel A), although 23 observations (17%) correspond to loss periods (MZA reported losses in 7 years, and NORTE in 16 years). These losses are accumulated in the start-up phase (1856–1874) and, particularly, in the institutionalisation phase (1919–1935), consistent with the explained historical context. In this last phase, 36% of years are loss-making years. Table 3 also reveals that the prior period adjustments are material. On average, they represent 5.7% of earnings, with a minimum adjustment of –287.9% and a maximum of 104.1%. Albeit they are on average negative (–2.7% in MZA; –8.9% in NORTE), only NORTE had both income-increasing and income-decreasing adjustments. In MZA the adjustments were consistently income-decreasing. This is evidence of heterogeneous use of the adjustments. In particular, and for MZA, if we assume that managers would prefer to report positive earnings, the adjustments never serve to increase earnings, as all adjustments are income-decreasing in nature. In the case of NORTE, 65% of the adjustments are

Table 3. Descriptive evidence.

Variable	Obs	Mean	Std. Dev.	Min	Max
Panel A: Full Sample					
Net earnings	159	5868.67	10800.00	–63700	28500
Prior period adjustments	159	–135.912	559.11	–4296	758.929
Adjusted earnings	159	5996.30	10600.00	–63700	28500
POS_ADJ	159	0.277	0.449	0	1
%ADJ	159	–0.057	0.331	–2.879	1.041
VELLON	159	0.315	0.466	0	1
Panel B: MZA					
Variable	Obs	Mean	Std. Dev.	Min	Max
Net earnings	80	7477.74	9583.77	–23000	28500
Prior period adjustments	80	–53.35	96.44	–476.561	0
Adjusted earnings	80	7529.75	9565.91	–23000	28500
POS_ADJ	80	0.000	0.000	0	0
%ADJ	80	–0.027	0.162	–1.270	0.394
VELLON	80	0.321	0.470	0	1
Panel C: NORTE					
Variable	Obs	Mean	Std. Dev.	Min	Max
Net earnings	79	4239.23	11700	–63700	22600
Prior period adjustments	79	–226.62	797	–4296.083	758.929
Adjusted earnings	79	4442.89	11500	–63700	23200
POS_ADJ	79	0.557	0.470	0	1
%ADJ	79	–0.089	0.448	–2.880	1.041
VELLON	79	0.310	0.465	0	1

Notes: Descriptive evidence of MZA and NORTE. The data for MZA covers the period 1856 to 1935, the data for NORTE covers the period 1860 to 1939. *Net Earnings* is net income for the period. *Prior Period Adjustment* is prior period net income adjustments as reported under ‘closed exercises’ line items. *Adjusted Earnings* is earnings before the adjustment, calculated by subtracting the Prior Period Adjustments from Net Earnings in period *t*. *%ADJ* is the ratio of *Prior Period Adjustments* over *Net Earnings*. *POS_ADJ* is a dummy variable that takes the value of 1 if the *Prior Period Adjustment* is income-increasing, 0 otherwise. *VELLON* is a dummy variable that takes the value of 1 if the data belongs to a period when numbers are originally reported in Rs.Vn.; 0 otherwise.

income-increasing (i.e. earnings are higher *because* of the adjustment). This is early evidence of income-increasing earnings management in NORTE, whilst the evidence in MZA is puzzling in the sense that if these adjustments reflect information that arrives late, due to logistical difficulties or lack of knowledge/proper accounting, why would these adjustments be always income-decreasing? Reason dictates that at least in some cases, MZA may have failed to reflect not only expenses, but also prior period revenue.

As noted above, we interpret that earnings persistence indicates a systematic application of accounting principles, and thus, reflects accounting reliability and quality. In our sample, the underlying economics are shared by NORTE and MZA, and they both operate in the same industry and are of very large size, therefore, we expect to observe similar earnings persistence. Although we make no predictions about the size of the persistence coefficient β_1 , to the extent that accounting numbers were not reliable, we would expect to observe reduced earnings persistence (lower persistence coefficient β_1 and also, lower Adj. R^2).

Tables 4 and 5 present the results of running our persistence models for the full sample, and then, separately for MZA and NORTE. Table 4 shows the evidence of running model (1), with E as our dependent variable. Because earnings are positively skewed, we log transform it. Panel A presents results for the full sample first without controls, and then, with controls.²⁶ The evidence

Table 4. Regression results.

	Main model			Main model (with controls)		
	Coef.	Std. Err.	$P > t$	Coef.	Std. Err.	$P > t$
Panel A: Full sample (Dependent variable = E_t)						
E_{t-1}	0.633	0.066	0.000	0.615	0.071	0.000
VELLON				2.933	2.592	0.260
Start-up				-3.964	5.459	0.469
Expansion				0.115	4.794	0.981
Consolidation				0.595	4.853	0.903
Institutionalisation				-1.363	4.767	0.775
Intercept	3.796	1.017	0.000	6.315	0.100	0.000
N			156			156
F			90.58			15.51
Adj R^2			0.366			0.360
Panel B: Prior period positive (income-increasing) adjustments (Dependent variable = E_t)						
E_{t-1}	0.738	0.085	0.000	0.700	0.088	0.000
POS_ADJ	1.498	2.077	0.477	-0.047	2.265	0.984
E_{t-1} *POS_ADJ	-0.286	0.135	0.036	-0.270	0.137	0.052
VELLON				3.243	2.554	0.206
Start-up				-3.607	5.475	0.511
Expansion				0.737	4.779	0.878
Consolidation				1.501	4.827	0.756
Institutionalisation				-1.190	4.843	0.806
Intercept	2.946	1.298	0.022	3.046	4.671	0.515
N			156			156
F			32.64			12.89
Adj R^2			0.379			0.380

Notes: Panel A presents regression results of running model (1) for the full sample, and then, Panel B of introducing the effects of prior period adjustments, for the period 1856–1939. E is the natural logarithm of *Net Earnings* (net income) for the period t . *POS_ADJ* is a dummy variable that takes the value of 1 if the *Prior Period Adjustment* is income-increasing, 0 otherwise. *VELLON* is a dummy variable that takes the value of 1 if the data belongs to a period when numbers are originally reported in Rs.Vn.; 0 otherwise. *Start-up* identifies the period 1856–1873; *Expansion* the period 1874–1899; *Consolidation* the period 1900–1919, and *Institutionalisation* the period 1919–1935.

Table 5. Regression results by firm.

	Dependent variable = E_t		Dependent variable = $EBADJ_t$		
	Coef. (p -value)	Coef. (p -value)	Coef. (p -value)	Coef. (p -value)	
Panel A: MZA					
E_{t-1}	0.841 (0.000)	0.793 (0.000)	EBADJ_{t-1}	0.842 (0.000)	0.794 (0.000)
Controls	No	Included	Controls	No	Included
N	79	79	N	79	79
F	119.77	24.55	F	120.08	24.62
Adj R^2	0.604	0.602	Adj R^2	0.604	0.602
Panel B: NORTE					
E_{t-1}	0.513 (0.000)	0.501 (0.000)	EBADJ_{t-1}	0.428 (0.000)	0.406 (0.000)
Controls	No	Included	Controls	No	Included
N	77	77	N	77	77
F	25.08	4.44	F	15.85	2.95
Adj R^2	0.241	0.214	Adj R^2	0.163	0.133

Notes: Regression results of running model (1) separately for MZA and NORTE, for the period 1856–1939. E is the natural logarithm of *Net Earnings* (net income) for the period t . $EBADJ$ is the natural logarithm of net income for the period t before the prior period adjustments. Untabulated controls include the following variables: *VELLON* is a dummy variable that takes the value of 1 if the data belongs to a period when numbers are originally reported in Rs.Vn.; 0 otherwise. *Start-up* identifies the period 1856–1873; *Expansion* the period 1874–1899; *Consolidation* the period 1900–1919, and *Institutionalisation* the period 1919–1935.

suggests earnings, overall, were highly persistent (Coeff. = 0.633, p -value < 0.01 for the full sample, Adj. R^2 of 0.366).²⁷ The results are similar when we add controls for the underlying economics (phases of the historical context); overall, these coefficients are not significant, and indicate that differences in profitability across phases do not drive the results. Interestingly, the results suggest a high level of persistence, comparable to current evidence in Dichev and Tang (2009). This facilitates interpreting the findings, although direct comparisons are of course not possible.

Table 4 Panel B shows results from modifying model (1) by interacting with a dummy that identifies years with income-increasing adjustments (POS_ADJ). The persistence coefficient is still positive and significant (Coeff. = 0.738, p -value < 0.01), and indicates greater persistence, and potentially quality, in years *without* adjustments. The interaction coefficient is significantly negative ($E*POS_ADJ = -0.286$, p -value = 0.04). Overall, this appears to indicate that the adjustments lower earnings persistence and, thus, accounting quality. The results are not sensitive to the inclusion of additional controls, or to the (untabulated) addition of a firm fixed effect.²⁸ Given that MZA adjustments are persistently income-decreasing, this result would be highly correlated with a dummy identifying NORTE, although the results indicate that it is in the years when the adjustments are income-increasing that we observe a decrease in earnings persistence. To better understand the earnings persistence of NORTE and MZA and the consequences of the adjustments, we look at the two firms separately.

Table 5 reports results of the running model (1) separately for MZA (Panel A) and NORTE (Panel B), first without controls (column 1) and then, with controls (column 2). We find evidence of different persistence. In particular, we find higher persistence in MZA (Coeff. = 0.841, p -val < 0.01, Adj. R^2 of 0.604) than NORTE (Coeff. = 0.513, p -val < 0.01, Adj. R^2 of 0.241). The difference between these coefficients for MZA and NORTE is statistically significant both in the main model (t -value for difference = 2.30; p -val = 0.023), and in the model with controls (t -value for

difference = 2.06; p -value = 0.041). This provides a compelling and contrasting picture, once again indicating that accounting was of heterogeneous quality across railway companies. NORTE and MZA were affected by common economic and country-wide effects, and had similar operating, financing and investment frameworks. Such large differences in accounting quality can then be attributed to the internal accounting information system in place in each firm, as well as to firm-specific characteristics.

To interpret our findings, we must take into account the historical context, and also, be cautious in reaching conclusions, as we are applying a modern concept of reliability. In further tests, we rerun model (1), but using earnings before adjustments (EBADJ) as our dependent variable. EBADJ is calculated by removing the prior period adjustment from earnings. Table 5 (columns 3 and 4 in both panels) presents the results obtained. Again, because EBADJ is positively skewed, we log transform it before running our models. As before, we find evidence of earnings persistence in all model specifications, and differences between NORTE and MZA both in the main model (t -value for difference = 2.81; p -value = 0.006) in column 3, and in the model with controls (t -value for difference = 2.61; p -value = 0.010) in column 4. The coefficients of earnings persistence in MZA change little with respect to those reported in columns 1 and 2, whilst the difference is larger for NORTE, we find a change in the coefficient, which is reduced to 0.406 in the full model (Adj. R^2 of 0.133) when we eliminate the adjustments. This could be explained because in MZA the adjustments appear in fewer years, they are systematically negative and of a lower magnitude (on average 2.7% of earnings, whilst in NORTE they represent 8.9% of earnings). This suggests that the adjustments affected accounting quality more in NORTE than in MZA. Although we must be necessarily cautious in interpreting this evidence, the results overall suggest that managerial decision-making shaped accounting quality.

6. Summary and conclusions

We provide novel evidence on the quality of railway accounting during the late nineteenth and early twentieth centuries, by studying accounting in the two major Spanish railway companies (NORTE and MZA) from when they were first incorporated (1856) until the end of the Spanish Civil War (1939). We study the quality of accounting information in two main ways. First, we analyse, for these eight decades and both companies, the earnings figures as well as two major accruals: depreciation and prior period adjustments. Second, we study the statistical persistence of earnings and of these accruals, first aggregating the data, and then, comparing the companies.

The evidence suggests that there are important differences between the two firms in accounting practices, which cannot be explained by differences in the underlying economics. We find differences in the accounting for depreciation and prior period adjustments, two accruals that reflect managerial accounting choices. Overall, we interpret this as evidence of managerial discretion. In particular, we use the persistence analyses to provide insights that may help to disentangle managerial opportunism from the extent to which accounting responded to a lack of knowledge or an underdevelopment of accounting frameworks. Our underlying assumption is simple: if errors or lack of knowledge drive accounting choices, we should not observe any systematic biases in the data. To the extent that intentional choice underlies accounting outcomes, the reported numbers will show systematic differences, both between firms, and when removing accruals from reported figures. We find evidence of both.

Regarding the analyses of accruals, and focusing first on depreciation, we find that MZA did not account for depreciation, showing higher profitability as a consequence. Such systematic 'forgetfulness' may not be justified as a lack of accounting knowledge, or a lack of managerial expertise. It cannot be argued that depreciation was not known by MZA, since we provide evidence that depreciation techniques and calculations were discussed even in the financial

press as far back as in 1884. In fact, NORTE, the competing firm, depreciated its assets (even though the practice was not systematic). Second, the managerial team could be presumed to have expertise, since the managers of MZA belonged originally to the Rothschild family. This family had ample experience in running railway, banking and mining firms across Europe. Thus, we must reject, for the case of MZA, the reasoning underpinning some prior research that accounting practice was justified by lack of either accounting knowledge or managerial expertise (see, e.g. Mason 1933, Pollins 1952a, 1956, Pollard 1965, Gourvish 1970, Edwards 1986, Perelman 1997, Arnold and McCartney 2002, Toms and Shepherd 2013). The study of depreciation and its evolution is not an easy task, given the ambiguity caused by the lack of a unique and precise nomenclature, as noted in Edwards (1986). Despite this, we do find evidence that NORTE accounted for depreciation but stopped when it presented losses. Subsequently, when it returned to profit, NORTE did not restart depreciating its assets. This abandonment by NORTE is similar to those described in Edwards (1986) and Gourvish (1970) for British railway firms during the railway-mania of 1845–1847. Thus, NORTE may have also managed its profits in the last decades of our analyses, by stopping its depreciation.

Regarding the second accrual studied: the prior period adjustments, presenting this accrual in the Operating Account could be a signal of conceptual and normative underdevelopment (other indicators are described in Pollins 1956, Gourvish 1970, or Lee 1975). This may be driven by the lack of governmental regulation on how to calculate profits (McCartney and Arnold 2003). Prior period adjustments were income-decreasing for 31 years in MZA. This is surprising, because to the extent that this accrual captures adjustments from prior periods, it could be expected that, in some years, it would have been income-increasing. The analysis of persistence suggests this accrual did not have a significant impact on the time-series properties of MZA earnings. Thus, we expect that MZA reports this accrual in the Operating Account because it did not know of any alternative way without affecting current earnings. Regarding NORTE, this accrual also exists, and indeed, represents both income-increasing and decreasing adjustments, as could be expected given its nature. The analysis of persistence suggests that, in this case, NORTE used this accrual to increase earnings in some periods, and overall, to smooth earnings, which is in line with a deliberate attempt to manage earnings.

Therefore, even though Villacorta Hernández (2014) suggests that in the period 1900–1923 the objective of railway companies was to minimise earnings, our view is that MZA and NORTE did not minimise earnings during the early twentieth century. In fact, the evidence suggest the opposite. They reported profits when the real earnings should have probably been losses in a number of years. On the one hand, both companies avoided recording expenses (i.e. depreciation) to report a level of profit that allowed them to distribute dividends. First, NORTE stopped recording depreciation expenses from 1917 onwards, and MZA directly never recorded them. Second, NORTE did not record the State's advanced payments as expenses,²⁹ and MZA recorded it simultaneously both as expenses and revenues in the income statement, thus without impact on earnings. Third, MZA stopped recording the prior period adjustments, which had been negative (income-decreasing), from 1898 onwards. On the other hand, we agree that the margin of profit had to be enough to distribute dividends, but not as high as to signal that railways did not need to receive public funds. To that end, we believe NORTE could have indeed used negative adjustments to report the level of earnings that would allow maintaining dividends and at the same time, not looking so profitable that the State would withdraw its support.

Overall, our evidence suggests these practices aimed to alleviate the expenses and increase earnings simultaneously, to pay a significant dividend and keep a level of earnings that would

not make the State stop providing public funds. Along the twentieth century, MZA and NORTE did not record all the real expenses, meaning that the distributed dividend likely contributed to equity depletion. Our thesis supports the reflection made by the report of the first auditory in the Spanish railway sector (1923), which considered that railway companies could not justify the need for further public funds to attend the operating expenses, whilst they were paying dividends and increasing the reserve funds (Peña and Pérez 1940, p. 109).

Existing literature defends the thesis of a lack of reliability in accounting numbers of railway companies during the nineteenth and twentieth centuries. A common explanation for this lack of reliability is the lack of a conceptual framework for accounting, suggesting management did not attempt intentionally to manage accounting figures. In the studied firms, MZA and NORTE, we document this lack of a conceptual framework, but also, what clearly appears to be systematic and purposeful managerial decision-making within the accounting process, which cannot be explained away by random behaviour driven by lack of knowledge and the spurious application of underdeveloped accounting criteria. Particularly for the case of NORTE, we document a number of practices consistent with manipulation, whilst the case of MZA is less evident, as the documented practices are more evasive in nature and suggestive of deliberate ignorance. In neither case do the documented practices appear consistent with lack of accounting knowledge or with lack of managerial expertise. In both cases, the evidence suggests that both MZA and NORTE managers intervened in the accounting process, potentially, to maintain profitability and dividend payments, consistent with the thesis in Edwards (1989, p. 167), who identified pressures from shareholders to receive dividends as an important reason underpinning the manipulation of financial statements in railway companies.

An important caveat is that we use a statistical analysis of earnings persistence to derive conclusions about accounting quality. There are many challenges and limitations of applying a modern concept such as earnings persistence to a historical case. Thus, our evidence must be interpreted with significant reservations and we are careful in drawing our conclusions. Indeed, given the evidence presented on the development of the accounting system during the period studied, the question arises of how earnings persistence analyses can provide insights into accounting quality. We interpret the development of accounting as referring to the accounting regulations and institutions that exist at a point in time in a given economy and that drive the bounds (or limits) of discretion. Under no regulation and absent discretion, the distance between bounds could be narrow, if managers are less aware of the plausible accounting options, and just use common knowledge to guide their choices. However, assuming discretion, these bounds could be far apart if each firm develops its accounting system without reference to any common background, as they could come up with idiosyncratic accounting treatments. Underdevelopment means that the absolute range of earnings persistence values is unknown, and thus, we focus most of our analyses on relative persistence. That is, rather than try to drive conclusions from the absolute level of persistence observed, we are interested in comparing persistence across firms. The study of persistence can then provide an understanding of differences in accounting quality across firms. The work of Sivakumar and Waymire (2003) uses measures of income smoothing and conservatism to study accounting quality in early twentieth century railroads in the US. This is in the spirit of our analyses and suggests that such methods can be useful in historical contexts.

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Disclosure statement

No potential conflict of interest was reported by the authors.

Notes

1. MZA is the acronym for *Compañía de los ferro-carriles de Madrid a Zaragoza y a Alicante*. NORTE is the acronym for *Compañía de los caminos de hierro del Norte de España*.
2. Bryer (1991, p. 449) points out the depreciation accounting of rolling stock was the ‘modal practice’ of railway companies in the early 1840s, but Edwards and Boyns (1994, p. 1177, fn. 10) and Arnold and McCartney (2002, p. 206) affirm that just a minority of companies charged depreciation on the track.
3. The word ‘mania’ is used frequently to refer to ‘the elated phase an inherently unstable alternation between excessive optimism and pessimism’ (Bryer 1991, p. 439, quoted in McCartney and Arnold 2003, p. 822). There were three booms of investments in UK best known as railway-mania: 1824–1825, 1835–1837, and 1845–1847.
4. Garcke and Fells (1893, pp. 95–96), Matheson (1893, p. 5) or Dodd (1895, p. 61) [in Edwards (1986, p. 206)].
5. See also Flesher and Previts (2009) for an excellent review of the literature on US railway companies.
6. Prior research in Spain usually focuses on one of the two leading railways and a single phase of the sector. In relation to MZA, the topics include: the treatment of the staff expenses in 1913–1935 (Martínez Vara 2001, 2004, 2006); the internal accounting regulations in 1857–1908 (Fidalgo and Miranda 2006); measurement criteria of fixed assets (Fidalgo et al., 2015); the coding system for expenses in the workshops (Villacorta Hernández and Martínez Vara 2009); the evolution and changes of the Capital Account and of the Operating Account, and the impact of the organisational structure on the accounting statements from 1856 to 1874 (Santos-Cabalgante et al. 2012a, 2012b, 2014). In relation to NORTE: the accounting treatment of depreciation during the twentieth century (Bentabol et al. 2011); the evolution of the Operating Account from 1900–1925 (Montoya and Guzmán 2011). Few studies compare both companies: e.g. the accounting and statistical functions of the Chief of a railway station (Montoya et al. 2012), and the first railway audits (Villacorta Hernández and Müller 2014).
7. Extent of railway open in 1847 (in miles): US (6565), UK (5000), Germanic States – including Denmark and Holland – (4542), France (1722), Belgium (457), Russia (200), and Italy (170) (Lardner 1850, p. 417).
8. Burghers were people belonging to the middle or upper stratum of the middle social class. They usually had certain financial capital and political influence.
9. Previously, in France, the Rothschild family had established the *Compagnie du Chemins de Fer du Nord du France*, a continuous reference for MZA (De Los Cobos and Martínez Vara 2009); the Pereire brothers had established the *Compagnie du Nord* (Comín et al. 1998).
10. Until 1881, all General Managers in NORTE were French and had been working in the Pereire’s railway business (Vidal and Ortúñez 2002, pp. 32, 35).
11. For information about the management style and the proprietorship of NORTE and MZA in Ortúñez (1993, 1997), Vidal Olivares (1996, 1997, 1999), and in Vidal Olivares and Ortúñez (2002).
12. In Spain, railway companies were exempt from paying duties (customs tariffs) when they bought railway stock abroad. This was criticised because it could constrain (even impede) the development of the domestic steel industry.
13. See Vidal Olivares and Ortúñez (2002) for further details on the reasons underpinning this increase in ownership.
14. Commercial Code (1829: Art. 36), Regulation (1848, 17-Feb) and Law (1856, 11-Jul).
15. Commercial Code (1829: Art. 36).

16. Regulation (1848, 17-Feb).
17. Regulation (1857, 12-Dic: Art. 1).
18. Royal Order (1864, Sep).
19. Commonly used also are value relevance models. These models study the relation between accounting and prices and returns, with higher correlations being interpreted as indicative of higher quality. In a historical context, their implementation is not always viable, since a strong assumption of these models is that capital markets (and therefore, prices and returns) are efficient and reflect all available information (Holthausen and Watts 2001).
20. NORTE had the following reserves that originated from retained earnings: (1) 'Reserve for exceptional maintenance and improvement': this reserve was used to cover the replacement and reinforcement costs of bridges (Annual Report NORTE 1907); (2) 'Contingency reserves': these funds were created to ensure the stability of dividends (Annual Report 1910); (3) 'Funds for the depreciation of material': these funds were assigned to cover losses when units of material were eliminated from the inventories (Annual Report 1911); and (4) Other Reserves.
21. Building on this sentence, Fidalgo et al. (2015) speculate that it is possible that the 'Extraordinary expenses and complementary' account was used to distribute the 'amortisation' of these machines to the operating account. These 13 machines were already out of service. Therefore, the substance of the operation was to remove these assets from the accounting, as they were useless, making it dubious evidence of depreciation. In fact, 'Extraordinary expenses and complementary' account appears in the income statements of MZA since 1869, when the main lines were built.
22. Considering only years with profits, the median pay-out ratio was 58% from 1920 to 1925, and 97% from 1926 to 1933. This was driven by a dividend which remained fairly stable despite a decreasing trend in earnings. These earnings would have been much lower if NORTE had accounted for depreciation. The average depreciation expense in the 5 years before they stopped the depreciation charge (from 1912 to 1916) was 8,422,435 ptas. Such a charge would have lowered reported earnings by a median of 47.77% from 1920 to 1934.
23. This explains why the persistence model can only be run for 156 observations. The model requires data for $t - 1$ is available. Data to provide descriptive evidence are available from 1856 for MZA and from 1860 for NORTE, but we have no data for 1855 for MZA and for 1859 and 1867 for NORTE.
24. Spanish railways reported earnings calculated in a uniform manner over time (Santos-Cabalgante et al. 2014).
25. Following the Monetary Reform of 1882, the equivalence was fixed at 1 *peseta* equals 4 *Reales de Vellón*. Both firms transition to using PTA in 1882, but this means that MZA uses Rs.Vn. until 1882 (included), whilst NORTE reports in PTA already in 1882.
26. When including the controls for the different phases of the historical context, we can retain all four identification variables in our main analyses (i.e. Start-up, Expansion, Consolidation and Institutionalisation) as well as the intercept as the last of our phases goes from 1919 to 1935, and we have data up to 1939.
27. Using a large sample for the period 1984 to 2004, Dichev and Tang (2009) run earnings persistence models by quintiles of earnings volatility. Their evidence suggests overall high persistence, with persistence coefficients that are on average between 0.51 (for the quintile with the highest volatility) and 0.93 (for the quintile with the lowest volatility). The Adj. R^2 in their models ranges from 0.296 (highest volatility quintile) to 0.704 (lowest volatility quintile). Although their data cannot be directly compared to ours, for obvious reasons, it is useful in providing a framework to understand the expected values of persistence coefficients and explanatory power of our models.
28. Prior research notes that the crisis of 1883 affected the territories where NORTE and MZA operated differently and that this was reflected in the figures of the two companies. Also, the average prices charged by the two companies before 1898 were different (see Gómez-Mendoza and San Román 2005, p. 513). To control for these potential sources of differences, we conducted a robustness analysis, where we introduce in the model a dummy variable to control for price differences (PRICE_DIF takes the value of 1 before 1898 and 0 otherwise), as well as to control for the crisis of 1883 (CRISIS_1883 takes the value of 1 in 1883 and 0 otherwise). The results, not reported, indicate that our main findings are retained, as our main inferences remain the same when we repeat the analyses of Tables 4 and 5 by company.
29. The report of the first auditory of railway companies criticised NORTE, because it did not record the advance payments as operating expenses (Villacorta Hernández and Müller 2014, p. 158), however, such recording would have lowered earnings, providing much more support for the need for public funds. The fact that NORTE opted not to record these expenses supports the view that the preference was not to minimise earnings.

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