Money Market Integration in Spain in the Ninetheen Century: The Role of the 1875-1885 Decade

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Abstract

Are transaction costs and half-lives between two cities the same in both directions in traditional city-based monetary systems? Market conditions and political circumstances may not justify this assumption; and we provide evidence that it does not hold in the 1825-1885 period in Spain. Moreover, we show empirical evidence that market integration in Spain from 1875 to 1885 was a slow process of monetary unification with decreasing transaction costs, and a very inefficient convergence. Therefore, full integration did not happen in the period 1875-1885 and had to wait until mid-1880s, when the Spanish money-market was unified due to financial innovations.

Keywords: Integration of monetary markets; Nineteenth century; Monetary and financial history; Market Convergence and Efficiency; Western Europe; Private Finance, Capital Markets.

JEL classification: E02, E42, F02, F15, F31, F36, L10, N13, N73.

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The importance of the economic integration processes in the era of the first industrial revolution has awakened noticeable interest as the result of its implications in the economic development and possible lag in certain national economies (see Levine 1977; Toniolo et al. 2003; and Schnabel and Shin 2004). In this framework, the money market integration processes have unique importance, undoubtedly because of their intense repercussion on the development of national economies and industrialization itself, since they affect the development of business, payment systems and the consumers themselves. Historically, the national monetary unification processes have required intense institutional change (Bodenhorn 2000, and Helleiner 2003), that out of necessity has been accompanied by the accelerated implementation of financial innovations that favored their formation (Officer 1997; Trenkler and Wolf 2005; Maixé-Altés and Iglesias 2009; Federico 2012; and Nogues-Marco et al 2019a). There is agreement in the literature with regard to the importance that certain financial innovations had as a convergence factor in the money market, especially the development of bank branch networks around the country, current account services and bank transfers, along with the establishment of national monopolies of banknote issuing and single banknotes.

This article analyzes the integration of the Spanish money market in the nineteenth century. This topic has been dealt with several times in the past; in the case of Europe, special attention has been given to the configuration of the money markets prior to their unification, studying the inland bills of exchange markets. These markets were the basis for a traditional system for transferring liquidity between cities, in short, a city-based monetary system grounded on commercial finance. Ashton (1945) showed evidence that the bills of exchange constituted an important means of exchange between industrial companies in Lancashire during the period 1790-1830. Nishimura (1971) suggests that the decline in inland bills of exchange in London was mainly due to the improvements in transportation and communication, but it also

played an important role in the bank merger movements that would later occur. In a similar manner, in France, the network of Bank of France branch offices made it possible to disseminate discounted bills of accommodation, issued by provincial banks on a national level (Nishimura 1995)[3]. In the case of Spain, Castañeda and Tafunell (1993) and Maixé-Altés (1997) were the first authors to consider these markets, focusing on the Barcelona market, showing evidence of their support for the payment system in a context of intense industrial development and in a framework of banking underdevelopment. Cuadras-Morató and Rosés (1998) insist on the industrialization factor in the case of Barcelona as a determining factor in the boom in these markets in the mid-19th century in contexts of a legal currency shortage. Finally, Maixé-Altés and Iglesias (2009) revealed that the money markets in Spain were structured over a very long period, based on the inland bill of exchange markets. For many decades of the 19th century, they channeled increasing flows of payments, resulting from the growth of the Spanish economy. Using multivariate GARCH models, it is suggested that "*the general tendency in the way these markets operated was towards a multilateral system of the balance of payments between cities*". They demonstrated the progressive multilateralization of the payment system, arguing that the final unification process of the Spanish money market occurred as a result of the financial innovations that took effect in the mid-1880s. At the same time, Flandreau et al. (2009) indicated the importance of the European monetary geography prior to the industrial revolution, underscoring the role of the inter-city linkages in the mid-18th century. Recently, in relation to the Spanish case, Nogues-Marco et al. (2019a), using a Band-Threshold Autoregression model applied to the market rates in Madrid for inland bills of exchange in different Spanish cities, have estimated the market convergence and efficiency during the 1825-1874 period. Nogues-Marco et al (2019a) examined and answered successfully a very relevant research question about convergence/efficiency for the economic history of Spain and the transformation of European payment systems from a commercial framework inherited from the

[3] See also Eagly and Smith (1976) on the London monetary market.

early-modern times to a modern payment infrastructure managed by one national bank. Due to the complexity of the analysis, they assumed that transaction costs and half-lifes were symmetric and also they did not analyze the 1875-1885 decade empirically in detail.

With this background information in mind, we have two main objectives: *first*, we test the assumed hypothesis in Nogues-Marco et al (2019a) that transaction costs and half-lives in Spain were the same from city 1 to city 2 than from city 2 to city 1 from 1825 to 1885. Li (2015), using data of the sixteenth-century London–Antwerp exchange markets, showed that this hypothesis may not hold due to differences in market conditions and political circumstances. Our objective is to find out if asymmetric transaction costs can also be found in the nineteenth century in Spain during the transformation process of the payment system to the one single bank. *Second*, Nogues-Marco et al (2019a)[4] confirmed the result of Maixe-Altés and Iglesias (2009) [5] that market integration remained incomplete until at least 1874. Nogues-Marco et al (2019a) also conjectured that full market integration happened in the period 1874-1884 in Spain, claiming that it was when the monetary system was nationalized. However, we argue that the implementation process for financial innovations that favored the full integration of the monetary market was slow and uneven, and full integration many not have occurred in the 1874-1884 period. In this paper, contrary to the conjecture of Nogues-Marco et al (2019a) and using their same methodology, we show that transaction costs decreased more rapidly in the 1875-1885 period than from 1825-1874, while inefficiency was even higher in the 1875-1885 period than from 1825-1874. The only exception was Madrid/Valencia, where in the period 1875-85, inefficiency and transaction costs significantly decreased. Therefore, in this paper, we show that full integration did not happen in Spain in the period 1875-1885, and it was not until the mid-1880s when financial innovations were fully effective that the city-based monetary

[4] Using a Band-Threshold Autoregression Model.
[5] Multivariate GARCH models were used to analyse co--movements since prices between integrated markets move together as justified in Chilosi et al (2013) and Murray and Silvestre (2020).

system languished. Inland bills of exchange markets did not have the capacity to respond to a greater need for means of payment and business expansion of the 1875-1885 period. It is very relevant to study the 1875-1885 period in Spain since we can use it as an example from where we can learn in detail about how a payment system behaves prior to the full development of central banking.

The paper is organized as follows: in section I we start by showing theoretical reasons why transaction costs and half-lives from city 1 to city 2 may be different than from city 2 to city 1. After that, in section II we provide theoretical reasons why full integration may not have happened in Spain in the period 1874-1884, contrary to the conjecture of Nogues-Marco et al. (2019a). Later we present the data and the model in Section III, followed by our empirical results in Section IV. Finally, in Sections V and VI we provide some discussion and conclusions.

I. SPATIAL ASYMMETRIC TRANSACTION COSTS AND HALF-LIVES CONSIDERING PAIRS OF CITIES IN A BIUNIVOCAL MANNER

Trenkler and Wolf (2005) and Nogues-Marco et al (2019a)[6] assumed that transaction costs from city 1 to city 2 are always the same than from city 2 to city 1 (i.e. symmetric transaction costs), and also assumed that half-lives where the same.[7] On the other hand, for example Li (2015) states that when studying two cities as London and Antwertp,

> "[...] Because of differences in [...] market conditions, and in political circumstances, the exchange rates quoted in London and Antwerp were structurally different from each other. The structural difference between two exchange markets was reflected in the discrepancies in exchange rates quoted in the same month. Hence, the average of the difference between the London-

[6] See Nogues-Marco et al (2019a, page 1102), were it reads "[...] we assume that the cost was the same in both directions [...]" and also see the symmetry in their Table 1.

[7] See the symmetry in Nogues-Marco et al (2019a), Table 2 and Trenkler and Wolf (2005), page 210.

> Antwerp and Antwerp-London exchange rates, when both are available for the same month, is used as a proxy for the structural difference between these two markets [...]".

The same theoretical reasons as in Li (2015) based on market conditions and political circumstances justify that, in our case[8], transaction costs and half-lives for example between Madrid and Barcelona may be different than from Barcelona to Madrid (i.e. that we may have spatial asymmetric transaction costs, opposite to the assumption made in Trenkler and Wolf (2005) and Nogues-Marco et al (2019a)). The hypothesis of the equality of transaction costs and half-lives is very important because if it fails, apart from showing that the results in Nogues-Marco et al (2019a, e.g. Tables 1 and 2) cannot be symmetric, this will also cast doubts about their procedure to obtain indirect estimates of exchange rates by combining direct exchange rates and their inverses and claiming that the transaction costs and half lives of indirect exchange rates are the same as those of the direct exchange rates. We will also show in our empirical section that two exchange rates that have a correlation coefficient larger than 0.95, they can have very different estimated transaction costs and half-lives.

II. REASONS WHY MARKET INTEGRATION MAY NOT HAVE HAPPENED IN SPAIN IN THE 1875-1884 PERIOD

Nogues-Marco et al (2019a, page 1123) conjectured that:

> "[...] As a consequence, the integration of the Spanish money market remained incomplete at least until the 1870s and full market integration had to wait until the nationalization of the monetary system. This took place between 1874 and 1884 through the concession of the note-issuing monopoly for the whole country to the Bank of Spain, the quick creation of the Bank's network of branches, the

[8] As stated in Castañeda (2001), the nine cities that are analyzed in Nogues-Marco et al (2019a) (i.e. Barcelona, Bilbao, Cadiz, Corunna, Malaga, Santander, Sevilla, Valencia and Zaragoza), were all having very different market conditions and political circumnstances in the period 1825-1885.

> introduction of national banknotes valid in the whole Spanish territory, and the adoption of a system of free transfers between the Bank's provincial branches [...]".

As shown in Maixe and Iglesias (2009, Table 4), the Bank of Spain had opened only 17 branches in 1875 while in 1885, that figure increased to 39 branches [9]. We had to wait until 1892 to have reached the figure of 56 open branches (see e.g. Castañeda (2001, Cuadro 1.3, pages 38-39)). This provides evidence of the slowness of the process. Also, as shown in Maixe-Altés and Iglesias (2009, page 515),

> "[...] the extra-regional expansion of Spanish banks did not take place until well into the twentieth century. The two preconditions for the unification of the monetary markets were the development of the single banknote and the transfer service provided by the Bank of Spain. The general circulation of banknotes was a process that began in 1878 and was finally enforced in 1884. The free transfer services between the Bank of Spain current account holders became effective in 1883, while at the same time a banker's draft service was made available to the general public. [...] Short-term inland bills of exchange were only of minor importance after 1884".

Therefore, there was a very slow process of monetary unification from 1875 until 1884 and it is not clear a priori if during the 1875-1885 decade full integration happened (as it is conjectured in Nogues-Marco et al (2019a)) or it we had to wait exactly until the technological innovation was enforced when in March 4th, 1884, in the Junta General de Accionistas, it was made known that the Bank of Spain forced the existence of a single banknote in Spain (see e.g. Castañeda (2001, Cuadro 1.7, page 91)) [10].

[9] Castañeda (2001, page 38, Cuadro 1.3) shows that branches in de Barcelona, Bilbao, Cadiz, Coruña, Malaga, and Zaragoza were opened in 1874, Valencia in 1873 and Santander and Seville in 1875.

[10] Quoting Castañeda (2001, page 87), "[...] In his study about the Bank of Spain, Gabriel Tortella (1970) mentions that going from the local convertibility to the national circulation was a very gradual process from 1874 to 1884 [...]". And quoting again Castañeda (2001, page 90), "[...]The general circulation of notes culminated in March of 1884, but far of being established very rapidly, it was a very slow process

In more detail, Nogues-Marco et al (2019a) establish the end of their analyzed period in 1874, the date on which the Bank of Spain obtains the national monopoly of banknote issuing. We argue that it is premature to end the series in 1874, since the factors that contributed to dismantling these markets were not effective until about the mid-1880s. Consequently, these markets were in force for a longer time and the decade of 1874-1884 is very relevant for the analysis of the integration process of the Spanish money market. In what follows, we will three reasons in favour of our argument.

As the literature has pointed out, the innovations that led to the unification of the Spanish money market were the establishment through the Bank of Spain of a nationwide issuing bank paper currencies system, the expansion of branch banking and an intra-national transfer system (see Tortella 1970, Castañeda 2001, Maixé-Altés and Iglesias 2009, Martín Aceña et al. 2013). These innovations led to the disappearance of a system for mobilizing liquid balances between national markets through the eight-day bill of exchange markets. Undoubtedly, the financial innovation that most contributed to making the traditional system obsolete was the implementation of a transfer service between Bank of Spain branches. This innovation occurred as Castañeda (2001, 98) points out in November 1883, when the Bank of Spain took a first step, agreeing to offer the service of transfers to its account holders and, simultaneously, money transfers at a reasonable price to the general public. This measure was not definitive, since the new service did not yet affect a sufficient number of companies. In the case of Barcelona, for example, in 1884 there was not yet a significant volume of companies with a current account at the Barcelona branch of the issuing bank (Castañeda 2001, 166). This is a first determining factor to sustain that the inland bill of exchange markets were in force until about the mid-1884, from then on they languished. However, there are two other elements that corroborate that the study

that was initiated in 1878 and only at the end it was accelerated due to the preassures that were coming from outside of the institution [...]".

period of the inland bill of exchange markets should end precisely on these dates and not in 1874 as maintained by Nogues-Marco et al (2019a). The second factor that supports our argument is that the branch network of the Bank of Spain, key to the diffusion of the innovations that were taking place, was gradually established in a period that goes from 1874 to 1892. In fact, in 1874 they were incorporated 12 new branches to the two existing up to that moment and in 1875 another three more (which represented 29.3 percent of what would be the final network). In fact, in the following years, between 1876 and 1883, the bank's branch policy was terribly conservative[11].

In short, in 1880 only 38 percent of the branch network was constituted, and in 1885, 67 percent of the branch network. The network itself was not completed until 1892 with a total of 58 branches. Finally, the third factor determining the settlement of these markets was the establishment of a nationwide issuing bank paper currencies in the whole country. The single banknote implementation process was complex and slow in terms of management and circulation. It began in 1878, but the problems that hindered its dissemination were not really solved until a few months after the Bank of Spain launched its transfer system in March 1884 (Castañeda 2001, 90) [12].

In the following Section we will provide empirical evidence that the process from 1874 to 1884 was not only a very slow process of monetary unification (as stated in Tortella (1970) and

[11] Castañeda (2001, 58-60) attributes this slow expansion to management and administrative factors related to the application of the regulation, lack of control of headquartes in Madrid over branch management, the need to capitalize the branches and political factors that diverted the attention of the government, less attentive to legislate around the development of the activity of the issuing bank.

[12] Until the end of the first quarter of 1884, the Bank of Spain did not agree on the general circulation of high-denomination banknotes (250, 500 and 1000 pesetas) for all of Spain (Castañeda, 2001, 91). The arrival of Juan Francisco Camacho as governor of the Bank of Spain on October 29, 1883 was key to streamlining the policies that the bank had formally established, but which in practice had remained in a state of lethargy.

Castañeda (2001)), but also was a period were transaction costs went on decreasing but that the convergence was very inefficient.

III. DATA AND MODEL

Appendix 1 (Graphs 1-18) shows the graphs of the exchange rates in Madrid for the same nine cities[13] (Barcelona, Bilbao, Cadiz, Corunna, Malaga, Santander, Sevilla, Valencia and Zaragoza) analyzed in Nogues-Marco et al (2019a) in the period 1825-1874 and in our extended period 1875-1885 that we hand-collected. The paper uses the Madrid exchange rate data of more than 110,000 hand-collected observations and kindly provided by Nogues-Marco et al (2019b) for the period 1825-1874. We have obtained the data for the period 1875-1885 from the same data sources as Nogues-Marco et al (2019a): exchange rate prices published in Diario de Barcelona and Gazeta de Madrid. Adding our extended period from 1875-1885 implies that we add 3,190 daily observations in the exchange rates of all nine cities. From 1886 onwards, information on these markets will gradually disappear in the economic press.

Maixe-Altés and Iglesias (2009, Section 4.2), using multivariate GARCH models showed that in the period 1875-1885 exchange rates of Barcelona with five cities (Madrid, Cadiz, Valencia, Zaragoza and Santander) where already showing co-movements (among the time series and also their volatilities) and this was considered a signal of integration of the monetary markets[14]. Indeed, it is possible to observe how in the period 1875-1885 exchange rates of Madrid with all nine cities analyzed in Nogues-Marco et al (2019a) were also having similar co-movements (see

[13] The map given in Figure 1 of Nogues-Marcos et al (2019a) shows why those specific 9 cities offer a very important geographic coverage of the inland bill money markets in Spain.

[14] Following the reasoning that prices between integrated markets move together as justified in Chilosi et al (2013) and Murray and Silvestre (2020).

Graphs 2, 4, 6, 8, 10, 12, 14, 16 and 18 in Apppendix 1). In the following table we show the correlation matrix among the exchange rates in the nine cities in 1875-1885 period (i.e. with 3190 observations). Table 1 shows that all 9 exchange rates are highly correlated being the smallest correlation coefficient 0.822 for the exchange rate Madrid/Corunna with Madrid/Malaga. This indicates that all exchange rates tend to be highly correlated in the 1875-1885 period (showing comovements and confirming the results in Maixe-Altés and Iglesias (2009, Section 4.2) in Spain for the same period).

Table 1: Correlation matrix of the exchange rates with Madrid of the other nine cities (1875-1885)

	Barcelona	Bilbao	Cadiz	Corunna	Malaga	Santander	Seville	Valencia	Zaragoza
Barcelona	1.000	0.888	0.918	0.847	0.886	0.926	0.946	0.935	0.890
Bilbao		1.000	0.897	0.918	0.884	0.923	0.886	0.877	0.897
Cadiz			1.000	0.858	0.900	0.920	0.956	0.936	0.932
Corunna				1.000	0.822	0.906	0.835	0.817	0.870
Malaga					1.000	0.864	0.904	0.916	0.911
Santander						1.000	0.925	0.909	0.903
Seville							1.000	0.956	0.932
Valencia								1.000	0.936
Zaragoza									1.000

As Maixé-Altés and Iglesias (2009) argued, the conceptual framework developed by Officer (1996) shows a suitable analytical approach to these markets. During the stages of economic stability, the mark-up of fluctuation of the bills of exchange rates ranges between the so called specie-points (gold or silver, due to the bimetallic system established in Spain).[15] In a traditional city-based monetary system, if the imbalance of the balance of payments between pairs of cities persisted and the inland bills of exchange rate exceeded specie-points, companies and private individuals would opt for a direct cash transfer[16]. Our theoretical model used in this paper is the same as that used by Nogues-Marco et al (2019a): a Band-Threshold Autoregression Model, precisely in order to study the integration of the Spanish monetary market like they did, but for a more extended period of time, from 1825 to 1885.[17] In this sense, the level of integration of

[15] During this period, Spain followed the bimetallic scheme of the Latin Monetary Union.
[16] For more details, see Maixé-Altés and Iglesias (2009), and Nogues-Marco et al (2019a).
[17] Other authors have already used this approach, for example, Canjels, Prakash-Canjels, and Taylor 2004; Volckart and Wolf 2006; Esteves, Reis, and Ferramosca 2009; Li 2015.

the inland bill of exchange markets can be analyzed in two dimensions: on the one hand, the price convergence of these short-term negotiable instruments (analysing the transaction costs); and on the other, market efficiency (analysing the half-lives), i.e., the non-persistence of asymmetric shocks (see Federico 2012).

Based on the fact that convergence and efficiency are the key dimensions for the study of the integration process of a money market, following Nogues-Marco et al (2019a), we acknowledge that the behavior of these markets can be captured through threshold autoregressive (TAR)-type models, which allow simultaneous analysis of the convergence and efficiency dimensions of market integration. The Band-TAR model takes the form of (see Nogues-Marco et al (2019a, page 1102)):

$$\Delta x_t = \begin{cases} -\lambda(x_{t-1} - \gamma) + \varepsilon_t^{out} & if\ x_{t-1} > \gamma \\ \varepsilon_t^{in} & if\ \gamma \geq x_{t-1} \geq -\gamma \\ -\lambda(x_{t-1} + \gamma) + \varepsilon_t^{out} & if\ x_{t-1} < -\gamma \end{cases} \quad 0 < \lambda < 1; \gamma > 0$$

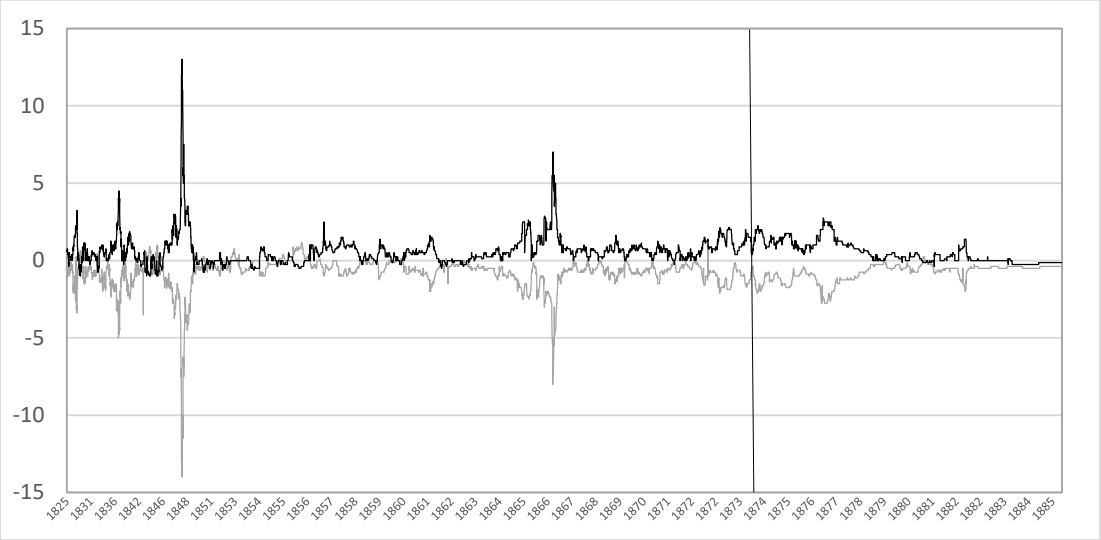
where x_t is the percentage deviation of the market exchange rate from the official parity, and Δ is the first difference operator. The parameter γ is the threshold that proxies for transaction costs, while λ sindicates the speed of adjustment to equilibrium. Following Nogues-Marco et al (2019a), half-lives are calculated as ln(0,5)/ln(1- λ) and the Band-TAR model is estimated by maximum likelihood under the assumption that errors are Gaussian.

IV. ESTIMATION RESULTS

Testing the Hypothesis if Transaction Costs and half lives in Barcelona-Madrid and Madrid-Barcelona exchange rates are the Same

Nogues-Marco et al (2019a, see page 1102) assume in all the analysis that transaction costs from city 1 to city 2 were the same than from city 2 to city 1 (see e.g. Nogues-Marco et al (2019a, Tables 1 and 2, symmetry was assumed). In order to test this hypothesis, we choose

Madrid and Barcelona, both cities were at this time the main economic centers in Spain. We collect data on the quasi-daily exchange rates of Barcelona-Madrid and from Madrid-Barcelona in the period 1825-1885[18], and we retain only those observations where we have a quotation in both markets in the same day. We obtain in this way a time series of size 10554 observations for both exchange rates. Graph A shows the evolution of those 10554 observations for both time series showing a clear symmetric pattern as expected. Both series in Graph A share in the period 1825-1885 a correlation coefficient of -0.927. If we split the 1825-1885 data in decades, the correlation coefficient is -0.867, -0.945, -0.975, -0.836, -0.957 and 0.923 for each of the decades respectively. The vertical line in Graph A indicates the moment where Nogues-Marco et al (2019a) stopped their analysis.



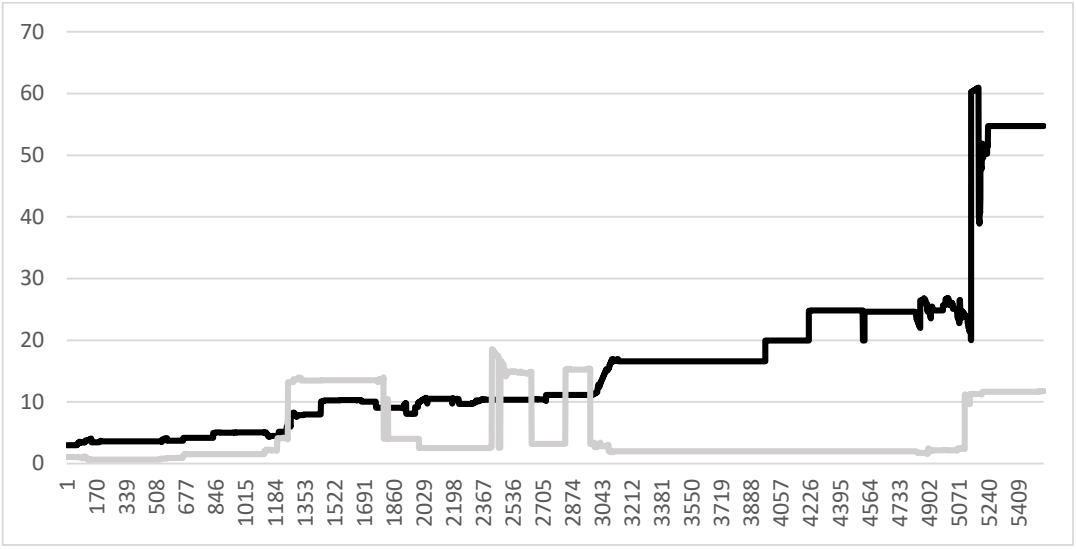
Graph A: Exchange rates for Barcelona-Madrid (grey line) and Madrid-Barcelona (black line) in the period 1825-1885 in those days where we have a quotation in both markets

We proceed now to test if transaction costs in the Barcelona-Madrid and Madrid-Barcelona exchange rates are the same. Following the same methodology as Nogues-Marco et al (2019a), we first remove outliers in our exchange rates by defining outliers as those observations with absolute median deviations larger than 3 times the interquartile range. After that, and based on the Band-TAR model, we use windows of data of 5,000 observations and we

[18] Using the exchange rate prices published in Diario de Barcelona and Gazeta de Madrid respectively.

estimate transaction costs and half-lives as in Nogues-Marco et al (2019a) [19]. Graphs B and C show in the Y-axes the estimated transaction costs and half-lives for the Barcelona-Madrid (grey line) and the Madrid-Barcelona (black line) exchange rates as shown in Graph A respectively. The X-axes in Graphs B and C show the number of estimated transaction costs and half-lives that we are able to obtain using rolling windows of size 5,000 as in Nogues-Marco et al (2019a).

Graph B: Estimated transaction costs for the exchange rates shown in Graph A for Barcelona-Madrid (grey line) and Madrid-Barcelona (black line).



Graph C: Estimated half lives for the exchange rates shown in Graph A for Barcelona-Madrid (grey line) and Madrid-Barcelona (black line).

[19] All results were obtained in GAUSS (www.aptech.com) and using the code kindly provided by Nogues-Marco et al (2019b) that derived from GAUSS programs made available by David E. Rapach (https://sites.google.com/slu.edu/daverapach/publications).

In Graph B we observe that transaction costs in Barcelona-Madrid (with an average of 1.16) tend to be higher than in Madrid-Barcelona (with an average of 1). If we test the null hypothesis that differences in the means is equal to zero, we clearly reject it with a p-value close to zero. That shows evidence that transaction costs were clearly larger in the Barcelona-Madrid than in the Madrid-Barcelona exchange rates in the period 1825-1885. We also clearly reject the null hypothesis of the equality of the variances of the estimated transaction costs in Barcelona-Madrid and Madrid-Barcelona. In Graph C we observe that half lives in Barcelona-Madrid (with an average of 4.77) tend to be much smaller than in Madrid-Barcelona (with an average of 15.95). If we test the null hypothesis that differences in the means is equal to zero, we clearly reject it with a p-value close to zero. That shows that estimated half-lives were clearly smaller in the Barcelona-Madrid than in the Madrid-Barcelona exchange rates in the period 1825-1885. We also clearly reject the null hypothesis of the equality of the variances of the estimated half lives in Barcelona-Madrid and Madrid-Barcelona. All this shows that tables 1 and 2 in Nogues-Marco et al (2019a) should not be symmetric.

Nogues-Marco et al (2019a, page 1100) argued also that they use the indirect exchange rates because the correlation coefficient between direct and indirect prices of bills of exchange rates in Barcelona were 0.9. However, we have just proved that the exchange rates Madrid-Barcelona and Barcelona-Madrid have a correlation coefficient of -0.927 and that even though, they have very different estimated transaction costs and half-lives. This argument will be reinforced in what follows, since by looking at our Table 1, all exchange rates tend to have a correlation coefficient around 0.90 or even higher, and as we will see in the estimated transaction costs and half-lives in the following subsections, despite those high correlation coefficients, the estimated transaction costs and half lifes are very different.

Estimated Transaction Costs in the Period 1825-1885

We follow again the same methodology as Nogues-Marco et al (2019a): we obtain first the adjusted-exchange rates for outliers and we use rolling windows of 5,000 observations to obtain the estimated transaction costs from the Band-TAR model. Appendix 2 shows the graphs of the estimated transaction costs. We add 3,190 daily observations to the series of the nine cities (when adding the 1875-1885 period) and therefore we have 3,190 extra estimated transaction costs to add to the ones obtained in Nogues-Marco et al (2019a) at the end of the sample. When adding the 1875-1885 period, this also alters the adjusted series for outliers in the 1825-1874 period, and this is what creates some divergences in the estimated transaction costs in the overlapped period from 1825 to 1874 (see the differences between the black and grey lines in Graphs 19-27). We show in the figures of Appendix 2 both the estimated transaction costs when we consider only the 1825-1874 period and when we extend it to 1885. We can see that the estimated transaction costs go on decreasing when adding the period 1875-1885. Also, in the overlapping period of 1825-1875, we see that the differences between the black and grey lines are very small what shows the robustness of the procedure. Moreover, from Table 2, we provide evidence that in the period 1875-1885 the estimated trend is always more negative in all nine cities than in the period 1825-1885 (and also than the period 1825-1875 given in Table 1 of Nogues-Marco et al (2019a)), what means that transaction costs decreased more sharply in the period 1875-1885 than in the period 1825-1874.

Table 2: Time Trend Coefficients of Transaction Costs estimates in the Spanish Money Market having Madrid as the base market

	Period 1825-1885	**Period 1875-1885**
Barcelona	-0.00009**	-0.000121**
	[0.000002]	[0.000005]
Bilbao	-0.000064**	-0.000072**
	[0.000001]	[0.000002]
Cadiz	-0.00007**	-0.0001862**
	[0.000008]	[0.000019]
Corunna	-0.00001**	-0.00001**
	[0.000001]	[0.0000012]
Malaga	-0.00013**	-0.00022**

	[0.0000025]	[0.000012]
Santander	-0.000113**	-0.000271**
	[0.000003]	[0.000013]
Seville	-0.00015**	-0.00046**
	[0.000003]	[0.0000017]
Valencia	-0.00005**	-0.00001*
	[0.000002]	[0.0000034]
Zaragoza	-0.000104**	-0.000207**
	[0.0000014]	[0.000006]

* indicates significant at the 5% level. ** indicates significant at the 1% level. Regression results by ordinary least squares and Heteroskedastic and Autorrelation (HAC) standard errors are shown in brackets. We have checked that the results are robust when using least absolute deviations and bootstrapped standard errors.

Efficiency and Speed of Adjustment in the Period 1825-1885

Appendix 3 shows the graphs of the estimated half-lives and Table 3 the corresponding estimated time trend coefficients. We can see that the estimated half-lives go on increasing when adding the period 1875-1885 in 8 cities except in Corunna. In Corunna, the same as in Nogues-Marco et al (2019a), half-lives decreased significantly both in 1825-1874 (see Table 2 in Nogues-Marco et al (2019a)), and the 1825-1885 (see our Table 3). However, in the 1875-1885 period, half lifes increased significantly showing as well clear inefficiency. So the reduction in transaction costs was not associated with an increase in efficiency in the period 1875-1885 in all nine cities. In fact, from Table 3 we show that the estimated trends are positive and larger than in the period 1825-1885 for all cities. Therefore, in relation to the conjecture in Nogues-Marco et al (2019a, page 1123) analysing that period, we provide empirical evidence that full market integration did not happen in the period 1875-1884 in Spain. In fact, full market integration had to wait until the aforementioned financial innovations were truly installed and effective in most of the Spanish geography. From Table 3 we show that the inefficiency in the period 1875-1885 was larger than in the period 1825-1885 since the estimated time trends are all positive and larger in the period 1875-1885 than in the period 1825-1885, and also larger than in the period 1825 if we compare our estimated time trends with those of Nogues Marco et al (2019a, Table 2). The only exception was Madrid/Valencia, where in the period 1875-85 inefficiency and transaction costs were significantly decreasing. This empirical evidence contradicts the

conjecture of Nogues Marco et al (2019a, page 1123) that full integration took place between 1874 and 1884.

Table 3: Time Trend Coefficients of Half-live estimates in the Spanish Money Market having Madrid as the base market

	Period 1825-1885	**Period 1875-1885**
Barcelona	0.00339**	0.01287**
	[0.000141]	[0.00043]
Bilbao	0.00010**	0.000884**
	[0.0000242]	[0.0000601]
Cadiz	0.007270**	0.01589**
	[0.0003974]	[0.000168]
Corunna	-0.00059**	0.002057**
	[0.000037]	[0.0000709]
Malaga	0.005846**	0.01822**
	[0.00019]	[0.000875]
Santander	0.00176**	0.01048**
	[0.000021]	[0.000281]
Seville	0.00343**	0.01352**
	[0.000121]	[0.00060]
Valencia	0.00126**	-0.00146**
	[0.00005]	[0.000080]
Zaragoza	0.01126**	0.00221*
	[0.00025]	[0.00088]

* indicates significant at the 5% level. ** indicates significant at the 1% level. Regression results by ordinary least squares and Heteroskedastic and Autorrelation (HAC) standard errors are shown in brackets. We have checked that the results are robust when using least absolute deviations and bootstrapped standard errors.

From Table 3 we can also show that Zaragoza, Coruña and Bilbao, although they were inefficient in the period 1875-85, they were less inefficient than the other 5 cities (Barcelona, Cádiz, Málaga, Santander and Seville). Also, Valencia had an efficient process in the period 1875-1885. From our Table 1, we showed that in the period 1875-1885, direct exchange rates of Madrid-Valencia and Madrid-Seville had a very large correlation coefficient of 0.956. On the other hand, our Table 3 shows that those two highly correlated time series did have very different estimated half lives during 1875-1885, being in one case efficient and in the other case inefficient. Therefore, we show evidence that two time series that share a correlation coefficient of 0.965 can have very different estimated transaction costs and half lives. This casts again doubts about the procedure of Nogues-Marco et al (2019a, page 1100) where they argue that

since direct and indirect exchange rates have a correlation coefficient of 0.9, that then they must have the same estimated transaction costs and half lives.

V. DISCUSSION

We have provided evidence that the process from 1874 to 1884 was not only a slow process of monetary unification (as stated in Tortella (1970) and Castañeda (2001)), it was also a period when transaction costs continued to decrease, but convergence proved to be very inefficient. This behavior in the 1875-1885 period may have occurred for several reasons.

Transaction Costs and the Raise of Quoted Cities from the 1870s

Our estimates for the 1825-1885 period agree with the results of Nogues-Marco et al. (2019a) for the period 1825-1874, with the added results that confirm that in the period 1875-1885, the transaction costs continued to fall at a fast pace. In this sense, our results corroborate the additional role that in the mid-1870s must be attributed to the development of the telegraph starting in the mid-1850s and the expansion of the railroad network in the 1860s, both of which were infrastructures that contributed to a faster decrease in transaction costs. In previous decades, as indicated by Nogues-Marco et al (2019a), the drivers of the falling transaction costs were the greater fluidity of postal mail and the improved road system (see Gómez Mendoza 1989; Bahamonde Magro 1993; Rosés et al. 2010).

Table 4 shows an apparently contradictory phenomenon that occurred in the last stage of operation of these markets: the increase in traded marketplaces. In fact, considering two significant places (Madrid and Barcelona), we can verify the increase in the number of traded marketplaces at the end of the period. Between 1875 and 1880, Madrid increased from 47 traded marketplaces to 61, while after 1870 in Barcelona, bills of exchange were traded in 45 marketplaces, while a few years earlier, in 1865, only 29 Spanish marketplaces traded them. The results obtained suggest that the accelerated drop in transaction costs could explain the

multiplication of the cities that were included on this circuit in the final years these markets were in operation (city-based bill of exchange markets), an aspect that the literature has failed to explain so far.

Table 4: Cities listed in Madrid and Barcelona bills of exchange markets (1790-1885)

	1790	1805	1820	1830	1840-50	1855-75				1880-85				
	(3)	(4)	(12)	(13)	(12)	(47)				(61)				
Madrid	Barcelona	Barcelona	Alicante	Alicante	Alicante	Albacete	Coruña	Murcia	Tarragona	Albacete	Castellón	Jaén	Palma de M.	Teruel
	Cádiz	Cádiz	Barcelona	Barcelona	Barcelona	Alicante	Cuenca	Orense	Teruel	**Alcoy**	Ciudad Real	**Jerez**	Pamplona	Toledo
	Valencia	Valencia	Bilbao	Bilbao	Bilbao	Almeria	Gerona	Oviedo	Toledo	Alicante	Córdoba	León	Pontevedra	**Tudela**
		Málaga	Cadiz	Cadiz	Cadiz	Avila	Granada	Palencia	Valencia	Almeria	Coruña	Lérida	***Reus**	Valencia
			Coruña	Coruña	Coruña	Badajoz	Guadalajara	Pamplona	Valladolid	Avila	Cuenca	**Linares**	Salamanca	Valladolid
			Granada	Granada	Granada	Barcelona	Huelva	Pontevedra	Vitoria	Badajoz	**Ferrol**	Logroño	San Sebastián	**Vigo**
			Málaga	Málaga	Málaga	Bilbao	Huesca	Salamanca	Zamora	Barcelona	Gerona	**Lorca**	Santander	Vitoria
			Santander	Murcia	Santander	Burgos	Jaén	San Sebastián	Zaragoza	**Béjar**	**Gijón**	Lugo	Sta. Cruz de T.	Zamora
			Santiago	Santander	**Santiago**	Cáceres	León	Santander		Bilbao	Granada	Málaga	**Santiago**	Zaragoza
			Sevilla	Santiago	Sevilla	Cadiz	Lérida	**Santiago**		Burgos	Guadalajara	Murcia	Segovia	
			Valencia	Sevilla	Valencia	Castellón	Logroño	Segovia		Cáceres	**Haro**	Orense	Sevilla	
			Zaragoza	Valencia	Zaragoza	Ciudad Real	Lugo	Sevilla		Cadiz	Huelva	Oviedo	Soria	
				Zaragoza		Córdoba	Málaga	Soria		**Cartagena**	Huesca	Palencia	Tarragona	

	1790	1805	1820	1830	1840	1850	1855-60	1865		1870		1875		1880-85	
	(3)	(4)	(10)	(11)	(10)	(16)	(19)	(29)		(45)		(46)		(42)	
Barcelona	Madrid	Madrid	Alicante	Alicante	Alicante	Alicante	Alicante	Alicante	***Reus**	Albacete	Málaga	Albacete	Málaga	Albacete	Málaga
	Cádiz	Cádiz	Cádiz	Cádiz	Cádiz	Bilbao	Almeria	Almeria	San Sebastián	**Alcoy**	Murcia	**Alcoy**	Murcia	**Alcoy**	Murcia
	Valencia	Valencia	(**Cartagena**)	(Coruña)	Granada	Cádiz	Bilbao	Badajoz	Santander	Alicante	Orense	Alicante	Orense	Alicante	Orense
		Zaragoza	Madrid	Madrid	Madrid	**Cartagena**	Cádiz	Bilbao	**Santiago**	Almeria	Oviedo	Almeria	Oviedo	Almeria	Oviedo
			Málaga	Málaga	Málaga	Granada	Coruña	Burgos	Sevilla	Badajoz	Palma M.	Badajoz	Palma M.	Badajoz	Palma M.
			***Reus**	Murcia	***Reus**	Lérida	Gerona	Cádiz	Tarragona	Bilbao	Palencia	Bilbao	Palencia	Bilbao	Palencia
			Tarragona	***Reus**	Sevilla	Madrid	Granada	**Cartagena**	Valencia	Burgos	Pamplona	Burgos	Pamplona	Burgos	Pamplona
			*(**Tortosa**)	Santander	Tarragona	Málaga	Lérida	Córdoba	**Vigo**	Cádiz	**Quintanar O.**	Cádiz	**Quintanar O.**	Cádiz	***Reus**
			Valencia	Tarragona	Valencia	Murcia	Madrid	Coruña	Zamora	**Cartagena**	***Reus**	**Cartagena**	***Reus**	**Cartagena**	Salamanca
			Zaragoza	Valencia	Zaragoza	Palma M.	Málaga	Gerona	Zaragoza	Castellón	Salamanca	Castellón	Salamanca	Castellón	San Sebastián
				Zaragoza		***Reus**	Murcia	Granada		Córdoba	San Sebastián	Córdoba	San Sebastián	Córdoba	Santander
						Santander	Palma M.	Lérida		Coruña	Santander	Coruña	Santander	Coruña	**Santiago**
						Sevilla	***Reus**	Logroño		***Figueres**	**Santiago**	***Figueres**	**Santiago**	***Figueres**	Sevilla
						Tarragona	Santander	Madrid		Gerona	Sevilla	Gerona	Sevilla	Gerona	Tarragona
						Valencia	Sevilla	Málaga		Granada	Tarragona	Granada	Tarragona	Granada	***Tortosa**
						Zaragoza	Tarragona	Murcia		Guadalajara	Toledo	Guadalajara	Toledo	Huesca	Valencia
							Valencia	Oviedo		Huesca	***Tortosa**	Huesca	***Tortosa**	**Jerez**	Valladolid
							Valladolid	Palma M.		**Jerez**	Valencia	**Jerez**	Valencia	Lérida	Vigo
							Zaragoza	Pamplona		Lérida	Valladolid	Lérida	Valladolid	Logroño	Vitoria
										Logroño	Vitoria	Logroño	Vigo	**Lorca**	Zaragoza
										Lorca	Zamora	**Lorca**	Vitoria	Lugo	
										Lugo	Zaragoza	Lugo	Zamora	Madrid	
										Madrid		Madrid	Zaragoza		

Sources: El Correo Mercantil de España y sus Indias, Diario de Barcelona, Gaceta de Madrid.
Note: those that are not provincial capitals appear in bold type and those that are exchanged less often are shown in parentheses. In 1833, a new division of Spain into provinces occurred (Javier de Burgos). The four capitals of the Catalonia region are: Barcelona, Tarragona, Lérida y Gerona. (*) Secondary marketplaces in the Catalonia region.

Decreased Efficiency in a Framework of Falling Transaction Costs in the Last Decade

The results obtained indicate that the transaction and efficiency costs were not associated in the final stage of the activity of these markets, since the reduction in transaction costs was not associated with improved efficiency during the period 1875-1885. An approach considering the macroeconomic behavior of the Spanish economy in those years could shed light on this trend. In the period 1870-1884, the Spanish economy experienced noticeable growth in which the cumulative average rate of the real per capita GDP between 1870-1884 was of 3.7%

(versus 0.2% in 1850-1870). This rate was far above the mean for the surrounding countries, even taking into account the comparative delay by Spain and the divergence sustained with its European milieu during the 19th century (Prados de la Escosura 2017).[20] Over the course of these years, Spanish economic growth unquestionably accelerated within the parameters of a lagging economy. Within this framework, it could be interpreted that the decrease in efficiency of the city-based inland bills of exchange markets from early modern times had provided support for the payment systems throughout Europe (see Fladreau et al (2009)). In spite of the drop in transaction costs which accelerated in the decade prior to the disappearance of these markets, their inefficiency increased, evidencing the inability of the traditional city-based monetary system to respond to an expanding economic system. The way out of this dilemma occurred, as previously with the rest of Europe, thanks to the dissemination of a series of financial innovations that unified the Spanish monetary market once and for all.

There were a very few exceptions to this decrease in efficiency, although some cities lost it more intensely than others. In this sense, various authors have shown that even in the early stages of the development of the modern Spanish economy, there was a noticeable trend towards asymmetrical development of the market potential of the different regions, a phenomenon that had intense effects of the spatial distribution of the economic activity (see Martínez-Galarraga 2014; Tirado et al.2013; González-Val et al. 2013). As a result, these differences in the loss of efficiency by the city-based monetary markets that we have detected reveal structural changes that are occurring in the Spanish economic geography, unevenly affecting each of the territories. Barcelona, Santander and the three Andalusian marketplaces (Cádiz, Seville and Málaga), experienced the sharpest decreases in efficiency, while Bilbao, A Coruña and Zaragoza also lost efficiency, but less intensively (see Appendix 3, Graph 28-34, 36). The only irregularity is Valencia, which as an exception in the decade in question actually gained

[20] At this time, France grew at a rate of 1.9%, UK by 1.3% and Germany by 1.7%; only the USA exceeded these rates, with 3.1% (Prados de la Escosura (2017), DATA-table 25).

in efficiency (Appendix 3, Graph 35). Along with the aforementioned asymmetries in market potential, specific conditions arose in these urban markets that contributed to these differences. In this sense, focusing on banking aspects, specific circumstances should be pointed out that affected some of the marketplaces involved. The entire set of marketplaces studied are found in those cities in which a branch of the Bank of Spain was set up: Valencia in 1873 and the rest in 1874-1875. However, the degree of penetration in the commercial and business activity of each of these branches was very different, insofar as the problems with new shareholders, management inefficiency and the response of the economic agents –including the former issuing banks and the rest of the banking institutions and local authorities– were very different (See Castañeda 2001, pages 58-60). We also mustn't forget the effect of the civil conflicts during this time, such as the "Third Carlist War" (1872-1876) and the successive political conflicts that occurred in the context of the First Republic and the subsequent monarchical restoration.[21] The exception of Valencia can be considered as the consequence of regional market dynamics, in which particularly important was the textile development of Alcoy, a manufacturing center in which, as indicated by Cuevas (2002), the secondary and informal liquidity markets were particularly important, creating an efficiency system for allocating the necessary resources for industrialization, without the need to resort to external liquidity markets. Traditionally, the regional marketplaces (Valencia and Alicante), traded in the markets of Madrid and Barcelona, at least starting in the early part of the century. Castellón later joined, and Alcoy was already being traded in Barcelona in 1870, and at the end of the decade in Madrid (Table 2bis). The Andalusian focus of Alcoy's production, the Valencia regional market and Madrid allows us to interpret the persistence and efficiency of the city-based Valencia market. Specifically, in

[21]Castañeda (2001) is the author who examined in greatest detail the different circumstances that occurred in the process of implementing each branch. See the details for the branches in A Coruña, Zaragoza and Santander (page 41), Bilbao (page 45). More or less the same thing occurred with the fluctuations in the circulation of the banknotes (page 65-66). In general terms, the results obtained by this author suggest an unequal impact on the different marketplaces according to specific economic and institutional circumstances.

relation to the Valencia regional market, Madrid played a substantial role as the neurological center of the articulation of the domestic market, as both a trading center for commodities and goods and a center for the negotiation of bills of exchange, see Cuevas (1999). These circumstances, along with the acceleration of the modernization-mechanization processes of Alcoy's industry starting in the 1870s suggests that the behavior of the Valencia market can be associated with improved efficiency of the system, before the financial innovations ultimately took root and eradicated the city-based markets.

Finally, the results by Maixé-Altés & Iglesias (2009), using a methodology that is very different from the one used in this work –i.e. multivariate GARCH models-, are not contradictory to the results we have just discussed. Essentially, the hypothesis of the progressive multilaterialization of the payment system remains valid in light of the hypotheses of monetary convergence and the unification of the Spanish money market as of 1885 (led by financial innovation). It can be stated that the strong correlation between the prices of bills of exchage on the different markets (Table 1) is coherent with the aforementioned hypotheses, something that was not perceived in the work by Nogues-Marco et al (2019a), since they did not consider the multilateralization hypotheses set out in Maixé-Altés and Iglesias (2009).

VI. CONCLUSIONS

The application of threshold autoregressive (TAR)-type models for quasi-daily trading of inland bills of exchange on the Madrid market for nine Spanish cities has made it possible to confirm, with a robust analytic basis, some aspects already identified in the literature, such as the fact that the unification of the money market did not occur in Spain until 1885 (Tortella 1970, Castañeda 2001, Maixé-Altés and Iglesias 2009, Martín Aceña et al. 2013). In this sense, the hypothesis by Nogues-Marco et al (2019a), which establishes 1874 as the end of its trading series

for inland bills of exchange, implies not considering a period during which these markets remained very active. The available studies reveal that the financial innovations we refer to were not established immediately and were subject to numerous drawbacks. In practice, they were not fully effective until about the mid-1880s.

Contrary to the conjecture of Nogues-Marco et al (2019a) and using their same methodology, we have provided empirical evidence that transaction costs decreased more rapidly in the 1875-1885 period than from 1825-1874, even though inefficiency was even higher in the 1875-1885 period than from 1825-1874.The only exception was Madrid/Valencia, where in the period 1875-85, inefficiency and transaction costs significantly decreased. Therefore, full integration did not happen in Spain in the period 1875-85 and had to wait until mid-1880s, when the unification of Spanish money market occurred, as the result of financial innovations.

The analysis developed in this article reveals that a city-based monetary system structured around inland bill of exchange markets operated during a large part of the 19th century in Spain. These markets were very active until practically the mid-1880s, manifesting a continuous decrease in transaction costs (greater in the last decade of the study period) but at the same time, a loss of efficiency that accelerated during the decade 1875-1884, before its activity languished. As a result, the unification of the money market did not occur as the consequence of a positive evolution of the operation of said markets, rather as the result of the effective dissemination of a series of financial innovations. It was precisely in these later years when the economic growth experienced by the Spanish economy pressured the structure of these markets, which did not have the capacity to respond to a greater need for means of payment and business expansion; as a result, the inland bill of exchange markets became more inefficient. The reduction of transaction costs was not associated with an improvement in efficiency during the 1875-1885 period. These results suggest that these markets, in spite of the improvement in communications, both by road and railway, and the deployment of the

telegraph network, gradually lost their capacity to meet the payment needs that the economic growth and progress of the Spanish economy was generating over the last quarter of a century. Only the effective incorporation of financial innovations, such as the development of branch networks of the Bank of Spain around the country, current account and bank transfer services, along with the establishment of issuance monopoly and single banknotes achieved the complete unification of the Spanish money market after 1885. In short, it was only the modernization of the currency and payment systems that created a modern financial structure that could replace the already inefficient city-based monetary system. This transition occurred with a lag behind industrialized Europe, which enjoyed levels of access to banking services far superior to those of Spain.

The results of our research show that the symmetry of the exchange rates on the inland bills of exchange markets does not imply symmetry in transaction costs and efficiency, unlike the conjectures professed by Nogues-Marco et al. (2019a). Li (2015), using data of the sixteenth-century London–Antwerp exchange markets, showed that this hypothesis may not hold due to differences in market conditions and political circumstances. We have verified this behavior, considering the changes between the two most important marketplaces during the nineteenth century period, Madrid and Barcelona, using the prices of the short-term bills of exchange from Madrid for Barcelona and Barcelona for Madrid. These results refer to the different conditions for each of the urban markets and the asymmetrical development of the market potential in the Spanish economic geography. The argument developed in this paper is coherent with the results obtained by Maixé-Altés and Iglesias (2009), who established that the city-based monetary system in effect during a large part of the 19th century was subjected to a progressive process of multilateralization and the definitive process of unification only occurred as a consequence of the financial innovations effective as of the mid-1880s.

The intense reduction of transaction costs in the last stage of operation of these markets, thanks to the development of the railroad and telegraph networks, explains the increase throughout Spain in the number of marketplaces traded in this market. This was the swan-song of these markets that were beginning their decline, as evidence in their downturn in efficiency. The nine marketplaces studied experience intense drops in efficiency to varying extents, and only Valencia improved its efficiency. This exception is due to the conditions of the textile development in the region, specifically surrounding the industrial district of Alcoy and its system of financing.

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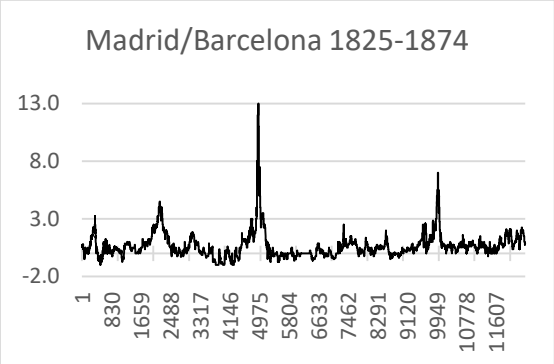
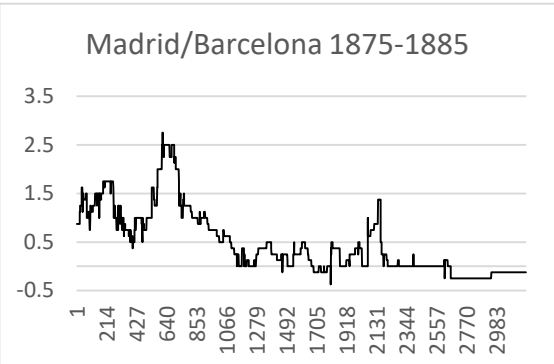
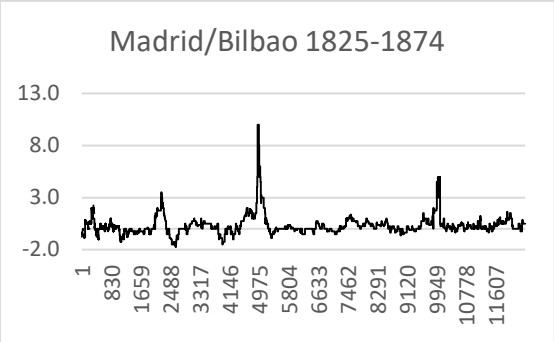
APPENDIX 1: GRAPHS OF UNADJUSTED DATA



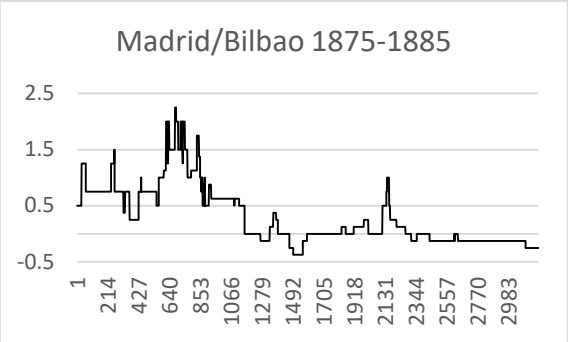
Graph 1



Graph 2



Graph 3



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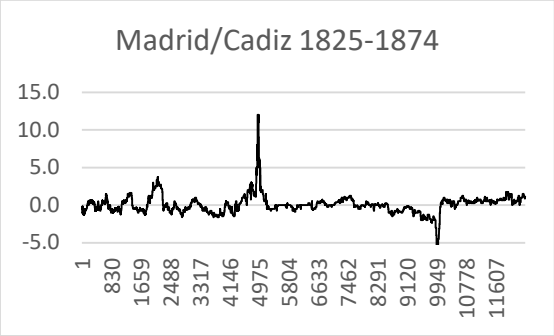

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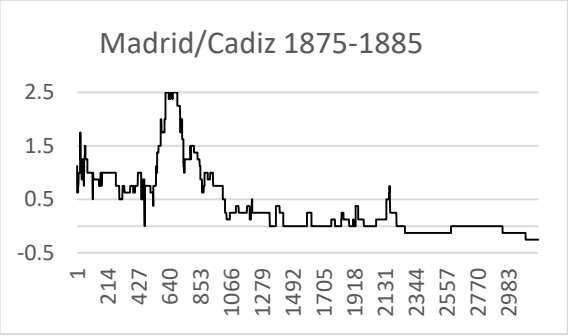

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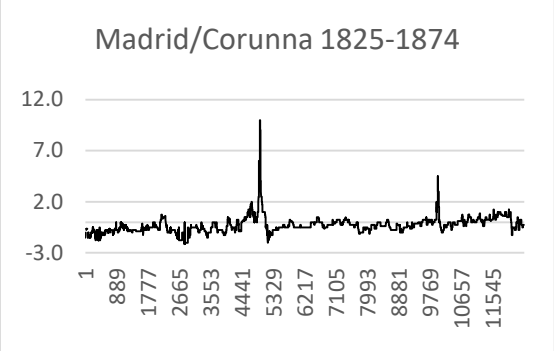

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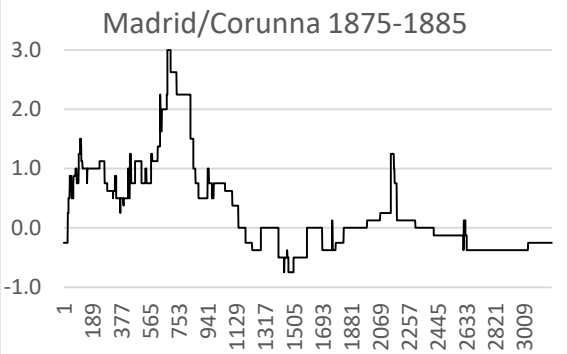

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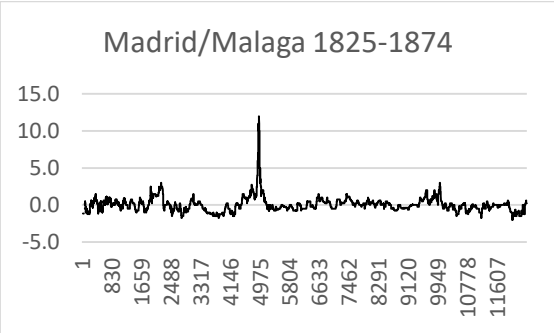

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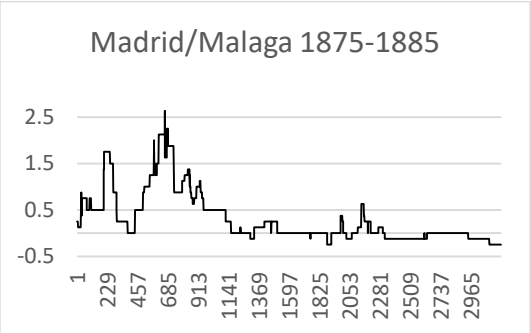

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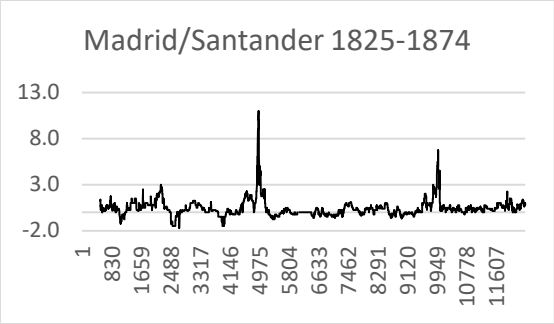

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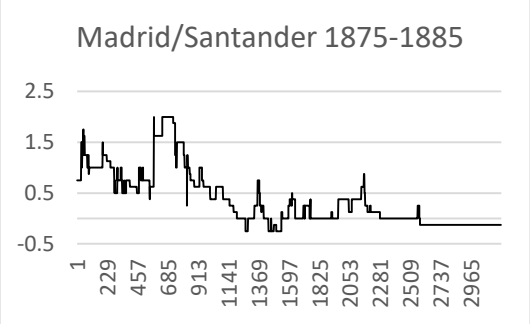

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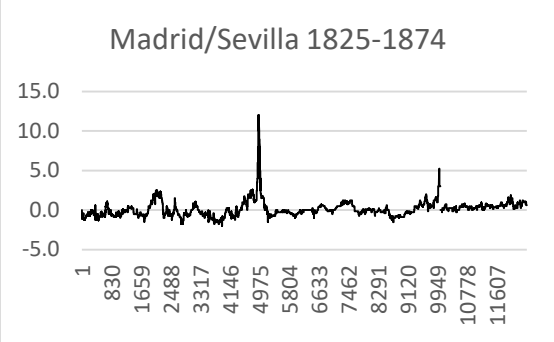
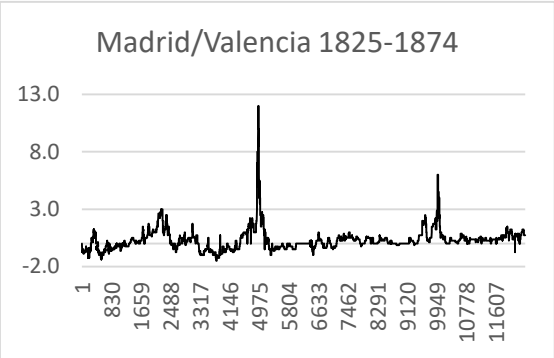


Graph 13

Graph 14



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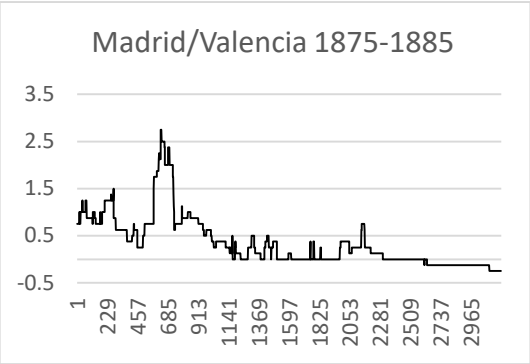

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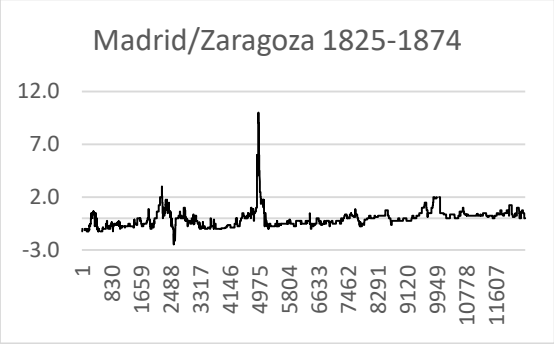

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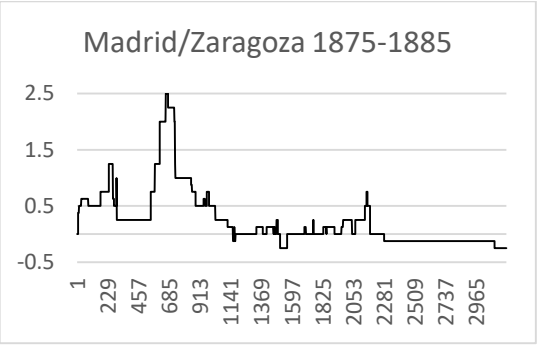
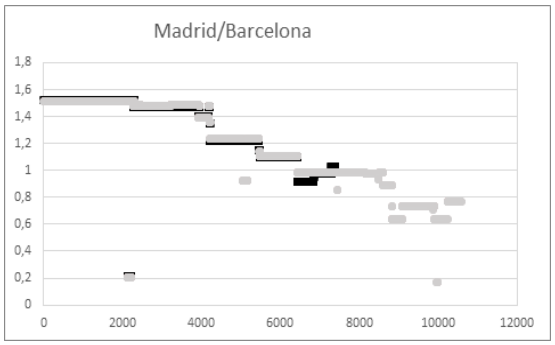


Graph 18

APPENDIX 2: ESTIMATED TRANSACTION COSTS (Series with data until 1874 (in black) and adding period 1875-85 (in grey)).



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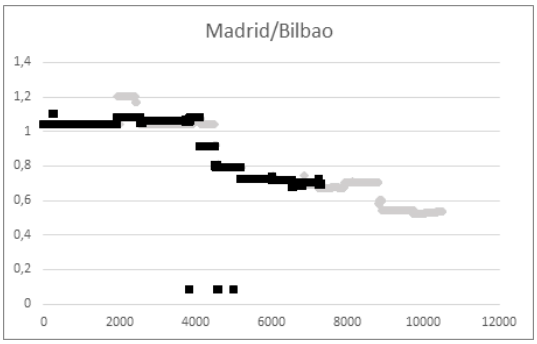
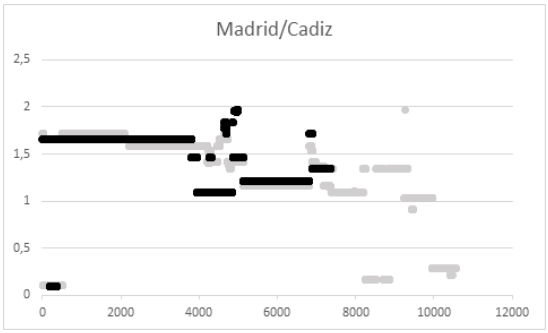


Graph 20



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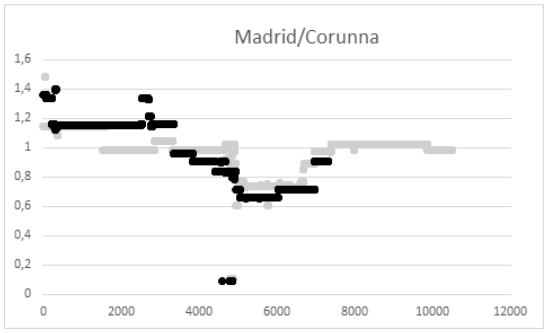

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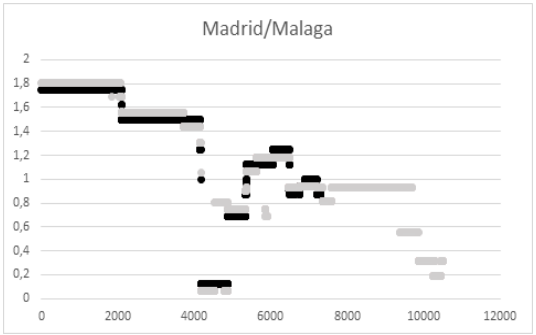

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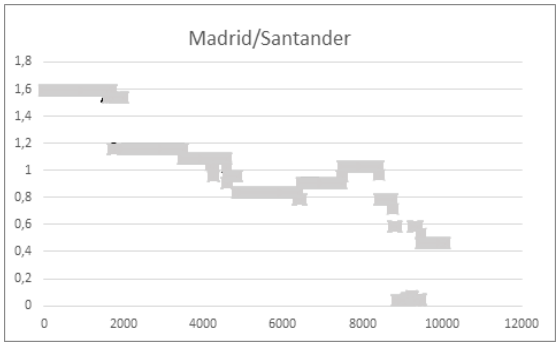

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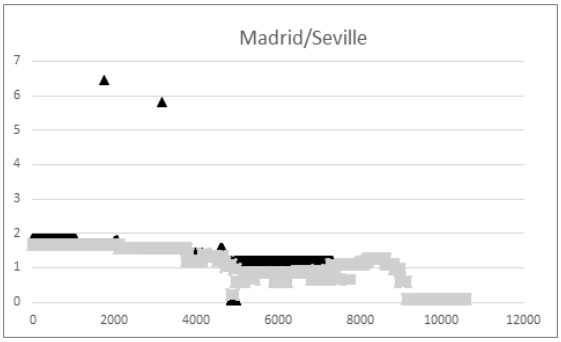

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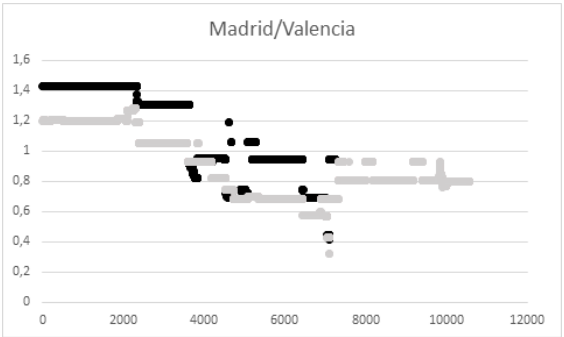

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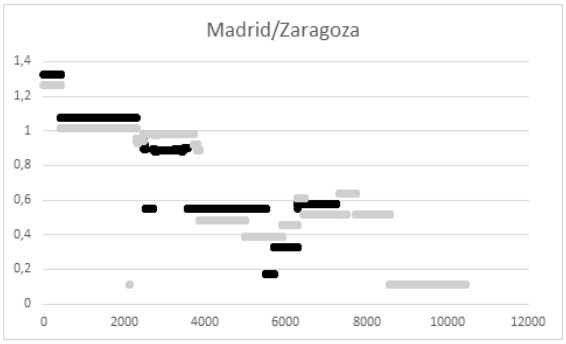
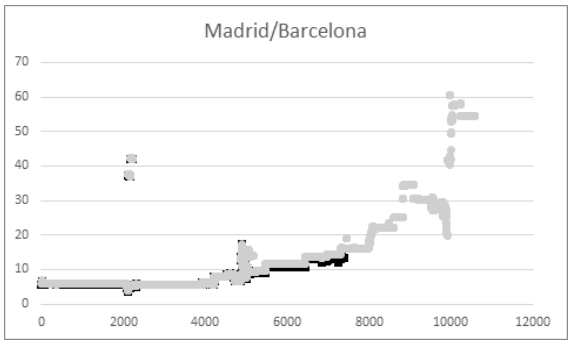


Graph 27

APPENDIX 3: ESTIMATED HALF-LIVES (SPEED OF ADJUSTMENT) (Series with data until 1874 (in black) and adding period 1875-85 (in grey)).



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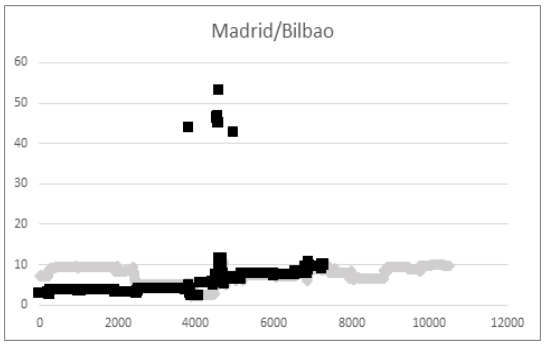

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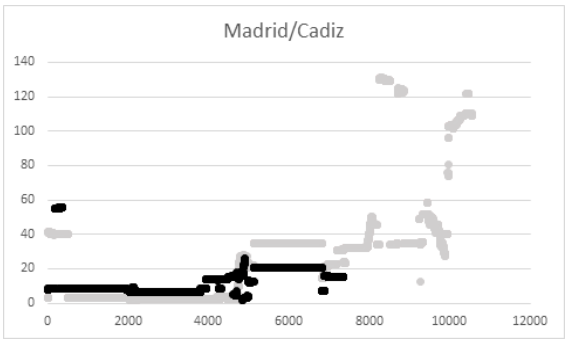

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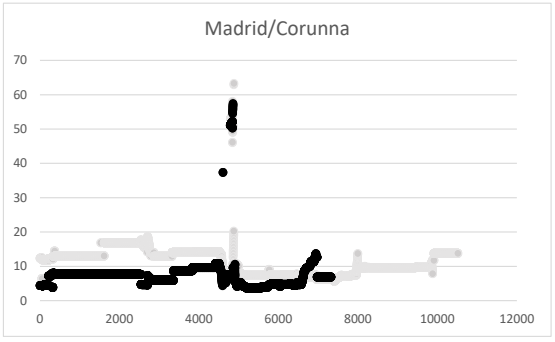

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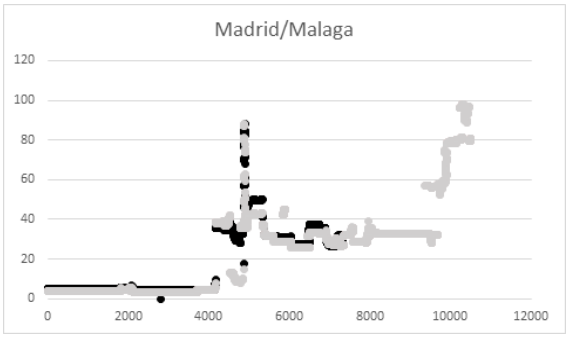

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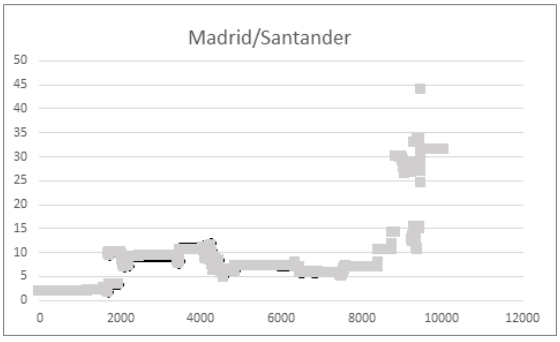

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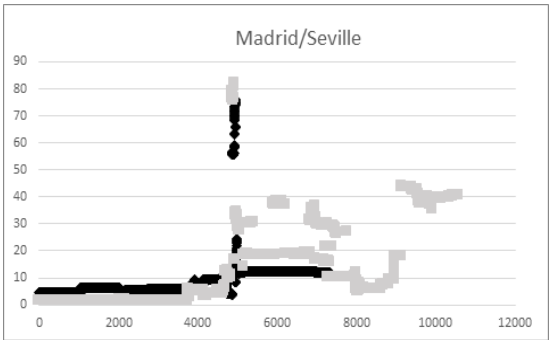

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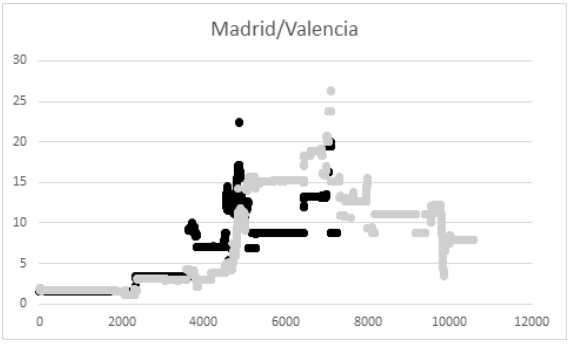

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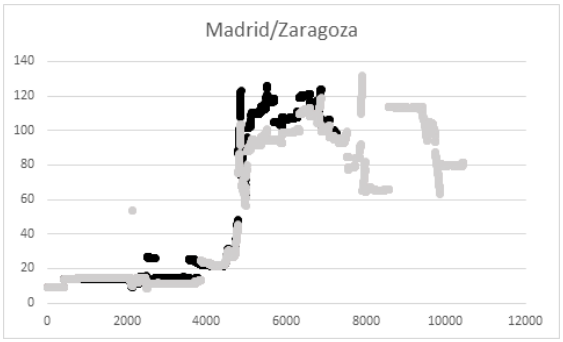

Graph 36