DID BULLIONISM MATTER?:
EVIDENCE FROM CADIZ SHADOW MARKET FOR SILVER, 1729-1742 *

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ABSTRACT

The most important achievement of early Foreign Exchange theory was the discovery of the specie point mechanism in an institutional setting of bullionist regulations. This is the first paper which tests empirically the incidence of bullionist regulations on specie point mechanism for silver between London and Cadiz thanks to the recent discovery of black market prices for silver in Cadiz at the beginning of 18th century. The conclusion is that Spanish bans on silver export did not keep specie at home. Spanish government put a stop to smuggling outflows through changes in the parity between the unit of account and the silver medium of exchange.

INTRODUCTION

This is the first paper which tests empirically the incidence of bullionist regulations on the specie point mechanism for silver between London and Cadiz at the beginning of 18th century (1729-1742). Bullionist regulations fixed specie price and prohibited the specie exchange with a premium, that is, free market price. And without the market price data, it is not possible to analyse the specie point mechanism. But thank to the recent discovery of shadow market price for silver in Cadiz, I can study arbitrage with bullionist controls in 18th century. This is interesting because, while Neal studied international arbitrage in 18th century between pure financial instruments without controls, this paper focus on international arbitrage in a setting of bullionist restrictions on specie exports.

The first section explains specie point mechanism theory and bullionist regulations proposed by early mercantilist economist in Early Modern Europe. The second section describes the silver point mechanism according to documents kept in Merchant House Roux and Compagnie Royale d’Afrique archive. Next sections measure arbitrage: third, fourth and fifth sections calculate and compare arbitrated par of exchange and spot exchange rates; and sixth section shows silver point mechanism according to smuggling costs.
1. SPECIE POINT MECHANISM THEORY AND BULLION REGULATIONS

The specie point mechanism measures the flow for a single metal $k$ between two centers $i$ and $j$ (Flandreau, 1996, p. 422 and 2004, p. 59):

$$(1 - c^i_j) \frac{p_i^k}{p_j^k} \leq x \leq (1 + c^i_j) \frac{p_i^k}{p_j^k}$$

(1)

where $p_i$ denotes the price of metal $k$ in market $i$; $p_j$ denotes the price of metal $k$ in market $j$; $x$ denotes the spot exchange rate between $i$ and $j$ centers; $c_{ji}$ is the cost of trading the metal $k$ from $j$ to $i$ center; and $c_{ij}$ is the cost of trading the metal $k$ from $i$ to $j$ center.

The discovery of the specie point mechanism was the most important achievement of early Foreign Exchange theory¹ (Einzig, 1962, p. 144). The bullionist writers focused on the specie point mechanism to understand the international flow of specie (Gresham (1558)², Malynes (1601), Clement (1695)). These economists described the specie point mechanism and proposed Foreign Exchange policies based on regulations on the variables of specie point mechanism (equation 1) to avoid bullion outflows.

These Foreign Exchange policies and the expected effect on the arbitrage equation are summarised in the following table.

¹ As Einzig (1962) underlined, the specie point mechanism discovered by economist in Early Modern Period had long been familiar to merchants. In this sense, merchants, as Cardosa (1622) and Hayes (1734, p. 285-288), wrote technical reports on specie point mechanism which comprised exhaustive break down of bullion prices, exchange rates and costs.

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>BULLIONIST POLICY</th>
<th>EFFECT</th>
<th>AUTHOR</th>
<th>Date of bullionist regulations abolition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs ($c$)</td>
<td>Bans and/or licences on specie exports</td>
<td>To increase the spread of specie point</td>
<td>Gresham (1558)</td>
<td>1663 gold and silver bullion and foreign coins&lt;sup&gt;3&lt;/sup&gt; 1819 English coins or bullion derived therefrom&lt;sup&gt;4&lt;/sup&gt; 1849&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td>Bullion prices ($p$)</td>
<td>To fix bullion prices at legal value</td>
<td>To forbid premium (market price)</td>
<td>Clement (1695)</td>
<td>1690 (before?) 1821-23 / 1854</td>
</tr>
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Bullionist regulations were abolished in Spain one century and half later than in England. England liberalized the domestic bullion market and bullion exports at the end of 17th century while Spain did at middle 19th century. This delay gives us the opportunity to understand specie point mechanism between a no-bullionist city (London) and a bullionist one (Cadiz). And the data available in Merchant House Roux help us to study empirically the logic of the mechanism.

Next section describes the primary source.

<sup>3</sup> Munro (1992, appendix B)
<sup>4</sup> Viner (1937)
<sup>5</sup> Real Orden 2 November 1849 (published in Gaceta de Madrid 6 November 1849)
<sup>6</sup> The Course of the Exchange
2. SPECIE POINT MECHANISM EVIDENCE IN MAISON ROUX ARCHIVE

The Merchant House Roux operated from 1 October 1728 to 3 February 1843. Roux practised a polyvalent business which embraced many commercial activities: trade of goods, but also weaponry, insurance, bank, etc. Roux worked either for his own count, to settle half or in third with foreign partners, or still as a commissioner. His activity was developed in a huge geographical domain: France, Europe, Levant, Barbary Coast and Antilles. And he also took part in the trade of South America through his Cadiz’s correspondents.

Spain concentrated the monopoly of trade with American-colonies in only one staple port; first, Seville (1495/1503-1717), through the ports of Cadiz and Sanlúcar, and later, directly Cadiz (1717-1765-1789). Spanish colonies produced great quantities of bullion in Early Modern Period and, according to shipping registers, huge amounts of silver arrived to Cadiz every year. Literature has focused on quantify the quantity of silver arrived from America to Cadiz (Morineau, Hamilton, Garcia-Baquero), but however, we do not know the logic of the silver distribution from Cadiz to other European centers.

The opacity to understand the logic of the mechanism is due to the legal prohibitions to exchange silver at free price in the Early Modern period. Spanish legislation fixed bullion prices at mint price according to scholastic theoretical idea of “just price”: bullion must sell at the Mint Price in the Mint and different coins had to be exchanged by official money-changers at the legal price. At the end of 18th century Spain was the only country without an official free bullion market, but the recurrent Royal Proclamations against bullion market seems to indicate the existence of a black bullion market. Indeed, foreign contemporaries

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7 Merchant House Roux archive is a remarkable 18th century commercial archive collected by La Chambre de Commerce et d’Industrie de Marseille. It is composed of 1,320 bundles, which comprise 78,274 pieces of correspondence, 14,516 pieces of accounting and 23,216 pieces of commercial matters (sea and land transport, weaponry, food, raw material and manufactured goods). Rebuffat (1965, section L.IX)

8 García-Baquero González (2002)

9 Grice-Hutchinson (1952). “Ordenamos y mandamos que a toda la plata de fuera de nuestros Reinos le sea puesto precio, según la ley y peso que tuviere, al respecto de cómo mandamos que valga la moneda de plata de nuestros Reinos por estas dichas nuestras ordenanzas; y después de la publicación de las mismas ordenanzas, en nuestra Corte en adelante no corran por más precio de aquel que justamente valiere, según la plata que tuviere al dicho respecto; y mandamos a las dichas nuestras justicias, doquier que la dicha moneda corriere, que se informen del justo valor de ella, de los oficiales de cualquiera de nuestras casas de moneda, y de aquel precio manden que no se suba, ni lo consentan”. Recopilación 8, título 21, book 5.

10 Larruga (1787-1800, vol. 3, pp. 49-57): “España es absolutamente el solo país de Europa donde no se hace el comercio de materias de oro y plata, y donde se carece de casas particulares autorizadas para este trato. […] La diferencia que hay entre el comercio que hacen las casas de moneda y las casas particulares de materias de oro y plata en otras partes, consiste en que estas pueden comprar a un precio superior que la del Rey estas materias, y venderlas igualmente a más alto precio después que estén ensayadas, lo que es lo esencial, y la base de su comercio: en lugar que las casas de moneda nunca las compran sin ensayarlas antes, y que las pagan a menos precio que los particulares mercaderes de oro y plata”
recognized the existence of a bullion market in Spain: “Gold in Spain and Portugal is of sixteen times more value than silver of equal weight and alloy; at which rate a guinea is worth 21s 1d net; this high price keeps their gold at home in good plenty and carries away the Spanish silver into all Europe. So that at home they make their payments in gold, and will not pay in silver without a premium. Upon the coming in of a plate [silver] fleet the premium ceases or is but small, but as their silver goes away and becomes scarce the premium increases and is most commonly about six per cent” (Newton 1717, in Shaw (1895, pp. 229-230)).

Due to bullion market prohibition, Spanish institutional sources do not give us indication about silver exchange mechanism; but, thanks to the recent discovery of silver black market in a commercial source, the Merchant House Roux, we can reconstruct the specie point mechanism. This is a great discovery which gives us the opportunity to understand the arbitrage in a context of bullionist regulations.

Arbitrage with pieces of eight was done by Merchant House Roux using three types of documents:

a. **Correspondent’s letters**: Cadiz correspondents reported silver prices and sometimes a description of the relationship between the exchange rates and the silver prices or, directly, a recommendation about arbitrage (to buy or not); for example: "Les mex neuves vallent 28p% vieilles 28 1/2 suvle pred vus ont les changes cet arbitrage ne donne aucun proffit"13, "les matieres vallent 30 les mex vielles et 28 1/2 les neuves et coll. Cet arbitrage desde vrezeu depuis quelque temps pour chez vous, nous souhaiterions qu'il changeat pour y faire quelque chose pour le compte a demi"14; and "les matieres sont a 33 1/4 a 1/2 sur le prix de nos changes il ny a rien a faire sur cet arbitrages"15. The silver prices appear at the end of the letter together the exchange rates and the cochineal price or inside the text (Illustration 1 shows one example of the Pieces of Eight’s quotations inside the text of the letter).

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11 Spanish Early Modern Period archives, *Archivo General de Indias* and *Archivo General de Simancas*, watch over institutional sources produced by Spanish Administration and, therefore can not help us to understand the system outside the rules of the law.
12 Fond Roux L.IX. Section IV : correspondance passive Cadix, liasses 810-856
13 Fond Roux L.IX, liasse 821, letter Athanase, Jean Jolif et Cie, 31/01/1736
14 Fond Roux L.IX, liasse 821, letter Athanase, Jean Jolif et Cie, 04/09/1736
15 Fond Roux, L.IX, liasse 822, letter Jean, Alain Jolif et Cie, 19/04/1739
b. **Invoices**: these invoices, named “*compte du cout et fraix*” broke down the following information (see Illustration 2):

- Shipment identification: ship and captain’s name, cargo’s correspondent sign and the sac’s number.
- Cargo description: type of pieces of eight, quantity and weight per sac, unitary market price, total price, expenses and final price.

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Illustration 2: “compte du cout et fraix”

Source: Fond Roux, L. IX liasse 1,261 : Monnaies d’or et d’argent : factures.
c. **Ledgers**\(^{17}\): account ledger for pieces of eight per partner (account 1/2) or partners (account 1/3) which comprises buying price per operations in Cadiz in debits and selling price per operations in London or Paris in credits. The profit, as the difference between the selling price and the buying prices, was shared among the partners.

The pieces of eight shadow prices were reported in letters from 1729 to 1741, usually by partner-correspondents in the account 1/2 or 1/3. The silver quotations are not written in correspondence after 1741, although invoices show the continuity with the arbitrage operations in the long run. These invoices also show that from 1741-1742 Roux operated with pieces of eight through the Compagnie Royale d'Afrique\(^{18}\). Effectively, correspondence from Cadiz to Compagnie Royale d'Afrique corroborate that the correspondents were the same correspondents who worked directly with Roux banker before the foundation of Compagnie Royale d'Afrique. Regrettably, few letters from Cadiz to Compagnie Royale d'Afrique has been preserved, and I only was able to collect pieces of eight prices from Compagnie for the first two years: 1741 y 1742\(^{19}\).

But the preservation of the invoices and ledgers in Roux and Compagnie Royale d'Afrique archive indicate the same logic for arbitrage operations during the whole 18\(^{th}\) century\(^{20}\). Therefore, although there are silver prices in correspondence only for a short period (1729-1742), thanks to the preservation of these documents, it is possible to reconstruct the arbitrage logic as the contemporary operated. Next sections focus on the relevant variables to understand the arbitrage operations: silver prices, exchange rates and costs.

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17 Fond Roux, L. IX liasse 53: compte arbitrage.
18 The Compagnie Royale d'Afrique archive was compiled in 1860 by Chambre de Commerce de Marseille. Rebuffat (1965, section L.III). The Compagnie Royale d'Afrique (1741-1793) were founded with 1,200 shares, 800 subscribed in Paris and 400 in Marseille (300 of them were subscribed by Chambre de Commerce de Marseille). It had the monopoly of the coral fishing and the trade of wheat, wool, wax and leathers which were transported in Marseilles to be sold. It purchases in Barbary Coast were regulated in Pieces of Eight, the only legal tender currency, which needed a great consumption (L.III liasse 1017).
19 Compagnie Royale d’Afrique. L. III. Liasse 364: Spanish correspondent letters. The Compagnie Royale d’Afrique archive have also « cashiers de livraison et reception des piastres » (L. III, liasse 1014, 1015) and « reçus du caissier d’achats de piastres et copies de ces reçus , 1741-1744» (L.III, liasse 444) and « livre de caisse des piastres, 1741-1794 » (L.III, register 446-448), but these sources are not usefull for my research because they are organized by correspondent, without price quotations for pieces of eight.
20 Fond Roux. L.IX liasse 1261 ; Compagnie royale d’africque : L.III liasse 1010
3. ARBITRATED PAR OF EXCHANGE

Arbitrated par of exchange between center $i$ and $j$ is defined by relative MARKET PRICES of metal $k$: $\frac{p^k_i}{p^k_j}$. Arbitrated par of exchange differs from par of exchange, which is defined by relative LEGAL PRICES: “A Par of Exchange is an equivalent sum in the money of one country, for a given sum in the money of another, each being estimated by the quantity of the same pure metal contained in the coins according to their nominal value” Tate (1819, p. 478)

“Par of exchange” was considered by contemporaries as the goal of Exchange rate policy, while “arbitrated par of exchange” was considered as an “accidental” price because it fluctuated: “In this and the other Calculations of the Par, Regard is had only to the coined Silver of Several Countries, and not to the accidental Price or Value that Silver in Bullion may be, for this never is long the same” (Newton, 1734)

This section shows arbitrated par of exchange and par of exchange. They were different and, therefore, arbitrage results are different if we consider the silver market price or the legal price. To calculate arbitrated par of exchange, I show silver prices in both markets, London and Cadiz. Arbitrated par of exchange differed from legal par because market prices differed from legal prices both in London and Cadiz.

3.1. Market prices for silver in London

Data are taken from The Course of the Exchange, financial publication which started publishing twice-weekly in the decade of the 1690s (McCusker and Gravestijn, 1991). These bulletins comprise data of exchange rates, prices of bullion, and prices of shares and debentures.

Silver price was measured in shillings (s) and pence (d) units of account per standard sterling ounce Troy. The Course of the Exchange collected the data of silver bars and

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21 Flandreau (1996, p.422 and 2004, p. 59). See also Tate (1834, pp. 169-170)
22 An exchange rate at par was considered as exchange rate in equilibrium. Viner (1937)
23 EQUIVALENCES AMONG UNITS OF ACCOUNT: 1 pound sterling (£-librae)=20 shilling, 1 shilling (s-solidi)=12 pennies (d-denarii).
MASS: Newton (1731): “That the English Pound Troy contains 12 Ounces; 1 Ounce, 20 Pennyweights; 1
foreign silver coins, concretely Pieces of Eight (Pillar Pieces of Eight, Mexican Pieces of Eight, and Small Pillar and Mexican Pieces of Eight from 15/08/1732). Pieces of eight were the only coins which quoted in London financial bulletins during all 18th century (until March 1795, when French New Louis started to quote together Pieces of Eight).

I collected half-monthly prices of Mexican Pieces of Eight around beginning and half of month (the exact date corresponds to the same date than Cadiz quotations). England used Julian calendar but, as Cadiz used Gregorian calendar, I corrected the dates of the Julian calendar (Old Style) into the Gregorian calendar (New Style) in order to maintain the homogeneity of the data. Graph 1 shows prices of Mexican Pieces of Eight in London stock exchange.

Graph 1: Price of Mexican Pieces of Eight in London Stock Exchange, 1729-1742
(shilling/std. ounce Troy)

Source: the Course of the Exchange for market prices and Feavearyear (1931, pp. 142-143, pp. 346-347) for Mint Price.

Pennywt, 24 Grains; and 1 Grain, 20 Mites.”. One standard ounce Troy is equivalent to 31.103496 grams in the International System of Units. Lemale (1875, p. 189)
3.2. Market prices for silver in Cadiz

Cadiz correspondents’ letters in Roux archive and Compagnie Royale d’Afrique reported almost half-monthly black market price of old and new pillar pieces of eight, old and new Mexican pieces of eight and old and new provincial pieces of eight. I collected half-monthly prices of Old Mexican Pieces of Eight\(^{24}\). Price was reported as the percentage of premium over *peso de cambio* or *de plata antigua* or *de plata vieja* per effective Old Mexican piece of eight\(^{25}\). *Peso de plata vieja* is an imaginary coin which legal equivalence with effective American pieces of eight is defined in Castile Legislation as follow:

\[ \text{from } 08/09/1728 \text{ to } 16/05/1737^{26}: \]

1 effective American Piece of Eight = 10/8 *peso de plata antigua*

\[ \text{from } 16/05/1737 \text{ to } 29/05/1772^{27}: \]

1 effective American Piece of Eight = \((10\ 5/8)/8\) *peso de plata antigua*

Graph 2 shows shadow market prices of Mexican pieces of eight in Cadiz

\(^{24}\) Letters were reported every week or two weeks. I have collected half-monthly prices available in 50 bundles of Cadiz correspondence from 1729 to 1742, which comprise around 5,000 letters. Fond Roux. L.IX, liasses 810-856. Compagnie Royale d’Afrique, L.III, liasse 364

\(^{25}\) “l’agio [était]… de 33 1/3 pour cent, plus ou moins; c’est –à-dire qu’on donne 100 piastres fortes pour 133 1/3 piastres de change, plus ou moins” (Ricard, 1732, in McCusker, 1978, p. 100). *Peso de cambio o de plata antigua* = *Piece of eight of exchange or Piece of eight of old silver* = “El peso escudo, de plata o de cambio, vale 8 reales de plata antigua, 15 reales y dos maravedís de vellon, 272 maravedís de plata o 512 maravedís de vellon. […] El real de plata antiguo que es la moneda más usual en el comercio vale 16 cuartos, 34 maravedís de plata antigua, o 64 maravedís de vellon” Villabertran (1826), p. 1, and Autos Acordados (1772), book 5, title XXI, auto 36, 04/11/1686

\(^{26}\) Autos Acordados (1772), book 5, title XXI, auto 61

\(^{27}\) Novísima Recopilación (1805), book 9, title XVII, law 8, and Innocencio Aparici (1741), pp. 24-26
Graph 2: market price of Mexican old pieces of eight in Cadiz, 1729-1742 (half-monthly observations), peso de plata antigua/Mexican old piece of eight

![Graph showing market value and legal value of Mexican old pieces of eight in Cadiz, 1729-1742.](image)

Source: Merchant House Roux and Compagnie Royale d'Affrique

### 3.3. Arbitrated par of exchange between London and Cadiz

London silver prices are provided per unit of mass (standard ounce) while Cadiz silver prices quoted per coin. Then, I need to convert Cadiz prices per coin to prices per unit of mass to calculate the arbitrated par of exchange; and, therefore, I need to know the net weight of the Old Mexican piece of eight.

Mexico Mint started to strike *Real* silver coins in May 1535, in three-reales, one-real and half-real pieces (and four-reales from 1537) \(^{28}\). Old pieces of eight were struck from 1572 to 1734 (cob coins-Equilateral Jerusalem Cross type). These Old pieces of eight stop striking in 1734, although they remained as legal tender; and New pieces of eight were struck from 1732 to 1772 (circular coins-Pillars of Hercules type) \(^{29}\).

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\(^{28}\) Leyes de Indias (1681), book 4, title XXIII, lawVII-VIII. Pradeau (2001, p. 35)

Old Mexican Pieces of Eight had the following legal features: 930.56± 3.472 thousandths of fineness and 27.518 grams of gross weight\(^{30}\). But they had a different net weight which defined by law due to wear and tear and technical imprecision. Newton’s test at the English Mints in 1717 calculated that Old Mexican pieces of eight had a gross weight of 27.121961 grams and a fineness of 92.0833\(^\%\).\(^{31}\) These values supposed a pure silver weight of 24.974797, which represents abrasion of 2.5%.

### 3.4. Par of Exchange between London and Cadiz

“By Par of Exchange is meant, the precise Equality between any Sum or Quantity of English Money, and the Money of a foreign Country, into which it is exchanged, Regard being had to the Fineness as well as to the Weight of each” (Newton (1729))\(^{32}\)

Par between London and Cadiz was defined according to relative net weight between pence sterling and pieces of eight of exchange. Par value was:

- \(54\) d sterling = 1 Piece of Exchange = 8/8 real plata vieja (before 08/09/1728)
- \(43.2\) d sterling = 1 Piece of Exchange = 8/10 real plata vieja (between 08/09/1728 and 16/05/1737)\(^{33}\)
- \(40.658824\) d sterling = 1 Piece of Exchange = 8/(10 5/8) real plata vieja (after 16/05/1737)

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\(^{30}\) Tale of real per Cologne Mark ingot: 67 (8 3/8 in pieces of eight) at 11 dineros and 4 granos of fineness. Ordinance 13/06/1497, Recopilación (1640), book 5, title XXI, laws 1-74 de las ordenanzas que han de guardar. (Céspedes del Castillo, p. 214-215). One Cologne Mark ingot is equal to 230.465 grams. García-Patón (1903), p. 23 (tablas anejas a la ley de pesos y medidas de 19 de junio de 1849 and pure silver (100% fineness) is equivalent to 12 dineros (1 dinero = 24 granos). Dasi (1950), vol. 1, p. 21.

\(^{31}\) Old Mexico Piece of Eight had 1 pennyweight worse than English standard and an absolute weight of 17 pennyweights and 10 5/9 grains (Newton, 1717; reproduced in several papers, like Hayes (1777, Appendix); Sumner, 1898, pp. 613-614 and Laughlin, 1898, p. 17).

\(^{32}\) “A Par of Exchange is an equivalent sum in the money of one country, for a given sum in the money of another, each being estimated by the quantity of the same pure metal contained in the coins according to their nominal value” Tate (1819, p. 478)

\(^{33}\) “Another Observation to be made on the Exchange with Spain, is, the late Alteration in the augmenting their Specie; the Dollar or Piastre which formerly went for 8 Rials, being now raised to 10; so that London exchanging upon the Piece of Eight Rials, on that Country still as formerly, the Alteration in the Course of Exchange should be in Proportion this, if 10 Rials of Plate, or a Dollar, be worth 54 d. Sterling, what is 8 Rials worth? Answ. 43.2 d” (Newton, 1729)
Graph 3 shows arbitrated par of exchange and par of exchange.

Graph 3: arbitrated par of exchange and par of exchange between London and Cadiz, 1729-1742 (half-monthly observations), pence sterling/peso de plata antigua (normalized at 54*8/10=1)

4. SPOT EXCHANGE RATES

4.1. Exchange rates between London and Cadiz at maturity

Exchange rate is the exchange rate of bills of exchange: “Foreign Exchanges are transfers from the money of account of one country to that of another, by the operation of Bills of Exchange. A Bill of Exchange is a written order for the payment of a specified amount in the money of one of the places concerned, the equivalent amount in the money of the other place being calculated by a rate of exchange” (Tate, 1834, p. 1)

According to the Course of the Exchange, London quoted on Amsterdam, Rotterdam, Antwerp, Hamburg, Paris, Bordeaux, Cadiz, Madrid, Bilboa, Leghorn, Genoa, Venice, Lisbon, Porto and Dublin. Exchange rates in London on Cadiz quoted at 2 months maturity (1 usance in Cadiz equal to 2 months) plus 14 days of grace at payment in Cadiz (Hewitt, 1740, p.25).
Cadiz exchange rate bulletins for 18th century are not kept, except very few exemplars\textsuperscript{34}, and Spanish newspapers did not report exchange rates until the end of the 18th century\textsuperscript{35}. But, luckily, correspondents in Cadiz reported systematically Cadiz exchange rates in commercial correspondence. Cadiz quoted on London, Paris, Amsterdam, Genoa and Madrid. Exchange rates in Cadiz on London quoted at 2 months maturity plus 3 days of grace at payment in London (Hewitt, 1740, p.25)

Exchange rates between London and Cadiz were reported in d sterling/piece of eight of exchange (old silver)\textsuperscript{36}

### 4.2. Spot exchange rates between London and Cadiz

Exchange rates at maturity comprise two concepts: spot exchange rate and interest rate. According to De Roover (1953, p. 129): "Quelle est la différence entre change et intérêt? L’intérêt est un bénéfice dû en proportion du temps pendant lequel l’emprunteur dispose de l’argent prêté. La caractéristique de l’intérêt, c’est qu’il est calculé d’après un pourcentage donné du capital. Entre l’escompte et l’intérêt il n’y a vraiment aucune différence essentielle. L’escompte est simplement un intérêt déduit d’avance de la valeur nominale d’un effet au lieu d’être perçu à l’échéance ou à la fin d’un terme convenu entre les parties. Par contre, le change est à proprement parler un bénéfice ou une perte qui provient des variations dans le cours des monnaies"

As exchange rate was reported in bulletins at a maturity, I should consider interest rates in order to calculate the appropriate spot exchange rate for bullion arbitrage operations\textsuperscript{37}. Interest rate is “the rate charged by the two houses of business, or at the market rate of discount” (Tate, 1834, p. 89). This commercial interest rate –the rate at which credit is extended to a merchant banker by his correspondent in other center- can be calculated according to the formula (Flandreau et al, 2006, p. 17-18)\textsuperscript{38}:

\textsuperscript{34} Nederlandsch Economisch-Historisch Archief and Chambre de Commerce et d’Industrie de Marseille
\textsuperscript{35} Correo Mercantil de España y de sus Indias (1792) (Biblioteca Nacional de España), Diario de Barcelona (1792) (Arxiu Municipal de Barcelona), Diario Mercantil de Cádiz (1800) (Archivo Histórico Provincial de Cádiz).
\textsuperscript{36} den sterling/piastre courante o piastre de change. Giraudreau, p. 239 and 536
\textsuperscript{37} “with respect to the Interest it is to be observed, that when the Bills are drawn from abroad, for Bullion imported into this Country, at a distant date, as 2 or 3 months, there will be a profit to allow for, or to deduct from the full amount, equal to the interest for the estimated time between the sale of the Bullion, and the day of the bills becoming due; thus sometimes when the result would be a loss, the advantage that is made of the money during this time repays it and leaves a profit” (Tate,1834, p. 199).
\textsuperscript{38} This formula is explained in contemporary financial books: “Supposez que d’une Lettre de Change de 4800 florins, ou livres, on veuille escompter 54 jours à raison de 4 pour cent l’année, multipliez les 4800 florins ou
where \( a_{ij} \) denotes the number of units of currency \( i \) that bankers give to get one unit of currency \( j \) in center \( j \) at \( n \) days, \( x_{ij} \) the number of units of currency \( i \) that bankers give to obtain one unit of currency \( j \) in center \( j \) on the spot, and \( r'_j \) the commercial interest rate in center \( j \) according to center \( i \).

Then, I can calculate directly spot exchange rate between Cadiz and London according to equation (2):

\[
x_{cl} = a_{cl}(1 + \frac{n}{365}r_l)
\]

where \( x_{cl} \) denotes the spot exchange rate, \( a_{cl} \) the exchange rate in Cadiz on London in 60 days and \( r_l \) the commercial interest rate in London

5. ARBITRATED PAR OF EXCHANGE AND SPOT EXCHANGE RATES

Graph 4 shows the relation between arbitrated par of exchange and exchange rates according to calculations explained in sections 3 and 4 respectively.

\[ a_{ij} = \frac{x_{ij}}{1 + \frac{n}{365}r'_j} \]

livres, par les 54 jours de l’Excompte, & divisez le produit par 9000 [360 jours de l’année Astronomique x 100/4 d’Intérêt] & vous aurez 28 florins, 16 sols, (ou livres) pour l’excompte de ladite Somme, la quelle étant soustraite des 4800 resterait à payer 4771 florins, 4 sols” (L’Espine,1710, p. 35). Intuitively spot exchange rate is, therefore, derived from the hypothetical amount that a merchant would obtain if he could cash instantly the bill in the center of destination: “Excompter ou discompter une Lettre de Change, c’est fournir ou prendre une Lettre de Change acceptée, payable dans la même Ville où elle s’excompte ou discompte, pour en recevoir ou en payer le montant avant l’Echeance avec excompte” (L’Espine, 1710, p. 36).

39 Long maturity for bills in Cadiz on London is 2 months (1 Usances; 1 Usance = 2 month), plus 3 days of grace at payment in London (Tate, 1819b, p. 3; Hewitt, 1740, p. 25). London interest rate is Bank of England foreign bills discount rate (Clapham 1994, vol. 1, p. 299)
Graph 4: arbitrated par of exchange and par of exchange between London and Cadiz, 1729-1742 (half-monthly observations), pence sterling/peso de plata antigua (normalized at $54\times8/10=1$)

According to graph 4 some conclusions can be indicated: first, par of exchange is a very bad proxy for arbitrated par of exchange, and arbitrage results are different if we consider one or the other; second, considering spot exchange rate or exchange rate at maturity does not change substantially results; and, third, although arbitrated par of exchange and spot exchange rates followed the same trend, there is a gap between both variables before the 1737 Spanish devaluation. Next scatter diagrams shows the gap (graph 5). The question is: was the gap big enough as to compensate costs and generate a systematic arbitrage? To answer this question, we should know the amount of silver arbitrage costs. Next section shows costs.
Graph 5: scatter diagrams arbitrated par-exchange rates, pence sterling/peso de plata antiqua (normalized at 54°8/10=1)

Mid-January 1729 to beginning-July 1737

Mid-July 1737 to mid-December 1742

6. MEASURING BANDS: SMUGGLING COSTS

Smuggling bands are defined by smuggling cost, available in Roux’s invoices (see Illustration 2). They were two kind of cost:

1. Financial costs:
   1.1. courtage d’abord: 2 %
   1.2. intermediation cost:
      1.2.1. if the correspondent is a partner → brokerage 2 %
      1.2.2. if the correspondent is a mediator → commission 1%

2. Petty handling fees:
   2.1. sacs et port à la maison: ¼ %
   2.2. port à bord 40: 1%

TOTAL MIN SMUGGLING COST: 1.425% (whether I consider the correspondent as a partner → intermediation cost is the brokerage at 2 %)

40 «Les Piastres en arrivant à Marseille, Gênes, Londres, Amsterdam, etc. payent un pour cent; c’est-à-dire une Piastre effective pour chaque 100 Piastres, que les Capitaines de Vaisseaux prennent des Sacs ». Giraudeau, p. 460
TOTAL MAX SMUGGLING COST: 2.225% (whether I consider the correspondent as a mediator→ intermediation cost is the commission at 1%)

Silver export from Cadiz to London is delimited by lower band of arbitrage equation (equation 1): \((1 - c_d^*) \frac{p_l^s}{p_c^s} \leq x\) 

where \(p_l^s\) denotes the price of Old Mexican pieces of eight in Cadiz; \(p_c^s\) denotes the price of Old Mexican pieces of eight in London; \(x\) denotes the spot exchange rate between Cadiz and London; \(c_d^*\) is the cost of exporting the silver from Cadiz to London.

Then, silver export is profitable when \((1 - c_d^*) \frac{p_l^s}{p_c^s} > x\), and profit is measured as:

\[
\text{profit} = (1 - c_d^*) \frac{p_l^s}{p_c^s} - x
\]

Graph 6 and 8 shows arbitrage equation (equation 4) considering minimum and maximum smuggling costs respectively. And graphs 7 and 9 shows profitability (equation 5)

Graph 6: lower band of arbitrage equation between London and Cadiz considering minimum smuggling costs, 1729-1742 (half-monthly observations), pence sterling/peso de plata antigua (normalized at 54*8/10=1)
Graph 7: profitability of export Old Mexican pieces of eight from Cadiz to London considering minimum smuggling costs, 1729-1742 (half-monthly observations) %

Graph 8: lower band of arbitrage equation between London and Cadiz considering maximum smuggling costs, 1729-1742 (half-monthly observations), pence sterling/peso de plata antigua (normalized at 54°8/10=1)
Graph 9: profitability of export Old Mexican pieces of eight from Cadiz to London considering maximum smuggling costs, 1729-1742 (half-monthly observations) %

As graphs 7 and 9 shows, exporting Old Mexican pieces of eight was profitable until 1737. The Spanish government reacted to smuggling with devaluation, which eliminated the gap between exchange rates and arbitrated parity.

Therefore, bullionist regulations in Spain did not avoid arbitrage, but give an incentive to smuggle: “Laws made against Exportation of Money or Bullion, will be all in vain. Restraint, or Liberty in that matter, makes no Country Rich or Poor: As we see in Holland; which had plenty of Money under the free liberty of its Exportation; and Spain, in great want of Money under the severest penalties against carrying of it out”\(^{41}\)

\(^{41}\) Locke (1695)
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