Prices, value and seigniorage in Ricardo’s monetary economics

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1. Introduction: arbitrages and Ricardian monetary theory

This article deals with arbitrages and the absence of arbitrage opportunities that found Ricardian conclusions regarding the price of gold, the value of paper money and its issue.

In order to demonstrate that the “high price of bullion is a proof of the depreciation of banknotes,” David Ricardo reasons in terms of arbitrages. Gold and silver bullions, coins and convertible bank notes are substitutes. This substitutability involves a structure of prices: £46 14sh 6d. for gold bullion, 21sh for the gold “guinea” coin, 1sh for the silver “shilling” coin and £1 for the one pound sterling bank note. These prices define exchange ratios: the gold bullion is exchanged for 15 \( \frac{9}{124} \) silver bullion, 44 \( \frac{1}{2} \) guineas, 934 \( \frac{1}{2} \) shillings, or £46 14sh 6d in bank notes. These prices and exchange ratios define an equilibrium with no arbitrage opportunities. For instance, if we consider the florin of Amsterdam, whose weight in silver is equal to 20/11 of the weight in silver of the English shilling, we can define the par of exchange between the pound and the florin as 1 pound sterling equals 11 florins. If the exchange rate between the bank deposits in London and Amsterdam is at this level, there is no arbitrage opportunity for the prices of gold and silver bullions, coins, convertible bank notes and bank deposits in London, and between London and Amsterdam. The analyses of Henry Thornton in 1802, then Ricardo from 1809 onwards, concur on this point. Ricardo’s forcefully expressed disagreement does not concern the definition of an equilibrium with no arbitrage opportunities, but the way in which this equilibrium is attained; i.e. the arbitrage that leads to this equilibrium. Ricardo contests the arbitrage mechanism of gold points described by Thornton.

To this effect, Ricardo considers cases in which the substitutability between bullions, coins and bank notes is disturbed. Firstly, because the convertibility of bank notes is suspended; secondly, because the quantity of gold increases upon discovery of a mine; thirdly, because banks issue notes; and finally, because coins lose value. Sometimes Ricardo describes the arbitrages, sometimes not. He relies on the quantity theory and David Hume’s mechanism of international arbitrage (1752), the Price Specie Flow Mechanism. He proceeds by analogies, which leads him to an original definition of the value of paper money, a
seigniorage, then to a project of banking reform that dissociates the bank note from credit. Since he was capable of convincing others, Ricardo contributed to establishing the domination of the quantity theory in economic thought.

Section 2 of this article analyses the arbitrage that ensures the stability of the market price of the gold commodity (bullion) when the Bank of England note is convertible. We see that in the event of inconvertibility, arbitrage disappears so entirely that the market price of the gold commodity may become stabilised above the legal price of coined gold. I will emphasise the fact that Ricardo’s originality resides not in the description of this arbitrage, which is already present in Thornton, but in its interpretation. Section 3 deals with the value of the gold commodity. I shall show that this value does not vary when wages vary, whether they are monetary or real wages. Section 4 introduces the Price Specie Flow Mechanism and defines an equilibrium with no arbitrage opportunities, in which the market price of the gold commodity exceeds the legal price of coined gold. In this section, the analysis concerns an economy in which there is only gold coins in circulation and not bank notes. The international value of the gold commodity is stable and the excess of the market price of gold in relation to the legal price is explained by the presence of debased coins. Section 5 introduces bank notes and presents the analogy established by Ricardo between the inconvertibility of the bank notes and debased coins. I will analyse why – according to Ricardo – the value of paper money depends exclusively on its quantity and why this value represents a form of seigniorage. Section 6 introduces the foreign exchange market with debased coins. We will see how, in the event of a rise in the market price of the gold commodity, the exchange rate must be reduced so that there is equilibrium with no arbitrage opportunities. In sections 4, 5 and 6, it appears that Ricardo defines equilibriums with no arbitrage opportunities in which the gold market price exceeds its legal price, but that he does not describe the arbitrages that lead to these equilibriums. Section 7 studies the conclusions that Ricardo draws from his analysis in terms of the issue of paper money.

Finally, in order to interpret Ricardian reasoning, it is necessary to discern two elements: 1) firstly, the definition of equilibriums with no arbitrage opportunities between values and the price of gold, debased coins, bank notes and exchange rates; 2) secondly, the description of the arbitrage processes that led to the formation of such equilibriums. de Boyer (2007), following Malthus (1811), Tooke (1848), Viner (1924), Angel (1926), Chipman (1984) and de Boyer (1987, 1992), emphasises the fact that Ricardo rejects the process of Thorntonian arbitrage that results in high bullion prices. This rejection is neglected in much of
the literature – Cannan (1919), Rist (1938), Mints (1945), Schumpeter (1954), Fetter (1965), Reisman (1971), Laidler (1986-a, b), Marcuzzo & Rosselli (1986), Arnon (1991), O’Brien (1994), Deleplace (1999) and Skaggs (1995, 2003, 2010). Annalisa Rosselli (2008) suggests that Ricardo and Thornton should no longer be placed in opposition. In my view, while it is correct that these authors may agree with respect to the description of certain situations of equilibrium with no arbitrage opportunities, this is not the case with respect to the process of arbitrage itself, which results in the formation of the equilibrium with high price of bullion. Moreover, this process is essential to the interpretation and identification of the causes of this equilibrium. Ricardo founds his quantity theory on the rejection of the Thorntonian arbitrage process. Here, I would show that Ricardo does not describe an alternative arbitrage process to the one described by Thornton. I would show that when he analyses the causes of the high price of bullion, Ricardo defines several equilibriums with no arbitrage opportunities, in which the market price of gold is superior to its legal price, but that he does not describe the arbitrage process that leads to these equilibriums, which causes the gold market price to rise.

2. Legal price of gold, gold market price and convertibility of bank notes

In 1797, in Great Britain, the unit of account was the pound sterling – written as “£”. The prices of goods, contracts and assets were made out in pounds sterling, shillings and pennies: £1 = 20 sh. = 240d. The legal tender comprised gold and silver coins with a fixed price, known as the golden guinea and the silver shilling. Specifically, the Troy ounce (ozt) of gold, which weighed 31.1034 grams, or 1/12 of a Troy pound (373.24 grams) of gold, was minted into guineas at the fixed price of £3 17sh. 10 1/2p. This fixed price for the ounce of gold was also known as the “legal price of gold”. Since Newton’s reform in 1717, the guinea had had a weight in metal that was equal to $\frac{1}{44,5}$ of a Troy pound of 22/24 carat gold, or 8.3874 grams$^3$, and its price – written as $\tilde{P}_g$ - was 21 sh. At the same time, the silver shilling had a weight in metal that was equal to $\frac{1}{62}$ of a Troy pound of 92,5/100 silver, or 6 grams$^4$, and its price was 1 sh. The legal price of the ounce of gold at £3 17sh. 101/2d. – i.e. £1 = 7.986 grams of 22/24 carat gold – was maintained during the period of suspension of

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$^3$ 7,6885 grams of fine gold ; 118,651 grains of fine gold
$^4$ 5,6 grams of fine silver ; 86 grains of fine silver
payments (1797-1821)\(^5\) and would continue once the payments began again. For the remainder of this analysis, our arguments will mainly focus on the ounce of gold.

That the guinea has a fixed price does not mean that its value is fixed, i.e. that its purchasing power over goods and labour is fixed. In fact, only the guinea had a legal fixed price; the prices in pounds sterling of each good \(i\) – written as \(\tilde{P}_i\) – and labour – written as \(\tilde{W}\) – are variable; they are determined on the markets through the interplay of supply and demand. Gold bullion was one of the commodities, weighing one Troy pound (or 12 ounces), and its price is written as \(\tilde{P}_{\text{bullion}}\). The formation of this price on the gold market was a major issue among others issues during the Bullionist Controversy (1801-1821)\(^6\). The protagonists agreed on the fact that the formation of the price \(\tilde{P}_{\text{bullion}}\) of gold bullion brings one or several forms of arbitrages into play. However, their opinions diverge as to the nature of some forms of arbitrage – when there was convertibility of bank notes and also when such convertibility was suspended.

Bank notes are debts on sight, made out in pounds sterling, issued by banks and payable in guineas. It is possible to convert notes into guineas, and we use the expressions “suspension of payments” and “resumption of payments”, to respectively refer to the suspension and resumption of this convertibility. Thus, the payments by the banks of their notes into guineas, at the price of £3 17sh. 101/2d per ounce, were suspended between 1797 and 1821. The suspension of payments had an essential impact on the price \(\tilde{P}_{\text{bullion}}\) of gold bullion.

The fact that the banks pay their notes in guineas, at the fixed price \(\tilde{P}_g = 21\) sh. was at the root of an arbitrage that stabilised the price of gold bullion to \(\tilde{P}_{\text{bullion}} = £46 14\) sh. 6p.\(^7\). The classical authors concur with respect to this arbitrage, which we also find in David Ricardo’s first article, *The Price of Gold* (1809). In the event that the gold ounce was worth more than £3 17sh. 101/2d. (for example £4 5 sh. 8 d.) on the gold market (for gold bullion), the arbitragists would sell the gold bullion on the market in exchange for bank notes, then they would convert these notes in the banks into guineas at the price of 21 sh., which they would melt down, then sell again on the gold market for a 10% profit. Once sold on the

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\(^5\) The Recoinage act of 1816 substituted the sovereign for the guinea. The sovereign weights 7.988 grams of 22/24 carat gold (7,3223 grams and 113,001 grains of fine gold), i.e. 20/21 of the guinea; its legal price is 20 sh. The weight of the shilling silver coin was reduced by 66/62.

\(^6\) Cf. de Boyer des Roches and Solis Rosales (2011)

\(^7\) 12 ounces \(\times\) £3 17sh. 10 ½ d. per ounce
market for £4 5 sh. 8 d., the gold is bought at the bank for £3 17sh. 101/2d. This arbitrage thus increases the supply of gold on the market, which leads to a fall in the price of gold until it returns to the level of £3 17sh. 101/2d. per ounce. In terms of a symmetrical relationship, if the price per ounce on the market is situated below its legal price in the banks, the arbitragists deposit the gold that they have bought on the market into the banks, which increases the demand for gold on the market, resulting in a rise in the market price of gold. The process lasts until the gold returns to the level of £3 17sh. 101/2d. per ounce. Hence, until 1797, by guaranteeing the convertibility of their notes and, symmetrically, by accepting the deposit of gold at their counters, banks were indirectly stabilising (via the arbitragists’ actions) the price of the ounce of gold on the gold bullion market at its legal price level. The convertibility of bank notes signified the buying and selling of gold at a fixed price.

Ricardo’s originality does not reside in the description of this arbitrage, but in its interpretation. To his eyes, this represents a process of correction of the quantity of notes. The payment of notes is above all interpreted as a reduction in the quantity of notes in circulation, rather than as the source of an additional supply of gold on the gold market. According to Ricardo, the arbitrage described above “would be continued till the Bank had withdrawn the superfluous quantity of their notes from circulation, and had thereby brought the market and mint prices of gold to a level. (…) No efforts of the Bank could keep more than a certain quantity of notes in circulation, and if that quantity was exceeded, its effects on the price of gold always brought the excess back to the Bank for specie.” Ricardo (1809, p. 16)

According to Ricardo, the corollary to any variation in the market price of gold was a variation in the amount of notes in circulation; and vice versa, the corollary to any variation in the quantity of notes was a variation in the market price of gold. While it is affirmed here within the context of the convertibility of notes, this property is also valid where there is an absence of convertibility. In fact, irrespective of whether convertibility was possible or not, Ricardo postulated the following causal relationship: any variation in the quantity of notes provokes a parallel variation in the price of gold; and reciprocally, any variation in the price of gold is provoked by a variation in the quantity of notes. However, as Sylvie Diatkine notes (2009), Ricardo does not explain the mechanism of this causality anywhere. This is simply postulated. Yet, contrary to Ricardo’s belief, noting that there is a reimbursement/issue of notes in the arbitrage described above does not mean that any variation in the quantity of money causes a variation in the price of gold. Indeed, the causality postulated by Ricardo is contradicted as soon as we consider – as Henry Thornton (1802) did – the variations in the
speed of circulation of notes and the role of Bank of England issues in ensuring the liquidity of the money market, as well as the liquidity of Exchequer bills\(^8\). However, Ricardo barely touches on these questions. Furthermore, the “quantity of bank notes – gold market price” causality postulated by Ricardo can be contested, following Thornton (1802) and Robert Malthus (1811), by considering the impact of international capital movements on the foreign exchange market, then on the gold market via the gold points mechanism. But Ricardo excludes the possibility that the variations in the market price of gold might be caused by the variations in the exchange rate\(^9\).

In short, according to Ricardo, the quantity of bank notes determines the market price of gold bullion and, in a regime of convertibility, the arbitrage described above leads to an adjustment of the quantity of bank notes in such a way that this market price of gold is adjusted to its legal price. In the case of inconvertibility, the arbitrage disappears so entirely that there is no automatic adjustment mechanism for the quantity of bank notes that leads to a convergence of the market price of gold and its legal price. In the case of inconvertibility, the market price of gold may durably establish itself above the legal price. What distinguishes inconvertibility from convertibility is the absence of the automatic adjustment mechanism for the quantity of bank notes\(^10\).

### 3. Natural value and market value of gold

Therefore, gold has a market price \(\bar{P}_{\text{bullion}}\) as a commodity, and a legal price \(\bar{P}_g\) as money. The first price is variable, whereas the second is fixed. The first adjusts itself to the second in the case of bank note convertibility. Reciprocally, the two prices may be different in the case of inconvertibility.

Now, what about the value of gold? When Ricardo mentions the value of gold, does he mean the gold commodity or the coined gold? Is he reasoning within a situation of convertibility or inconvertibility of bank notes? In order to answer these questions, it seems opportune to refer to both the monetary writings and to the *Principles of Political Economy and Taxation* (1817) in which Ricardo develops his theory of the value of commodities.

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\(^8\) Mentioned however by Hume (1752), Steuart (1767) and Smith (1776). Cf. de Boyer (2005; 2008) and de Boyer & Bentemessek (2010).

\(^9\) Cf. de Boyer (2003, 2007).

\(^10\) In the event of an excess of notes, the legal price of the gold ounce contained in gold coins is inferior to the market price of the ounce of gold contained in gold bullion, to such an extent that the coins go out of circulation and are hoarded or melted.
As a commodity, gold has a value. This value is expressed in the form of a value that is relative to other commodities, which is equal to the inverse relationship of exchanged quantities. This relative value is therefore of a different nature than its price (expressed in the unit of account, the pound sterling). To say that the gold ounce is worth 10 quintals of wheat expresses an exchange of two commodities: gold on the one hand, and wheat on the other. When Ricardo speaks of the “value of gold” – whether in bullion or coin – he is referring to this relative value of gold in relation to other commodities. In other words, he is referring to the purchasing power of gold commodity over other commodities. But is the relative value of gold stable? Is it variable? In order to respond, I suggest that we seek inspiration in Adam Smith’s terminology, which distinguishes between natural prices and market prices. We will thus draw a distinction between two types of relative value of gold: the natural relative value of gold on the one hand, and the market relative value of gold on the other. As we shall see, the former is stable, whereas the latter may vary.

The natural relative value of gold

Firstly, there is the natural relative value of gold that results from the respective conditions of production of gold and of other commodities, on the one hand, and, on the other hand from the level of wages. Clearly, it is the gold commodity – bullion – that is in question here. We shall write this natural relative value of gold as $V_N^{bi}$; it is independent of supply and demand.

In the first chapter of the Principles, Ricardo shows that a variation in wages has a different impact on the natural relative value of gold depending on whether it is a nominal or real variation. A nominal variation in wages that leaves the real wage rate unchanged, and hence the rate of profit, does not modify the natural relative value of commodities, including the commodity of gold. This is the case when bank note inflation occurs. Here, monetary wages, the price of the gold commodity (bullion) and the prices of all the other commodities increase proportionally:

$$\frac{\delta \tilde{P}_{\text{bullion}}}{\tilde{P}_{\text{bullion}}} = \frac{\delta \tilde{P}_i}{\tilde{P}_i} = \frac{\delta \tilde{W}}{W} > 0$$

$$\delta V_N^{bi} = \delta \frac{\tilde{P}_{\text{bullion}}}{\tilde{P}_i} = 0$$

$$\delta V_N^{bW} = \delta \frac{\tilde{P}_{\text{bullion}}}{\tilde{P}_W} = 0$$
The *natural relative value* of the gold commodity, bullion, in relation to each of the commodities does not vary in the case of an overall and proportional rise in the prices of commodities and labour. However, we shall see later that the price of gold, of bullion, does not rise in accordance with the same mechanisms as the prices of other commodities.\(^{11}\)

On the other hand, a variation of the real wage (for example, as a result of cultivating less fertile land) modifies each of the *natural relative values* of gold in the different commodities. In the case of a rise in the rate of real wages, the *natural relative value* of the gold commodity increases in relation to the commodities \(i^+\) whose production requires relatively more capital; it decreases in relation to the commodities \(i^-\) whose production requires relatively less capital. However, Ricardo hypothesises that the conditions of production of the gold commodity are situated at the average level of the different commodities:

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"May not gold be considered as a commodity produced with such proportions of the two kinds of capital as approach nearest to the average quantity employed in the production of most commodities? May not these proportions be so nearly equally distant from the two extremes, the one where little fixed capital is used, the other where little labour is employed, as to form a just mean between them?"

If, then, I may suppose myself to be possessed of a standard so nearly approaching to an invariable one, the advantage is, that I shall be enabled to speak of the variations of other things, without embarrassing myself on every occasion with the consideration of the possible alteration in the value of the medium in which price and value are estimated.

To facilitate, then, the object of this enquiry, although I fully allow that money made of gold is subject to most of the variations of other things, I shall suppose it to be invariable, and therefore all alterations in price to be occasioned by some alteration in the value of the commodity of which I may be speaking." Ricardo (1817, p. 45-6)
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We can express the hypothesis made by Ricardo by establishing that the *natural relative value* of the gold commodity in relation to the aggregate of all of the goods – written as \(V_{N}^{b, z, i}\) – is stable:

\[
\frac{\delta \tilde{P}_{\text{bullion}}}{\delta P^{i^+}} > 0
\]
\[
\frac{\delta \tilde{P}_{\text{bullion}}}{\delta P^{i^-}} < 0
\]
\[
\delta \ V_{N}^{b, z, i} = 0
\]

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\(^{11}\) Whereas Boyd (1801) sees in the rise in the price of gold, the effect on gold – as on any other commodity – of the increase in the quantity of bank notes.
Thus, according to Ricardo, while the price of the gold commodity in pounds sterling may vary, its *natural relative value* in relation to all of the goods – that is, its purchasing power, or its value – is always stable\(^\text{12}\): \(\delta V^b_i = 0\). For the remainder of this analysis, we do not deal with the case of variation of real wage, but nominal wage.

*The market relative value of gold*

As a parallel to the stable *natural relative value of the gold commodity* (\(V^b_i\)), Ricardo stresses the fact that the value of gold may vary in the short term. It decreases (increases) when the quantity of coins and/or bank notes increases (decreases). We use the term *market relative value* of the gold commodity to analyse this variable value of gold, and write it as \(V^m_i\) since it is the relative value of coined gold – guineas – that is essentially concerned. In the short term, as long as the substitutability between guineas, bullion and bank notes is in effect, this fall in the market relative value also concerns the gold commodity (bullion), whose price remains fixed: \(\delta \tilde{P}_{bullion} = \delta \tilde{P}_g = 0\). However, if the substitutability between guineas, bullion and notes is imperfect\(^\text{13}\), the value of the gold commodity detaches itself from the value of coined gold and/or notes. In this case, the market price of the gold commodity may rise: \(\delta \tilde{P}_{bullion} \neq 0\).

We have seen that in the event of inflation, in which the increase in the price \(\tilde{P}_{bullion}\) of the gold commodity matches the increase in the overall level of prices, or \(\frac{\delta \tilde{P}_{bullion}}{\tilde{P}_{bullion}} = \frac{\delta \tilde{P}_i}{\tilde{P}_i}\), that this increase has no effect on the *natural relative value* – i.e. the purchasing power – of the gold commodity: \(\delta V^b_i = 0\).

\[
\frac{\delta \tilde{P}_{bullion}}{\tilde{P}_{bullion}} = \frac{\delta \tilde{P}_i}{\tilde{P}_i} \iff \delta V^b_i = \delta \frac{\tilde{P}_{bullion}}{\tilde{P}_i} = 0
\]

However, since the *prix* \(\tilde{P}_g\) of the guinea is fixed, there is a decrease in the *market relative value* of the guinea \(V^m_i = \frac{\tilde{P}_g}{\tilde{P}_i}\):

\[
\delta \tilde{P}_g = 0 \implies \delta V^m_i = \delta \frac{\tilde{P}_g}{\tilde{P}_i} < 0
\]

\(^{12}\) Following a variation in the rate of real or monetary wages.

\(^{13}\) Due to the debasement of coins or the suspension of bank note convertibility. Cf. infra.
Therefore, when Ricardo wrote, in the third edition (1810) of the *High Price of Bullion* that “An increase of paper currency ... lowers the value of gold bullion but raises its money price”, he appears to be referring to gold bullion substituting the guinea in the first case, and to bullion that is no longer a substitute for the guinea in the second. In the first case, it is a question of the relative value of the guinea in comparison with goods – i.e. its purchasing power – whereas the second case concerns the market price of bullion.

If we take all of these elements into account, for Ricardo, the stability of the price $\tilde{p}_{\text{bullion}}$ in pounds sterling of the gold bullion signifies the stability of the purchasing power of the guinea, of the currency; the fixed price of the gold ounce under the convertibility regime (i.e. the gold standard) is synonymous with the stability of the purchasing power of the currency. This idea of Ricardo’s nourished the British Quantitativist tradition of the nineteenth century.\(^{14}\)

### 4. Low value of guineas and high price of bullion

**Balance of trade and Price Specie Flow Mechanism**

The mines that produce gold are not located in England, the gold comes from outside its borders; hence the importations and exportations of gold played a central role in Ricardo analysis. Ricardo opposed Hume’s approach (1752) to Thornton’s explanation in 1802 of gold importations and exportations via exchange rate fluctuations. In the article *High Price of Bullion* (1810), he takes up the Price Specie Flow Mechanism (PFSM) again and develops it, opposing it to the Gold Point Mechanism -- an opposition that has been widely overlooked.

Next, like Thornton, Ricardo emphasises that gold is imported and exported as a commodity, that is, according its prices and/or values. “Gold ... seeks, like (other commodities), that country in which it is the dearest,” writes Thornton in 1802 (p. 145). “Gold and silver, whether in coin or in bullion, obeying the law which regulates all other commodities ... would leave the country where they were cheap, for those countries where they were dear” Ricardo writes, eight years later (p.54).

However, beyond this idea, the two economists diverge. In Thornton’s analysis, gold is imported or exported according to the exchange rate of the pound sterling and to the legal price $\tilde{P}_{g}$ of the guinea [and of foreign coins], whereas in the analysis of Hume/Ricardo, gold

\(^{14}\) It was to be called into question by the European and North American neoclassical quantity economists at the end of the 19\(^{th}\) century.
is imported or exported according to its purchasing power\textsuperscript{15} $V^g_{m} = \frac{\tilde{P}}{\tilde{P}^i}$. This article will not present the critique of Thornton’s analysis developed by Ricardo\textsuperscript{16}, I will limit myself to an exposition of the latter’s theory.

Following Hume, his point of reference, Ricardo invites us to study the properties of an economy in which monetary circulation is exclusively made up of gold, without distinguishing coins from bullion [“whether in coin or in bullion” writes Ricardo]. Let us suppose (cf. the diagram below) that before the discovery of a mine, the quantity of money is $G_0$, the quantity of goods to be traded is $X$ and the general price level is $\tilde{P}$. The purchasing power of the guinea $\frac{\tilde{P}}{\tilde{P}}$ is determined at $E_0$, the point of intersection between the equilateral hyperbole of the equation\textsuperscript{17} $\frac{\tilde{P}}{\tilde{P}} G_0 = X$ and the line stemming from $G_0$. Let us assume that the purchasing power of the guinea is equal to the natural relative value of gold - $\frac{\tilde{P}}{\tilde{P}} = V^b = \frac{\tilde{P}}{\tilde{P}} = 1_{44,5} V^b = \frac{1_{44,5}}{\tilde{P}}$ - the latter also being the prevailing value outside of England.

\textsuperscript{15} Cf. de Boyer and Diatkine (2008)
\textsuperscript{17} This equation is deducted from the relation $\tilde{P}_g G_0 = \tilde{P} X$. The velocity of coin circulation is supposed to be equal to 1.
Let us imagine that the discovery of a gold mine multiplies by the quantity of money: \( G_1 = \lambda G_0 \) [displacement towards the right of the line representing the quantity of money]. The price level \( \tilde{P} \) of the goods increases [displacement to the right on the X curve] until it reaches the point of equilibrium \( E_1 \) at which the price level of the goods multiplied by \( \lambda \) and at which the purchasing power of gold -“whether in coin or in bullion”- is divided by \( \lambda \). Given that this purchasing power has remained unchanged outside of England, the gold leaves England for the continent where it is “dearer”. The dispatch of the gold reduces the quantity of gold in England [displacement towards the left of the line representing the quantity of money], which causes its purchasing power to increase [leftwards displacement on the X curve]. The process lasts until the situation initial is restored \( (G_0, E_0) \).

**Debased coins and the high price of bullion**

The process described above applies to coins whose weight in metal is intact. In the event of circulation of debased coins, the exportation process of coins – and hence the reduction of the quantity of money – will stop before the initial purchasing power of the coins has been recovered. For example, if, for a large number of guineas previously in circulation, the weight in metal represents only \( \beta \) of the 8.3874 grams of gold that they should have, then the guineas will stop going out of circulation when point \( D_1 \) has been attained: the quantity of money in circulation will be \( DG \) and its purchasing power will be stabilised at the level \( \frac{1}{44.5} V^n_b \). In Ricardo’s terms, the guineas are depreciated.

The interpretation of this depreciation is essential in the history and success of the quantity theory in the 19th century. According to the latter, if the coins are depreciated it is not because their weight in metal has diminished, but because their quantity has increased.

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18 We are describing the following process: “If a mine of gold were discovered in either of these countries, the currency of that country would be lowered in value in consequence of the increased quantity of the precious metals brought into circulation, and would therefore no longer be of the same value as that of other countries. Gold and silver, whether in coin or in bullion, obeying the law which regulates all other commodities, would immediately become articles of exportation; they would leave the country where they were cheap, for those countries where they were dear, and would continue to do so, as long as the mine should prove productive, and till the proportion existing between capital and money in each country before the discovery of the mine, were 1 again established, and gold and silver restored every where to one value. In return for the gold exported, commodities would be imported; and though what is usually termed the balance of trade would be against the country exporting money or bullion, it would be evident that she was carrying on a most advantageous trade, exporting that which was no way useful to her, for commodities which might be employed in the extension of her manufactures, and the increase of her wealth.” (Ricardo 1810, p. 54)

19 We suppose that Enland is a very little country in comparison with the rest of the world.
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(DG>G₀). At E₀, before the discovery of the mine, even though they are debased, the guineas had a purchasing power equal to \( \frac{\hat{P}_g}{\hat{P}_i} = \frac{1}{44.5} V_N^b \). It is therefore because we have the quantity DG of coins instead of the quantity G₀ that the debased guineas are depreciated at the point of equilibrium D₁. To convince ourselves of this, let’s imagine that the quantity X of goods to be traded is X+ΔX [displacement of the X curve towards the right], hence, the point of equilibrium is at D₂, with a purchasing power of debased guineas that once again establishes itself at the level \( \frac{1}{44.5} V_N^b \). The debasement of coins only has an effect on their value indirectly, by limiting their exportation.

Let us return to the case of the debased coins at the point of equilibrium D₁. At this point, the substitutability of guineas and bullion ends. The guineas only have \( \beta<1 \) of their legal weight in metal, that is, \( \beta \) of 8.3874 grams of gold, whereas bullion contains 373.24 grams, or a weight in metal that is no longer that of 44.5 guineas, but of \( \frac{44.5}{\beta} \) guineas. With the legal price of the guinea at 21sh, this represents \( \hat{P}_{\text{bullion}} = \frac{£46 \ 14 \ sh. \ 6p.}{\beta} \). With this “high price of bullion”, we have the equilibrium with no arbitrage opportunities, as follows:

\[
\frac{\hat{P}_g}{\hat{P}_i} = \beta \cdot \frac{1}{44.5} V_N^b \\
\frac{\hat{P}_{\text{bullion}}}{\hat{P}_i} = V_N^b \\
\hat{P}_{\text{bullion}} = 44.5 \cdot \frac{1}{\beta} \hat{P}_i = \frac{£46 \ 14 \ sh. \ 6p.}{\beta}
\]

At D₁, if \( \hat{P}_{\text{bullion}} < \frac{£46 \ 14 \ sh. \ 6p.}{\beta} \), an arbitrage is possible. For example, bullion is bought in order to be exported, which raises the price of bullion, thus proving the depreciation of the guinea. Yet Ricardo does not describe this kind of arbitrage²⁰.

5. Seigniorage and bank notes

i - Debased coins and seigniorage

The case of the debasement of coins is instructive for Ricardo, however. Since it allows the quantity theory to be validated while providing an explanation for seigniorage at

²⁰ Note that Ricardo did not think that the high price of bullion in 1810 was due to the presence of debased coins.
the same time; i.e. a tax on the minting that the State is capable of putting in place once it controls the quantity of coined metal. Without depreciating the guineas, at E₀ and D₂, because it limits its quantities at G₀ and DG respectively, the State can mint, in a one pound bullion, at the price of \( \tilde{P} \) each, \( \frac{44.5}{\beta} \) guineas containing \( \beta (8.3974) \) grams of gold instead of 44.5 guineas containing 8.3874 grams of gold. The seigniorage is equal to \( \left( \frac{1-\beta}{\beta} \right) 44.5 \tilde{P} \): “by a limitation of its quantity, a debased coin would circulate at the value it should bear, if it were of the legal weight and fineness, and not at the value of the quantity of metal which it actually contained.” (Ricardo, 1917, p. 353)

This conclusion led Ricardo to define paper money as a money issued with 100% seigniorage: “It is on this principle that paper money circulates: the whole charge for paper money may be considered as seigniorage. Though it has no intrinsic value, yet, by limiting its quantity, its value in exchange is as great as an equal denomination of coin, or of bullion in that coin.” (Ricardo, 1917, p. 353). A definition that he also applies to bank notes: “After the establishment of Banks, the State has not the sole power of coining or issuing money.” (Ricardo, 1917, p. 3..).

In so doing, Ricardo substantially distances himself from the bank note theory of his two great predecessors, Adam Smith (1776) and Thornton (1802). Unlike them, he does not analyse the issue of bank notes by associating it with credit or liquidity risks. He studies the bank note via its effect on prices, following Richard Cantillon (1728-30) and Hume (1752). Hence the analogy between the institution of banks and the discovery of new gold mines:

“If instead of a mine being discovered in any country, a bank were established, such as the Bank of England, with the power of issuing its notes for a circulating medium; after a large amount had been issued either by way of loan to merchants, or by advances to government, thereby adding considerably to the sum of the currency, the same effect would follow as in the case of the mine. The circulating medium would be lowered in value, and goods would experience a proportionate rise. The equilibrium between that and other nations would only be restored by the exportation of part of the coin.” Ricardo (1810, p.54-5).

The modalities of issue do not interest Ricardo. He does not consider the bank note as a debt, but as a currency that, in its effects, is similar to the guinea, debased or not debased.

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21 Eds. 1 – 2 do not contain ‘and’.
22 Cf. de Boyer (2013)
ii - Seigniorage, convertibility and depreciation of bank notes

Let us suppose that the guineas are not debased and imagine an issue of the quantity $N_0$ of bank notes in addition to the quantity $G_0$ of guineas in circulation, such that the total quantity of money $G_0N_0$ is equal to $\lambda G_0$ (cf. the diagram below). The equilibrium $E_1$ replaces the equilibrium $E_0$, and the value of the money is divided by $\lambda$. The result is an exportation of guineas that continues so long as the value of the money is less than $\frac{1}{44,5} V^b_N$, that is until the sum $G_1N_0$ of the quantity $G_1$ of guineas and of the quantity $N_0$ of bank notes is equal to the quantity $G_0$ of guineas that were in circulation before the bank was instituted. The substitution of bank notes for guineas in the monetary circulation is effectuated by way of the price mechanism described by the Price Specie Flow Mechanism$^{23}$.

Let us now suppose that the quantity of notes increases again, attaining the amount $N_1 = G_0$, to the extent that all of the guineas go out of circulation. What happens in the event of a new issue? The answer depends on whether or not the bank notes are convertible.

\[ 23 \text{ Ricardo (1811, pp. 327-8) criticises Smith and Bentham for not having understood this.} \]
If the notes are convertible into gold at the bank, since any new issue will cause a decrease in the value of money – *whether in coin, in bullion, or banknotes* – the arbitragists will request the conversion of notes to gold, and then they will export this gold. The price level will fall, the equilibrium $E_0$ will be restored, and the value of the money will return to the level $\frac{1}{44.5} V^b_n$. Naturally, if the value of the money is stabilised at this level, it is not because the gold that comes out of the bank coffers is exported, it is because the notes that are converted into gold are taken out of circulation. In this case, there is never any “high price of bullion”. So long as the bank has a gold reserve that ensures the convertibility of notes at the legal price of gold, the quantity of money will adjust in such a way that the market relative value of the gold commodity will be stabilised at the level of its natural relative value. This is therefore the fundamental argument underpinning the assimilation of the arbitrage (described at the very beginning of this article) to a process of adjustment of the quantity of money alongside the adjustment of the price of gold.

If the notes are not convertible, the overissue will not be corrected and the value of the money will be durably decreased. For example, if the quantity of notes attains $N_2 = \mu N_1$, the equilibrium is located at $D_1$. This equilibrium is identical to the one that was defined above, although it concerned debased coins in an economy without notes. We would also obtain this equilibrium with a quantity $DG_3$ of debased coins circulating conjointly with the quantity $N_3$ of notes, where $DG_3 + N_3 = N_2$; or if the notes were convertible into debased guineas. Ricardo establishes the analogy between these different cases: each time there is a depreciation of the money – debased guineas and notes – because its quantity cannot be reduced. Furthermore, in each case, with the market price of bullion at £3 17sh. 10 1/2p per ounce, it is best to export the bullion, i.e. there is an arbitrage opportunity. However, Ricardo does not describe the arbitrage process that results in the “high price of bullion”.

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24 To paraphrase Ricardo.

25 It is therefore important to adopt a form of banking legislation that prevents these guineas from being reintroduced into circulation, namely via credit. The idea, which is at the heart of the Plan of 1823, would be taken up again by Pennington [cf. Béraud (2010)], then the *Currency School* and would lead to the 1844 Bank of England reform.
6. Arbitrage and exchange rate

Arbitrage opportunity and arbitrage process

We saw (supra, p. 5) that, in his very first article, Ricardo described the arbitrage process that prevents the market price of the gold ounce (in the form of bullion) to depart from its legal price in a situation in which the bank notes are convertible. In his subsequent writing, based on Hume’s Price Specie Flow Mechanism, he presents two cases in which there is an arbitrage opportunity if the market price of the gold ounce (in the form of bullion) does not exceed its legal price. In the first case, it is because there is an excessive amount of debased coins. In the second, it is because there is an excessive amount of inconvertible bank notes. However, in neither of these two cases does he describe the arbitrage process that causes the market price of the gold commodity (bullion) to rise. Quantity theory explains the rise in the overall level of prices (passage from $E_0$ to $E_1$), then the fall in the overall level of prices (passage from $E_1$ to $D_1$), but not the rise in the market price of gold that intervenes when [and only when] the coins are debased and/or the notes are inconvertible. The high price of bullion stems from an arbitrage provoked by the blockage of the process of reduction of the quantity of money. Ricardo demonstrates the necessity of this arbitrage, but he does not describe the process.

Therefore, we have seen that, before introducing the exchange rate into his analysis, Ricardo discusses three cases in which an arbitrage associated with the market price of gold is conceivable. The first case reflects a situation in which the bank note is convertible; Ricardo describes the arbitrage process that prevents any rise in the market price of gold. In the two other cases—debased coins and inconvertible bank notes—Ricardo defines a situation in which arbitrage will occur, but does not describe the arbitrage process in question. This is also the case when he takes the exchange rate into consideration.

Concerning the arbitrage process that occurs when the bank note is convertible, and which eliminates the high price of bullion, Ricardo appears to concur with Thornton. However, he only concurs with respect to the description of the arbitrage process. Regarding its interpretation, he opposes Thornton. According to the latter, the initial appearance of a high price of bullion is the effect of an earlier arbitrage, consecutive to a fall in the exchange rate. Ricardo contests this analysis. According to Ricardo, the initial appearance of a high price of bullion is the consequence of an excess of money$^{26}$; no arbitrage causing the

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$^{26}$ In this case, bank notes.
exchange rate to have an effect is at work at this stage! Ricardo concludes that the high price of bullion is the consequence of an excess of money by basing his argument on the two effects described in the arbitrage process\textsuperscript{27} that eliminate the high price of bullion: on the one hand, this process reduces the amount of bank notes, on the other hand, and at the same time, it lowers the price of bullion. According to Ricardo, since these two effects of the arbitrage process are concomitant, this proves that an excess of bank notes is the cause of the high price of bullion.

\textit{The exchange rate and the high price of bullion}

The participants in the bullionist controversy agreed that the price of bullion would not be high if bank notes were convertible. However, given a situation of inconvertibility of the bank note, via what mechanism does the price of bullion increase? Via which market process? Ricardo, following Thornton, understands that the rise in the price of bullion eliminates any arbitrage opportunity. He notes that in the absence of an increase, an arbitrage opportunity would appear, which would set off an arbitrage process, the effect of which would be to provoke the increase. However, unlike Thornton, Ricardo does not describe this arbitrage process that causes the market price of gold to rise\textsuperscript{28}. Using the quantity theory inherited from Hume, he describes a situation with arbitrage opportunities, and deduces that Thornton’s analysis, which is different from his own, is erroneous. Hence, he rejects the Gold Points Mechanism whereby the rise in the price of bullion is provoked by the fall in the exchange rate. According to Ricardo, it is the high price of bullion that provokes the fall in the exchange rate: \textit{“Here, and in many other parts of the same article, the fall in the exchange, or the unfavourable balance of trade, is stated to be the cause of the excess of the market above the mint price of gold, but it appears to be the effect of such excess. An increase of paper currency ... lowers the value of gold bullion but raises its money price. It is the fall in its value which causes its exportation, and therefore the fall of the exchange”}(Ricardo, 1810, third ed., p. 64, footnote 1)

In order to support his argument, Ricardo once again defines a situation with arbitrage opportunities, however, this time, the example involves an economy with a foreign exchange market. He evokes the cases of the debased coins and inconvertible bank notes. Let us now follow his reasoning.

\textsuperscript{27} See supra, section 2, p.6.
\textsuperscript{28} Cf. Rosselli (2008, p. 75)
First of all, Ricardo defines the par of exchange between London and Amsterdam, or rather, between the pound sterling and the florin. The ratio is 1 pound for 11 florins. This exchange rate exists “because the pure silver contained in eleven florins is equal to the pure silver contained in twenty standard shillings.” (1810; p. 71). This means that one may purchase 11 florins with \(\frac{20}{21}\) guineas, or, 231 florins with 20 guineas, or 1.100 florins with 100 pounds sterling in coins (the equivalent of 47 guineas and 3 shillings).

Ricardo thus specifies that on the foreign exchange market in London, a banker selling 1 100 florins payable in Amsterdam will accept the sale for £100 payable in London on the condition that the means of payment in London is in coins, golden guineas and silver shillings that are undebased, or bank notes that are convertible to undebased coins:

“While the circulating medium consists, therefore, of coin undebased, or of paper-money immediately exchangeable for undebased coin, the exchange can never be more above, or more below, par, than the expenses attending the transportation of the precious metals. But when it consists of a depreciated paper-money, it necessarily will fall according to the degree of the depreciation.” (1810, p. 72).

In this case, the exchange rate of 11 florins per pound offers no arbitrage opportunities.

This is not the case however if the English coins are debased. If, for example, the guinea only contains 80% of the metal that it should contain, then \(\frac{20}{21}\) of a guinea no longer corresponds to 100% of 11 florins, but 80%. A banker will not offer 1.100 florins payable to Amsterdam for 100 pounds sterling in debased coins. The exchange rate of 11 florins for one pound will be arbitrated. So that it is not arbitrated, the exchange rate of the pound sterling must be lower; it must be £125 for 1.100 florins, or £1 5sh. for 11 florins. Ricardo concludes that the depreciation of coins is the cause of the fall in the exchange rate.

While he is on the subject, Ricardo extends the argument to the purchase of Bills of Exchange with bank notes. Here, the banker, who offers the florins payable in Amsterdam, will focus on the price of gold in London: “If I pay him in paper money; as he cannot send it abroad, he will consider whether it will purchase as much gold or silver bullion as is contained in the coin for which it is a substitute; if it will do this, paper will be as acceptable

\[\text{29 In order to simplify the argument, we will disregard the risks connected to the melting and exportation of coins, as well as the transport and insurance costs for precious metals.}\]
to him as coin; but if it will not, he will expect a further premium for his bill, equal to the depreciation of the paper.” (p. 72). If the price of the bullion payable in inconvertible bank notes has risen by 25% on the gold market in London, the banker will not offer 1 100 florins payable in Amsterdam for 100 pounds sterling in inconvertible notes. So that it is not arbitrated, the exchange rate of the pound sterling must be lower; it must be £125 per 1.100 florins. Ricardo concludes that the high price of bullion is the cause of the fall in the exchange rate.

By analogy between the two cases, Ricardo concludes that a high price of bullion proves that the bank notes are like debased coins, i.e. that they are depreciated. He concludes that this depreciation explains the fall in the exchange rate, that it causes it.

However, this analogy is contestable since debasement of the coins, which modifies the definition of the par of exchange, is exogenous to the market process whereas the high price of bullion is the consequence of a market process. The debasement of coins is exogenous just as a devaluation of the pound sterling would be, i.e. an increase in the price $\tilde{P}_g$ of account of the guinea containing 8.3874 grams of gold, i.e. an increase in the legal price of the gold ounce. Nothing of the sort took place at the time of the bullionist controversy. However, there was a high price of bullion, which was the consequence of a market process that required an explanation.

Bullionists and anti-bullionists agreed on the fact that the price of bullion was inevitably at a level whereby no arbitrage opportunity could exist. In developing the Gold Points Mechanism, Thornton was describing an arbitrage process that explained how the price of bullion had established itself at this level. Ricardo was contesting the pertinence of the Thorntonian arbitrage process, but did not propose a description of the market process leading to the high price of bullion.

7. The 1823 Plan

In 1816, in his “Proposals for an Economical and Secure Currency”, Ricardo proposed that the Bank of England note be made “legal tender”, a proposition that he took up again in the “Principles” (1817), then for notes in his “Plan for the Establishment of a National Bank” (1823). This proposal is linked to his analysis of paper money, that is, he sees at not as a debt payable in “legal tender” (in this case, the guinea), but as a means of circulation devoid of intrinsic value – a means of circulation with a value that depends exclusively on its quantity, a value that represents a seigniorage acquired by the issuing party.
The bank money that Ricardo proposed to establish in 1823 is economical because it does not contain an ounce of gold, it is economical for the Nation because the seigniorage attached to it returns to the State. The National Bank, unlike the Bank of England, would belong to the Nation. It will not make the Treasury pay interest on the State bonds that it has in its portfolio and that it finances via its issues of notes. It must have monopoly of issue.

This conception of the bank note breaks away from the Smithian vision of an economy of capital immobilised in monetary practices permitted by bank credit. It also breaks away from the Thortonian vision of paper money as a kind of paper credit. In Smith and Thornton, the bank note is a debt issued by acquiring another debt. The bank note is linked to credit. Ricardo breaks away from this vision. His National Bank will not grant loans. It issues its notes by buying gold, and extinguishes them by selling gold. In this case, seigniorage takes the form of accumulation of gold by the National Bank.

The rule of issue is that of convertibility: the purchase and sale of gold at a fixed price, but it is bullion that is purchased, not coins. The ban for the National Bank to accord loans by issuing notes, as well as the issue of notes in answer to the supply and demand of gold at a fixed price, coupled with the monopoly of issue, were to inspire the reform of 1844.

Specifically, the rule of issue was to issue notes to buy the gold as soon as its market price dropped to £3 17sh. 6p., and to sell the gold for notes as soon as its price attained £3 17sh. 9p.. The aim of implementing this rule was not so much to stabilise the price of gold as it was to adjust the quantity of notes in order to stabilise the value of notes. This stability of the value of money does not presuppose that the quantity of notes is stable, only that it must vary as the gold reserve varies. The idea was inherited from the 1809-1811 writings, and also inspired the 1844 reform.

There is however one proposal, the originality of which has been underlined by de Boyer (1987) and Diatkine (1994) and which appears for the first time in Ricardo’s writing in 1823 (pp. 293-4). It would later disappear from his students’ work. Ricardo explains that the National Bank, instead of buying gold when its price dropped to £3 17sh. 6d, could buy exchequer bills. Reciprocally, it could sell exchequer bills, instead of selling gold, when the price of gold attained £3 17sh. 9d. In the first case, according to Ricardo, the purchase of exchequer bills will make the price of gold increase. Clearly, we find here the two main ideas

30 If Ricardo ever had a project to demonetize coins in his 1816 proposals, while the suspension of payments was in force, the idea was not taken up again in the 1823 plan, even though the Bank of England had restored the payment of its notes in coins two years before. Cf. Fetter (1965, pp. 91-9)
of the 1809 article: 1) the price of gold evolves with the quantity of money; 2) the stability of the price of gold is equivalent to the stability of the purchasing power of the money. However, Ricardo does not explain – no more than he does in 1809 – how and why the price of gold bullion fluctuates, here within this price bracket [£3 17sh. 6d; 3£ 17sh. 9d.]. Nor does he explain why it is the price of gold, and not the interest rate\(^{31}\), that varies when the Bank buys and sells exchequer bills.

Paris, February, 1, 2012

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