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Source: *The Journal of Political Economy*, Vol. 97, No. 3 (Jun., 1989), pp. 535-560

Published by: [The University of Chicago Press](#)

Stable URL: <http://www.jstor.org/stable/1830454>

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Tulipmania

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Though it is always mentioned first among the list of obvious manias, no serious effort has ever been expended to investigate the market fundamentals that might have driven the tulip speculation. This paper compiles time series on individual tulip prices and examines market fundamentals potentially driving prices. Most of the “tulipmania” was not obvious madness. High but rapidly depreciating prices for rare bulbs is a typical pattern in the flower bulb industry. Only the last month of the speculation, during which common bulb prices increased rapidly and crashed, remains as a potential bubble.

I. Introduction

Gathered around the campfires early in their training, fledgling economists hear the legend of the Dutch tulip speculation from their elders, priming them with a skeptical attitude toward speculative markets. That prices of “intrinsically useless” bulbs could rise so high and collapse so rapidly seems to provide a decisive example of the instability and irrationality that may materialize in asset markets. The Dutch tulipmania of 1634–37 always appears as a favorite case of speculative

I am grateful to Herschel Grossman, Robert Hodrick, Susan Gentleman, Salih Neftci, David Ribar, Rudiger Dornbusch, and James Peck for useful discussions; to Guido Imbens for resourceful research assistance; and to Marina van Dongen for helpful translations. Librarians at Harvard’s Houghton, Kress, Arnold Arboretum, and Grey Herbarium Libraries and at the Massachusetts Horticultural Society provided valuable guidance. I have benefited from the comments of three anonymous referees and from participants in workshops at Brown University, the Board of Governors of the Federal Reserve, City University of New York, Columbia University, Queen’s University, University of California, Los Angeles, Massachusetts Institute of Technology, and Northwestern. I have received support for this research from National Science Foundation grant SES-8606425.

[*Journal of Political Economy*, 1989, vol. 97, no. 3]
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excess, even providing a synonym in our jargon for a speculative mania.¹ As a nonessential agricultural commodity, the tulip could be reproduced rapidly and without limit, should its relative price have increased. Since market fundamental prices under any reasonable explanation should not have attained recorded levels, the tulipmania phenomenon has made it more likely that a sizable body of economists will occasionally embrace a rational or irrational "bubble hypothesis" in debates about whether bubbles have emerged in other episodes.²

In this paper, I shall describe the tulip spot and futures markets that emerged during the speculation and compile price data for several varieties of bulbs. I shall conclude that the most famous aspect of the mania, the extremely high prices reported for rare bulbs and their rapid decline, reflects normal pricing behavior in bulb markets and cannot be interpreted as evidence of market irrationality. Nevertheless, a less emphasized aspect of the mania, the speculation in common bulbs, does defy explanation.

The paper is divided into seven sections. Section II presents the traditional version of the tulipmania. Section III traces the sources of the traditional version and studies its influence on the recent economics and financial literature. Section IV describes the nature of tulip markets, focusing on how the reproductive cycle of the tulip itself determined behavior. Section V contains an analysis of seventeenth-century tulip prices. Since the data are too limited to construct "market fundamentals," I simply characterize the movement of prices for a variety of bulbs during and after the mania. I compare the pattern of price declines for initially rare eighteenth-century bulbs with that of

¹ The Mississippi and South Sea bubbles are the other two examples that appear on everyone's short list; these provide yet another synonym for speculative mania. Samuelson (1957) uses "tulipmania" interchangeably with "Ponzi scheme," "chain letter," and "bubble."

² Economists have placed numerous historical and contemporaneous episodes in the "bubble" category. For example, Kindleberger (1978) catalogs a long sequence of financial panics and manias and provides a descriptive pathology of their dynamics. Blanchard and Watson (1982) found evidence that can be interpreted as an indication of a bubble in gold markets. Recently, West (1984) and Shiller (1987) have interpreted stock market behavior as potential bubbles or fads, and Mankiw, Romer, and Shapiro (1985) and Summers (1986) have questioned hypotheses either that asset prices reflect fundamental values or that markets price assets efficiently. Shiller and Pound (1986) have proposed a contagion model of psychological forces in determining asset prices. Economists studying exchange rate determination such as Dornbusch (1982), Woo (1984), Krugman (1985), Evans (1986), Frankel and Froot (1986), and Meese (1986) have argued that recent market values of the dollar may have been driven by a speculative bubble. Major conferences and journal volumes are now devoted to the study of how crowd psychology affects asset prices. Other researchers, however, have found no evidence of bubbles in a variety of asset markets. For an extensive review of this burgeoning literature, see Camerer (1987).

seventeenth-century bulbs. In Section VI, I use the evidence to address the question whether the seventeenth-century tulip speculation clearly exhibits the existence of a speculative mania. Section VII contains concluding remarks.

II. The Traditional Image of Tulipmania

Descriptions of the tulip speculation are always framed in a context of doubt about how the Dutch, usually so astute in their speculations, could be caught in such an obvious blunder. Modern references to the episode depend on the brief description in Mackay (1852), which I summarize in this section.³ The tulip originated in Turkey but diffused into Western Europe only in the middle of the sixteenth century, carried first to Austria by a fancier of the flower. The tulip was immediately accepted by the wealthy as a beautiful and rare flower, appropriate for the most stylish gardens. The market was for durable bulbs, not flowers. As in so many other markets, the Dutch dominated that for tulips, initiating the development of methods to create new flower varieties. The bulbs that commanded high prices produced unique, beautifully patterned flowers; common tulips were sold at much lower prices.

Beginning in 1634, nonprofessionals entered the tulip trade in large numbers. According to Mackay, prices of individual bulbs reached enormous levels; for example, a single *Semper Augustus* bulb was sold at the height of the speculation for 5,500 guilders, a weight of gold equal to \$50,000 evaluated at \$450 per ounce.⁴ Mackay provided neither the sources of these bulb prices nor the dates on which they were observed, however.

Mackay emphasized the lunacy of the event through a pair of anecdotes about a sailor's mistakenly eating valuable bulbs and an unsuspecting English traveler's experimenting with them by peeling off their layers.⁵ He also described some barter transactions for acquiring

³ Mackay's first edition appeared in 1841. Wirth (1858) adds little that was not presented in Mackay. P. T. Barnum (1865) plagiarized his description of the episode from Mackay without attribution.

⁴ The guilder was the unit of account. It was denoted by the sign fl (florin) and was divided into 20 stuivers. The stuiver was further subdivided into 16 pennings. The guilder was a bimetallic unit, equivalent to 10.75 g of fine silver from 1610 to 1614, 10.28 g from 1620 to 1659, and 9.74 g thereafter (see Posthumus 1964, p. cxv; Rich and Wilson 1975, p. 458). Its gold content was 0.867 g of fine gold in 1612, 0.856 g in 1622, 0.77 g in 1638, and 0.73 g in 1645 (see Posthumus 1964, p. cxix). Prices of foodstuffs, metals, and fibers did not display significant secular movements from 1600 through 1750; so given the orders of magnitude of bulb price changes that we will observe, we can take the price level as approximately constant in interpreting nominal prices during this 150-year period.

⁵ Note the implausibility of a Dutch businessman's leaving a highly valuable bulb

rare bulbs so that the monetary expenditure may be translated into units of goods more meaningful to the modern reader.

Mackay then shifted to the final speculative frenzy, stating that large amounts of foreign funds entered the country to add to the speculation and people from all classes hurriedly liquidated other assets to participate in the tulip market.⁶ Finally and inexplicably, the frenzy terminated; and, overnight, even rare bulbs could find no buyers at 10 percent of their previous prices, creating a long-term economic distress. No evidence of postcollapse transactions prices of the rare bulbs was produced, however. Mackay cited prices from bulb sales from 60 years, 130 years, or 200 years after the collapse as indicators of the magnitude of the collapse and of the obvious misalignment of prices at the peak of the speculation. Also, no evidence was provided of the general economic context from which the speculation emerged.

III. Some *Dogmengeschichte*

Chroniclers of the tulip speculation and modern writers who invoke it take for granted that it was a mania, selecting and organizing the evidence to emphasize the irrationality of the market outcome. In the twentieth century, a strong intellectual influence on participants and observers of the financial markets has been exerted by Mackay's version of the tulipmania, although he devoted to it only seven pages of text.⁷ The pre-1950s academic literature written by major profes-

lying about for a loutish sailor to eat for lunch or for a presumptuous English experimenter to dissect.

⁶ He presents no evidence of the sources and quantity of these foreign funds.

⁷ Bernard Baruch wrote an introduction to Mackay's book, whose reprinting he had encouraged, emphasizing the importance of crowd psychology in all economic movements. Dreman (1977), who also stresses psychological forces in asset price determination, uses the tulipmania as a prototype of market mania. Relating the same anecdotes as Mackay, he invokes the tulipmania as a constant metaphor in discussions of succeeding major speculative collapses. He states that "if, for example, my neighbor tried to sell me a tulip bulb for \$5,000, I'd simply laugh at him The tulip craze, like the manias we shall see shortly, created its own reality as it went along. It is ludicrous to pay as much for a flower as one pays for a house" (p. 52). Whenever large and rapid fluctuations of asset prices occur, the popular media recall the tulipmania. For example, when gold prices jumped in 1979, a *Wall Street Journal* (September 26, 1979) article stated that "the ongoing frenzy in the gold market may be only an illusion of crowds, a modern repetition of the tulip-bulb craze or the South Sea Bubble." The October 19, 1987, stock market crash brought forth similar comparisons from the *Wall Street Journal* (December 11, 1987), and the *Economist* (October 24, 1987) explained the event as follows: "The crash suffered by the world's stockmarkets has provided a beginning and middle for a new chapter updating Charles Mackay's 1841 book 'Extraordinary Popular Delusions and the Madness of Crowds' which chronicled Dutch tulip bulbs, the South Sea bubble It was the madness of crowds that sent the bull market ever upward It is mob psychology that has now sent investors so rapidly for the exits" (p. 75). Malkiel (1985) extensively cites Mackay in his chapter "The Madness of Crowds,"

sional economists contains little direct reference to the tulipmania.⁸ The tulipmania made its first appearance in serious economics journals with the development of capital theory in the 1950s and the discovery of the potential existence of multiple, dynamically unstable asset price paths.⁹ The advent of the “sunspot” literature has generated a revival of references to tulips as a motivation for the line of research.¹⁰ In the finance literature, the emergence of empirical anomalies has also generated references to tulipmania as bubble and fad explanations have regained respectability.¹¹

Given its strategic position in current views of tulipmania, it is vital

including the anecdote about the sailor and the claim that the collapse led to a prolonged depression in Holland. In reference to other speculative episodes, he asks, “Why do such speculative crazes seem so isolated from the lessons of history? I have no apt answer to offer, but I am convinced that Bernard Baruch was correct in suggesting that a study of these events can help equip investors for survival. The consistent losers in the market, from my personal experience, are those who are unable to resist being swept up in some kind of tulip-bulb craze” (pp. 44–45).

⁸ *Palgrave's Dictionary* (1926, p. 182) includes a paragraph on tulips in its section on bubbles, citing Mackay. In his well-known study of manias, Kindleberger (1978) does not include the tulipmania among those episodes examined in detail because “manias such as . . . the tulip mania of 1634 are too isolated and lack the characteristic monetary features that come with the spread of banking” (p. 6). In his article on “bubbles” in the *New Palgrave* (1987), however, Kindleberger includes the tulipmania as one of the two most famous manias.

⁹ Samuelson (1957, 1967) presents the tulipmania metaphor and associates it with “the purely financial dream world of indefinite group self-fulfillment” (1967, p. 230). Students of Samuelson, in a flurry of research activity concerning the “Hahn problem,” employ the tulipmania as an empirical motivation. Shell and Stiglitz (1967, p. 593) state that “the instability of the Hahn model is suggestive of the economic forces operating during ‘speculative booms’ like the Tulip Bulb mania.” Burmeister (1980, pp. 264–86) summarizes these models.

¹⁰ For example, Azariadis (1981, p. 380) argues that “the evidence on the influence of subjective factors is ample and dates back several centuries; the Dutch ‘tulip mania,’ the South Sea bubble in England, and the collapse of the Mississippi Company in France are three well-documented cases of speculative price movements which historians consider unwarranted by ‘objective’ conditions.” More recently, Azariadis and Guesnerie (1986, p. 725) state that “the reading of economic historians may suggest that these factors (sunspots) have some pertinence for the explanation of phenomena like the Dutch tulipmania in the seventeenth century and the Great Depression in our own.” Under the topic “tulipmania” in the *New Palgrave* (1987), Calvo does not refer to the seventeenth-century Dutch speculative episode at all. Rather, he defines tulipmania as a situation in which asset prices do not behave in ways explainable by economic fundamentals. He develops examples of rational bubbles, of both the explosive and “sunspot” varieties.

¹¹ In his presidential address to the American Finance Association, Van Horne (1985) embraces the possibility of bubbles and manias and as an example refers explicitly to the tulipmania, in which a “single bulb sold for many years’ salary” (p. 627). In a series of papers, Shiller (1984, 1987) and Shiller and Pound (1986) have promoted the hypothesis that asset prices are driven by crowd behavior or fads. Shiller (1987) argues that the standard and accurate view, until the last few decades, has been that asset markets are driven by capricious investors acting on the basis of fads and bubbles. As one example, he provides a quotation of one of Mackay’s descriptions of the high prices paid for tulips during the mania.

to investigate from which sources Mackay constructed his version of the speculation. While at one point he includes a minor citation to Beckmann (1846), he plagiarized most of his description from Beckmann with a little literary embellishment.¹² Beckmann carefully reported his sources of information about the functioning of the markets and bulb sales prices, using notably the dialogues between Gaergoedt and Waermond (Anonymous, 1637, 1643*a*, 1643*b*) and Munting's (1672, 1696) discussions of this episode. Gaergoedt and Waermond is a series of three pamphlets in dialogue form that provides details about the markets and numerous prices of various bulbs, taken mostly from the final day of the speculation.¹³ Munting was a botanist who wrote a 1,000-folio volume on numerous flowers. Though Mackay claims that the volume was devoted to the tulipmania, only the six pages allocated to tulips discuss the episode.¹⁴ All the price data described in Munting can be found in the dialogues, so we must conclude that they are Munting's primary source. Thus the current version of the tulipmania, to the extent that it is based on scholarly work, follows a lattice of hearsay fanning out from the Gaergoedt and Waermond dialogues.

A more careful line of research has had little impact on our current interpretation of the tulip speculation. Solms-Laubach's (1899) history of tulips in Europe provides an extensive description of the available literature on tulips, including the dialogues. Most of his price data originate in Gaergoedt and Waermond, but he also explores records left by notaries of tulip contracts written during the mania.

Van Damme (1976) documented the tulipmania in a series of short articles written from 1899 to 1903.¹⁵ This series consists of reprints of

¹² Beckmann wrote originally in German at the end of the eighteenth century; only the fourth English edition (1846) of his book was available to me. Beckmann, the original source of the two anecdotes referred to in the previous section, cites Blainville (1743) as his source for the story of the Englishman. A careful reading of Blainville turns up only a one-sentence report that a tulip speculation occurred from 1634 to 1637 in what is otherwise a baroque travelogue of Haarlem. Indeed, Blainville's description of his travels through Holland was a diary of a tour made in 1705, 70 years after the speculation. For the sailor story, Beckmann mentions that the incident occurred while John Balthasar Schuppe (1610–61) was in Holland, without other reference. However, the context of the paragraph in which the story appears seems to indicate that it happened after the tulip speculation. Mackay, who greatly dramatizes both stories, cites Blainville as the source for both, obviously without having researched beyond Beckmann.

¹³ These pamphlets were motivated by a moralistic attack against speculation by the authorities, as were all of the numerous pamphlets that appeared immediately after the end of the episode. For a list of these pamphlets, see the references in Krelage (1942, 1946).

¹⁴ Mackay must have recorded Beckmann's reference to Munting without examining the Munting text.

¹⁵ These were published in the *Weekblad voor bloembollencultuur* and are reprinted in van Damme (1976).

the dialogues, reproductions of some precollapse pricing contracts, and details of bulb auctions from just before the collapse and from 6 years after the end of the speculation.¹⁶

Posthumus (1926, 1927, 1929, 1934), the only economist in this literature, extended the available data by compiling and reproducing more of the notaries' contracts. Most of his discussion, however, again depends on price information in the dialogues and information compiled by van Damme.

Finally, Krelage (1942, 1946) provides an extensive description of the markets, though his prices for the speculation period also seem to come from Gaergoedt and Waermond. Krelage (1946) does provide tulip price lists from sales in 1708 and 1709 and a 1739 bulb catalog. In addition, he compiles a time series of prices for a large variety of hyacinth bulbs during the eighteenth and nineteenth centuries.

Even this line of research accomplishes little more than gathering additional price data, and those data that we have are not organized in a systematic time series. Posthumus does attempt to analyze the functioning of the futures markets that materialized at the end of the speculation; but in spite of his efforts, we have inherited the concept of the tulipmania as the most famous of bubbles accompanied by no serious attempt to describe what might constitute the market fundamentals of the bulb market.

IV. The Tulip and the Tulip Markets

An understanding of the tulip markets requires some information about the nature of the tulip. A bulb flower, the tulip can propagate either through seeds or through buds that form on the mother bulb. Properly cultivated, the buds can directly reproduce another bulb. Each bulb, after planting, eventually disappears during the growing season. By the end of the season, the original bulb is replaced by a clone, the primary bud that is now a functioning bulb, and by a few secondary buds. Asexual reproduction through buds, the principal propagation method, produces an increase in bulbs at a maximum annual rate of from 100 percent to 150 percent in normal bulbs (see Mather 1961, p. 44).

A bulb produced directly from seed requires 7–12 years before it flowers. The flowers appear in April or May and last for about a week. The amount of time required before the secondary buds flower depends on the size of the bulb produced from the bud.¹⁷ In June, bulbs

¹⁶ Since many of the prices in Gaergoedt and Waermond are also on the earlier auction list, it provides a key confirmation of the validity of the prices in the dialogues.

¹⁷ Hartmann and Kester (1983, p. 499) state that the time before flowering of a bulb less than 5 cm in diameter is 3 years, of a bulb from 5 to 7 cm is 2 years, and of a bulb greater than 8 cm is 1 year.

can be removed from their beds but must be replanted by September. To verify the delivery of a specific variety, spot trading in bulbs had to occur immediately after the flowering period, usually in June.

Tulips are subject to invasion by a mosaic virus whose important effect, called "breaking," is to produce remarkable patterns on the flower, some of which are considered beautiful. The pattern imposed on a particular flower cannot be reproduced through seed propagation: seeds will produce bulbs that yield a common flower since they are unaffected by the virus. These bulbs may themselves eventually "break" at some unknown date but into a pattern that may not be remarkable. A specific pattern can be reproduced by cultivating the buds into new bulbs.

As another effect, the mosaic virus makes the bulb sickly and reduces its rate of reproduction.¹⁸ Smith (1937, p. 413) states that broken bulbs do not "proliferate as freely" as undiseased plants but that this weakening need not cause broken bulbs to succumb, giving as an example the broken *Zomerschoon*, which has been actively cultivated since 1620.¹⁹ Van Slogteren (1960) claims that the mosaic virus may cause total loss of a plant or a 10–20 percent reduction in propagation rates.

The high market prices for tulips to which the current version of the tulipmania refers were prices for particularly beautiful broken bulbs. Single-colored breeder bulbs, except to the extent that they could potentially break, were not valued, and all the important tulip varieties in the first two centuries of European cultivation were diseased. Broken bulbs fell from fashion only in the nineteenth century (see Doorenbos 1954). Indeed, since breaking was unpredictable, some have characterized tulipmania among growers as a gamble, with growers "vying to produce better and more bizarre variegations and feathering" (Mather 1961, pp. 100–101).²⁰

¹⁸ Although seventeenth-century florists thought that breaking was a normal stage in the maturing process of breeder bulbs (the stock of bulbs vulnerable to attack by the virus), theories arose that broken tulips were diseased. For example, la Chesnee Monstereul (1654), contrasting the theory of breaking as "self-perfection" with a disease theory, noted that broken bulbs had smaller bulb and stem sizes and that they never produced more than three buds.

¹⁹ Almost all bulbs traded in the tulipmania have by now completely disappeared. For example, the Royal General Bulbgrowers Society's (1969) classification of thousands of actively grown tulips mentions such important bulbs of the tulip speculation as *Admiraal Liefkens*, *Admiraal van der Eyck*, *Paragon Liefkens*, *Semper Augustus*, and *Viceroy* only as historically important names. The only bulbs still grown were the *Gheele Croonen* and *Lack van Rijn*, despised in the 1630s as common flowers except at the height of the speculation. Even these bulbs are currently grown only by collectors.

²⁰ Though it is now known that the mosaic virus is spread by aphids, methods of encouraging breaking were not well understood in the seventeenth century. Gaergoedt and Waermondts suggested grafting half a bulb of a broken tulip to half a bulb of an

The Bulb Market, 1634–37

The market for bulbs was limited to professional growers until 1634, but participation encompassed a more general class of speculators by the end of 1634.²¹ A rising demand for bulbs in France apparently drove the speculation.²²

Market participants could make many types of deals. The rare flowers were called “piece” goods, and particular bulbs were sold by their weight. The heavier bulbs had more outgrowths and therefore represented a collection of future bulbs. The weight standard was the *aas*, about one-twentieth of a gram. For example, if a Gouda of 57 *azen* (plural of *aas*) were sold for a given price, the sale contract would refer to a particular bulb planted at a given location. Once markets developed in common bulbs, they were sold in standardized units of 1,000 *azen* or 1 pound (9,728 *azen* in Haarlem, 10,240 *azen* in Amsterdam). Purchase contracts for “pound” goods would not refer to particular bulbs.

A purchase between September and June was necessarily a contract for future delivery. Also, markets materialized for the outgrowths of the rarer bulbs. The outgrowths could not be delivered immediately since they had to attain some minimum size before they could be separated from the parent bulb to assure the viability of the new bulb. Hence, the contracts for outgrowths were also for future delivery.

Formal futures markets developed in 1636 and were the primary focus of trading before the collapse in February 1637. Earlier deals had employed written contracts entered into before a notary. Trading became extensive enough in the summer of 1636 that traders began meeting in numerous taverns in groups called “colleges,” where trades were regulated by a few rules governing the method of bidding and fees. Buyers were required to pay $\frac{1}{2}$ stuiver (1 stuiver = $\frac{1}{20}$ guilder) out of each contracted guilder to sellers up to a maximum of 3 guilders for each deal for “wine money.”²³ To the extent that a trader ran a balanced book over any length of time, these payments

unbroken tulip to cause breaking (van Slogteren 1960, p. 27). La Chesnee Monstereul (1654, p. 163) states that the art of “speeding transformation” was controversial among florists. D’Ardène (1759, pp. 198–217) devotes a chapter to breaking in tulips, shedding little light on methods to encourage breaking.

²¹ Most of the remainder of this section is reconstructed from the discussions in Posthumus (1929) and Krelage (1942, 1946).

²² In France, it became fashionable for women to array quantities of fresh tulips at the tops of their gowns. Wealthy men competed to present the most bizarre flowers to eligible women, thereby driving up the demand for rare flowers. Munting (1696, p. 911) claims that at the time of the speculation a single *flower* of a particular broken tulip was sold for 1,000 guilders in Paris.

²³ Posthumus (1929) translates the stuiver as a “penny,” but it is clear from the context that he means stuivers and not pennings (= $\frac{1}{16}$ stuiver).

would cancel out. No margin was required from either party, so bankruptcy constraints did not restrict the magnitude of an individual's position.

Typically, the buyer did not currently possess the cash to be delivered on the settlement date and the seller did not currently possess the bulb. Neither party intended a delivery on the settlement date; only a payment of the difference between the contract and settlement price was expected. Thus, as a bet on the price of the bulbs on the settlement date, this market was not different in function from currently operating futures markets.²⁴ The operational differences were that the contracts were not continuously marked to market, required no margin deposits to guarantee compliance, and consisted of commitments of individuals rather than an exchange so that a collapse would require the untangling of gross, rather than net, positions.

It is unclear which date was designated as the settlement date in the college contracts. No bulbs were delivered under the deals struck in the new futures markets in 1636–37 prior to the collapse because of the necessity of waiting until June to exhume the bulbs. It is also unclear how the settlement price was determined. Beckmann (1846, p. 29) states that the settlement price was “determined by that at which most bargains were made,” presumably at the time of expiration of a given contract. Again, this is the standard practice in current futures markets.

Serious and wealthy tulip fanciers who traded regularly in rare varieties did not participate in the new speculative markets. Even after the collapse of the speculation, they continued to trade rare bulbs for “large amounts” (see Posthumus 1929, p. 442). To the extent that rare bulbs also traded on the futures markets, this implies that no one arbitrated the spot and futures markets. To take a long position in spot bulbs required substantial capital resources or access to the financial credit markets. To hedge this position with a short sale in the futures market would have required the future purchaser to have substantial capital or access to sound credit; substantial risk of noncompliance with the deal in the futures market would have undermined the hedge. Since participants in the futures markets faced no capital requirements, there was no basis for an arbitrage.

During most of the period of the tulip speculation, high prices and recorded trading occurred only for the rare bulbs. Common bulbs did not figure in the speculation until November 1636.

²⁴ See Munting (1672, p. 636) for a description of the types of bets undertaken by his father. All discussions of the tulipmania openly criticize the activity of buying or selling for future delivery without current possession of the commodity sold or an intention to effect delivery. They attack futures markets as a means of creating artificial risk and do not consider their role in marketing existing risks.

Posthumus (1929, p. 444) hypothesizes the following timing of events:

I think the sequence of events may be seen as follows. At the end of 1634, the new non-professional buyers came into action. Towards the middle of 1635 prices rose rapidly, while people could buy on credit, generally delivering at once some article of value; at the same time the sale per aas was introduced. About the middle of 1636 the colleges appeared; and soon thereafter the trade in non-available bulbs was started, while in November of the same year the trade was extended to the common varieties, and bulbs were sold by the thousand azen and per pound.

V. Some Characterization of the Data

In figures 1–8, I depict the “time series” for guilders per bulb or guilders per aas that I have been able to reconstruct for various bulbs.²⁵ The last observations for each series (except for the Switsers) were recorded on February 5, 1637, apparently the peak of the mania. For that date there are usually several price observations for each flower, but their order of appearance in the figures has no meaning. Specifically, the figures do not indicate a price explosion at an infinite rate on February 5. I have connected the price lines to the weighted average of prices for February 5.

A natural way to separate categories is to split the sample between “piece” goods and “pound” goods. Posthumus claims that there was a class difference between those who traded in piece goods and those who traded in pound goods, even in the colleges. Members of the middle classes and capitalized workers such as the weavers disdained the pound goods and traded only in the rarer bulbs.

The bulbs that can be included among piece goods are *Semper Augustus*, *Admirael Liefkens*, *Admirael van der Eyck*, and *Gouda*. Among these, the *Gouda* can be considered a standard since we have the most detailed price series for this bulb, starting at the beginning of the speculation. The bulbs that can be included among the pound goods, that is, bulbs trading in 1,000-aas or 1-pound lots, are *Gheele ende Roote van Leyden*, *Groote Geplumiceerde*, *Oudenaerden*, *Swit-*

²⁵ Data for a large number of observed prices for many varieties of bulbs plus descriptions of the data are compiled in a data appendix available on request from the author. These figures consist of data gathered from auctions, contracts recorded with notaries, and the *Gaergoedt* and *Waermond* dialogues. Data in figs. 5–8 are in terms of guilders per aas for standardized weights of pound goods, but data in figs. 2–4 are for individual bulbs, which vary in weight from 3 to many hundred azen. Particularly, fig. 4 is a combination of prices for buds and for mature bulbs.

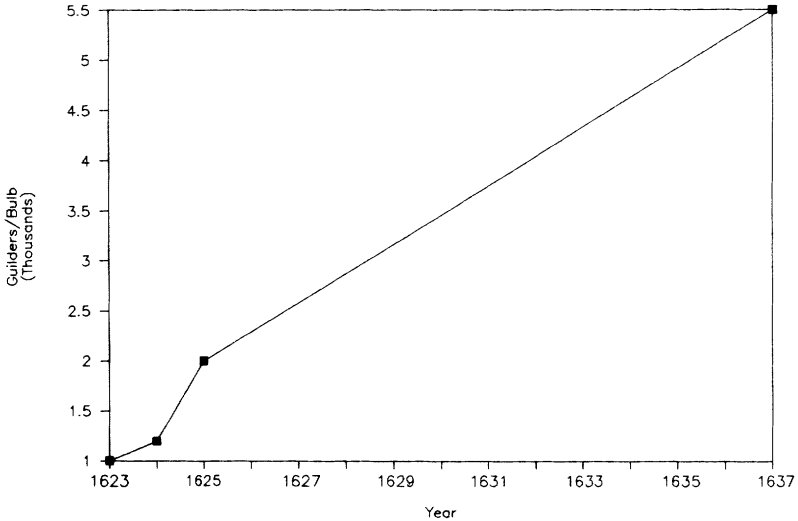


FIG. 1.—Semper Augustus

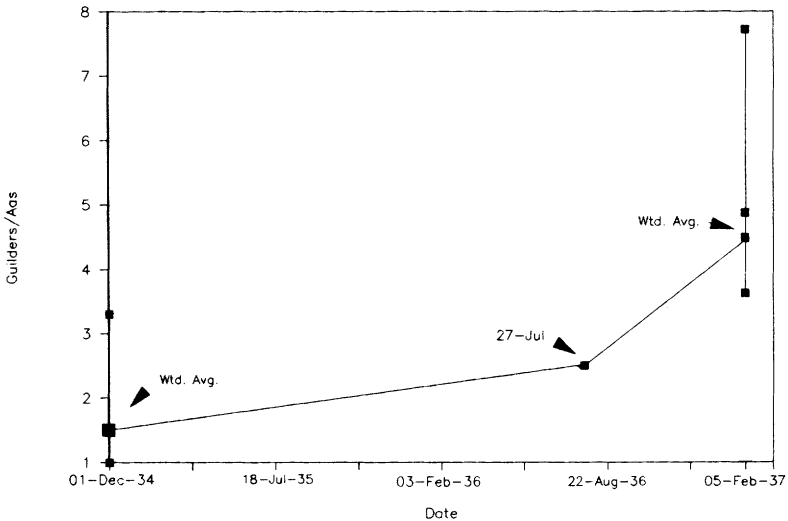


FIG. 2.—Admirael van der Eyck

sers, and Witte Croonen.²⁶ The pound goods sold at much lower prices per aas than the piece goods. In the last month of the speculation, however, their prices increased much more rapidly than those of the piece goods, rising up to twentyfold. Over a much longer period, the prices of the piece goods doubled or perhaps tripled.

²⁶ Others are more difficult to classify, encompassing different deals in which either odd weights or standard weights appear.

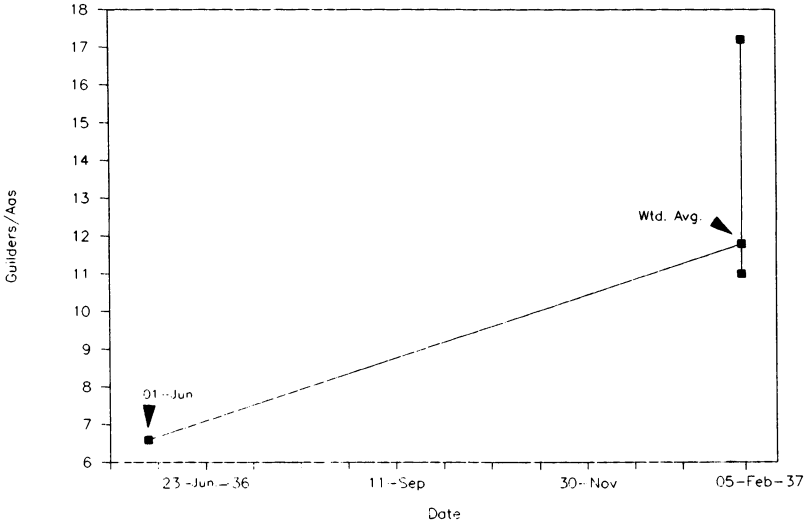


FIG. 3.—Admirael Liefkens

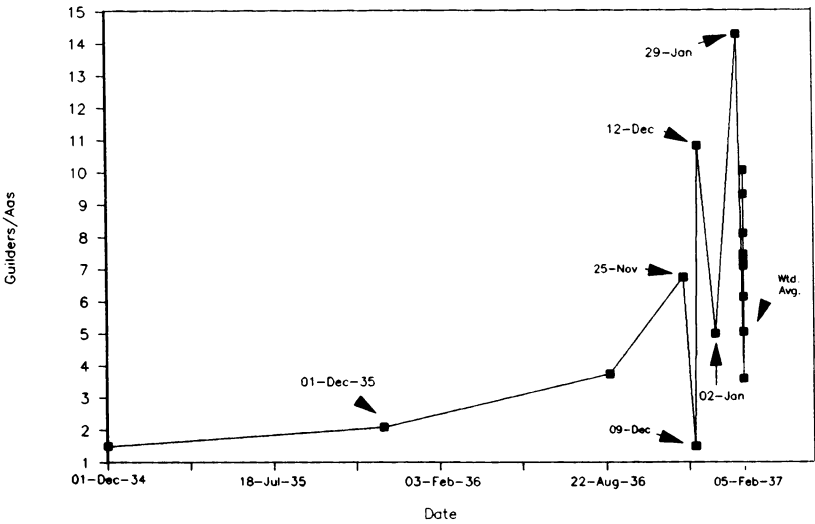


FIG. 4.—Gouda

Postcollapse Tulip Prices

The tulip speculation collapsed after the first week of February 1637. Apparently, a general suspension of settlement occurred on contracts coming due. On February 24, 1637, delegates of florists meeting in Amsterdam proposed that sales of tulips contracted on or before November 30, 1636, should be executed and that for later contracts,

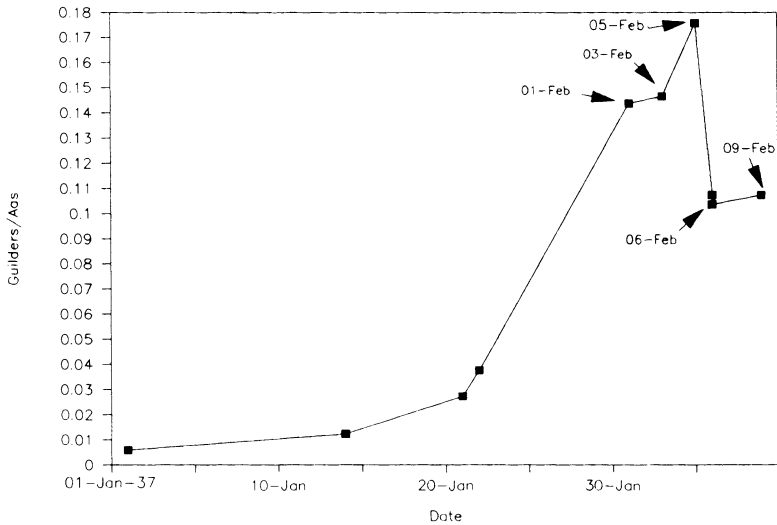


FIG. 5.—Switzers

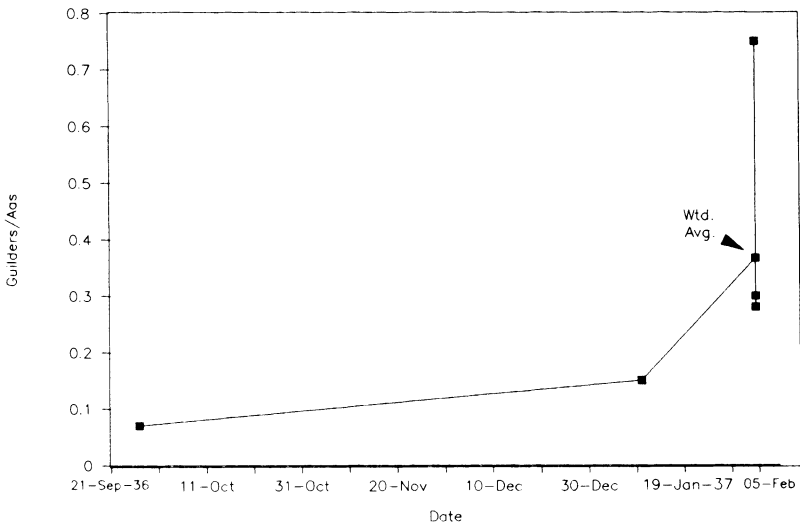


FIG. 6.—Grootte Geplumiceerde

the buyer would be given the right to reject the deal on payment of 10 percent of the sale price to the seller. The authorities did not adopt this suggestion. On April 27, 1637, the states of Holland decided to suspend all contracts, giving the seller the right to sell contracted bulbs at market prices during the suspension. The buyer would be responsible for the difference between this market price and what-

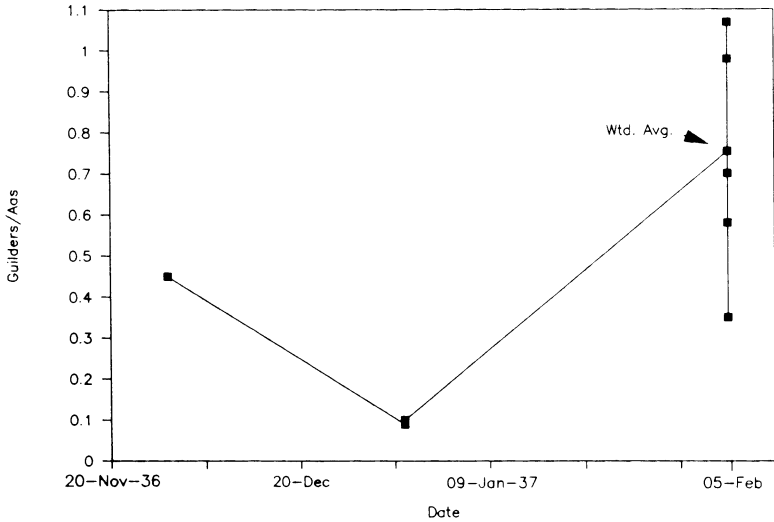


FIG. 7.—Gheelee ende Roote van Leyden

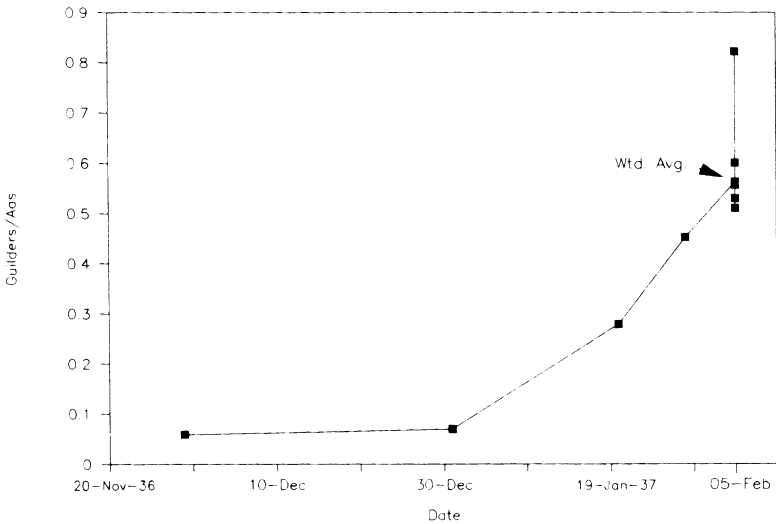


FIG. 8.—Oudenaerden

ever price the authorities eventually determined for contract settlement. This decision released the growers to market the bulbs that would emerge in June. After this decision, the disposition of further settlement becomes murky, though Posthumus (1929, pp. 446-47) states that many cities followed the example of Haarlem, where in May 1638 the city council passed a regulation permitting buyers to

terminate a contract on payment of 3.5 percent of the contract price.²⁷

With the end of large-scale bulb trading after February 1637, records of transaction prices virtually disappeared. Prices no longer were publicly recorded, and only an occasional estate auction of an important florist would reveal the magnitude of prices.²⁸ Fortunately, van Damme (1976, pp. 109–13) reports prices from a postcollapse estate auction in 1643. In the estate auction of the bulb dealer J. van Damme (no relation), fl 42,013 were raised through the sale of bulbs.²⁹ This amount reflects a bulb value comparable to the fl 68,553 derived from the February 1637 estate auction from which we have received most of the tulipmania peak price data. Details from this latter auction are reported in “Liste van eenige tulpaen” (1926).

Individual bulbs could still command high prices 6 years after the collapse. Four bulbs whose prices were listed individually also appear among the bulbs traded in 1636–37: Witte Croonen, English Admiral, Admiraal van der Eyck, and General Rotgans (Rotgansen). Witte Croonen bulbs were pound goods, and the others were piece goods. Table 1 presents a comparison of 1637 and 1642 or 1643 prices. Even from the peaks of February 1637, the price declines of the rarer bulbs—English Admiral, Admiraal van der Eyck, and General Rotgans—over the course of 6 years are not unusually rapid. We shall see below that they fit the pattern of decline typical of a prized variety.

²⁷ Even the precollapse legal status of the futures contracts was unclear. Early price manipulation and bear raids in East India Co. shares led to legal bans on short sales on the Amsterdam exchange in 1610. Future sales were permitted only to individuals already holding the shares to be delivered. In edicts of 1621, 1630, and 1636, the ban was reiterated and buyers of a short contract could legally repudiate the agreement. Whether the ban applied to traders on the new tulip futures market is unclear. Ultimately the courts did not uphold any contracts for tulips, but local attempts at settlement were made. See Penso de la Vega (1688) on the effects of this ban on short sales of stock.

²⁸ This was a return to the pre-1634 situation. Prior to 1634 only a handful of prices are available from recorded sales contracts: a pair of bulbs from 1612 reported by Posthumus (1929) in his contract nos. 3 and 4; a 1625 sale of three bulbs; and a 1633 sale of a pair of bulbs, both reported in Posthumus (1934). Even the series in fig. 1 for the *Semper Augustus* is based on undocumented stories emanating from the historical authority Wassenauer in the 1620s, as reported by Solms-Laubach (1899, p. 77), among others.

²⁹ This total was not broken down into individual bulb prices. For those few bulbs sold in which the estate held a fractional interest, however, the sales prices were reported (p. 111); one *Tulpa Meerman*, fl 430; one *Vrouge Brantson*, fl 25; one *Verspreijt*, one *Vroeg Brantson*, and one-quarter interest in an English Admiral, fl 582; and one *General Rotgans*, fl 138. In addition, in the records detailing the settling of the estate's accounts, there is a list of 1643 cash expenditures for bulbs purchased in 1642: ½ pound *Witte Croonen*, fl 37 st 10; one *Admiraal van der Eyck* and one outgrowth of an English Admiral, fl 225; and one English Admiral, fl 210.

TABLE I
POSTCOLLAPSE BULB PRICES IN GUILDERS

Bulb	January 1637	February 5, 1637	1642 or 1643	Annual Depreciation (%)*
Witte Croonen (½ lb)	64	1,668 (avg.)	37.5	76
English Admiral (bulb)	...	700 (25-aas bulb)	210	24
Admiraal van der Eyck (bulb)	...	1,345 (wtd. avg.)	220 [†]	36
General Rotgans (Rotgansen)	...	805 (1,000 azen)	138	35

* From February 1637 peak.

[†] Adjusted downward fl 5 to account for the English Admiral outgrowth.

Eighteenth-Century Tulip Prices

Though a few prices are available from the years immediately after the collapse, a gap of about 70 years arises in detailed tulip price data.³⁰ High prices are available only for much later periods, and these are of an order of magnitude lower than these quoted during the speculation.³¹

In table 2, I report prices for bulbs from January 2, 1637; February 5, 1637; 1722; and 1739.³² Even starting in January 1637, before the peak of the speculation, the price decline is remarkable. Prices fall to

³⁰ While price data disappeared, at least the names of the important tulips from the speculation remained current 32 years after the collapse. Van der Groen (1669) mentions the important tulips that a fashionable garden might hold. Among them were Vroege Bleyenberger, Parragon Grebber, Gheel ende Roote van Leyden, Admiraal van Enchuyzen, Brabanson, Senecours, Admiraal de Man, Coorenaerts, Jan Gerritz, Gouda, Saeyblom, Switsers, Parragon Liefkens, and Semper Augustus.

³¹ Van Damme (1976) reproduces numerous announcements of bulb sales and auctions printed in such periodicals as the *Haarlemscher courant* in the latter half of the seventeenth century, but there is no record of prices generated in the auctions.

³² These prices come from several sources. Krelage (1946) reproduces tulip lists from auctions on May 17, 1707, in the Hague (p. 542) and on May 16, 1708, in Rotterdam (p. 541), on which a participant fortuitously annotated the final sales prices. While the 1707 auction list contains 84 different bulb names and that of 1708 contains 12, no bulb name of the hundreds commonly traded in 1637 appears in the lists. Krelage reproduces only the first page of the 1708 price list. The entire list was sold to British buyers with the breakup of Krelage's library, and I have been unable to examine it as yet. Bradley (1728) reproduces the 1722 bulb catalog of a Haarlem florist. The majority of the hundreds of bulbs in this catalog were offered at prices of less than one guilder, and only one, Superintendent Roman, sold for 100 guilders. The list, however, does contain prices for 25 bulbs that appeared in the 1637 tulip speculation. Krelage (1946) also reproduces a 1739 Haarlem price catalog of hyacinth and tulip bulbs. Of its several hundred different bulbs, only six names match those of bulbs traded in 1637. Interestingly, it offers Semper Augustus bulbs for 0.1 guilders.

TABLE 2

GUILDER PRICES OF TULIP BULBS COMMON TO 1637, 1722, AND 1739 PRICE LISTS

Bulb	January 2, 1637	February 5, 1637	1722	1739
Admirael de Man	18	209	...	.1
Gheele Croonen	.41	20.5	...	.025*
Witte Croonen	2.2	57	...	.02*
Gheele ende Roote van Leyden	17.5	136.5	.1	.2
Switsers	1	30	.05	...
Semper Augustus	2,000 [†]	6,290	...	.1
Zomerschoon	...	480	.15	.15
Admirael van Enchuysen	...	4,900	.2	...
Fama	...	776	.03*	...
Admirael van Hoorn	...	65.5	.1	...
Admirael Liefkens	...	2,968	.2	...

NOTE.—To construct this table I have assumed a standard bulb size of 175 azen. All sales by the bulb are assumed to be in the standard weight, and prices are adjusted proportionally from reported prices. When more than one bulb price is available on a given day, I report the average of adjusted prices.

* Sold in lots of 100 bulbs.

[†] This was the price of the Semper Augustus bulb on July 1, 1625.

levels of 1 percent, 0.5 percent, 0.1 percent, or 0.005 percent of their January 1637 values in a century. Also noteworthy is the convergence of prices of all individually sold bulbs to a common value, regardless of the initial bulb values.

In table 3, I have compiled the prices of bulbs common to the 1707 auction and either the 1722 or the 1739 price lists. While this was not a period known for a tulip speculation or crash, prices display the same pattern of decline. Bulbs appeared on an auction list if they were recently developed rare varieties that commanded relatively

TABLE 3

GUILDER PRICES OF TULIP BULBS, 1707, 1722, AND 1739

BULB	1707	1722	1739	ANNUAL DEPRECIATION (%)	
				1707-22	1722-39
Triomphe d'Europe	6.75	.3	.2	...	...
Premier Noble	409	...	1.0	19*	...
Aigle Noir	110	.75	.3	33	...
Roi de Fleurs	251	10.0	.1	22	27
Diamant	71	2.5	2.0	22	...
Superintendant	...	100	.12	...	40
Keyzer Kazel de VI	...	40	.5	...	26
Goude Zon, bontlof	...	15	10.0	...	2
Roy de Mouritaine	...	15	2.0	...	12
Triomphe Royal	...	10	1.0	...	14

SOURCE.—Krelage (1946); Bradley (1728).

* 1707-39.

high prices.³³ By the time they appeared on a general catalog, they had diffused sufficiently to become relatively common. Again, in 32 years prices declined to 3 percent, 0.25 percent, 0.35 percent, or 0.04 percent of their original values, repeating the pattern of decline of the bulbs from the tulipmania. Indeed, the valuable bulbs of 1707 even converged approximately to the same prices as the valuable bulbs of 1637.

We now have a pattern in the evolution of prices of newly developed, fashionable tulip bulbs. The first bulbs, unique or in small supply, carry high prices. With time, the price declines rapidly either because of rapid reproduction of the new variety or because of the increasing introduction of new varieties. Anyone who acquired a rare bulb would have understood this standard pattern of anticipated capital depreciation, at least by the eighteenth century.

To apply this pattern to the postcollapse period, we treat as rare all eighteenth-century bulbs selling for at least 100 guilders (Premier Noble, Aigle Noir, Roi de Fleurs, and Superintendent).³⁴ Prices for these bulbs declined at an average annual percentage rate of 28.5 percent. From table 1, the three costly bulbs of February 1637 (English Admiral, Admirael van der Eyck, and General Rotgans) had an average annual price decline of 32 percent from the peak of the speculation through 1642. Using the eighteenth-century price depreciation rate as a benchmark also followed by expensive bulbs after the mania, we can infer that any price collapse for rare bulbs in February 1637 could not have exceeded 16 percent of peak prices. Thus the crash of February 1637 for rare bulbs was not of extraordinary magnitude and did not greatly affect the normal time-series pattern of rare bulb prices.

Eighteenth-Century Hyacinth Prices

As further evidence of this standard pattern in bulb prices, I now turn to the market for hyacinths. Krelage (1946) supplies prices of hyacinths during the eighteenth and nineteenth centuries. Hyacinths replaced tulips at the start of the eighteenth century as the fashion-

³³ None of the bulbs on the 1739 list carried a price greater than 8 guilders, while most prices were much lower. Rare and valuable bulbs would not appear on a standard dealer's list. Conversely, auctions would not likely bother with common, inexpensive bulbs. Since the 1637 rare bulbs had become common by 1707, it is not surprising that their names disappeared from auction lists.

³⁴ For example, Roi de Fleurs would be counted as rare when its price was fl 251 in 1707. By 1722, its price was fl 10, so it would no longer be considered rare. The price declined between 1707 and 1722 by 96 percent, and the average annual decline was 21.5 percent. This 21.5 percent annual decline was averaged with similarly computed declines for other rare bulbs to produce an overall average.

TABLE 4
HYACINTH PRICE PATTERNS (Guilders)

Bulb	1716	1735	1739	1788	1802	1808
Coralijn*	100	12.75	2	.6	...	...
L'Admirable	100	...	1	1	...	...
Starrekroon	200	...	1	.3	...	.3
Vredenrijck	...	80	16	1.5	...	...
Koning Sesostris	...	100	8	1	1	...
Staaten Generaal	...	210	20	1.5	2	...
Robijn	...	12	4	1	1	.5
Struijsvogel	...	161	20	...	...	...
Miroir	...	141	10	...	...	...
Bulb	1788	1802	1815	1830	1845	1875
Comte de la Coste	200	50	1	.75	.5	.15
Henri Quatre	50	30	1	3	5	1
Van Doeveren	50	...	1	2	1.2	.75
Flos Niger	60	20	10	...	.25 [†]	...
Rex rubrorum	3	1.5	.3	1	.35	.24

SOURCE.—Krelage (1946), pp. 645–55.

* Krelage (p. 645) notes that the Coralijn bulb originally sold for 1,000 guilders, though he does not include a year.

[†] 1860.

able flower, and once again a large effort arose to innovate beautiful varieties.³⁵

Krelage provides long price series for many hyacinths after their introduction. In table 4, I have mainly selected the price patterns for bulbs carrying particularly high prices at the time of introduction. Note that the pattern is similar to that for prized tulips in the seventeenth and eighteenth centuries. Within three decades, prices of even the highest-priced bulbs usually fell to 1–2 percent of the original price. Both originally highly priced and inexpensive bulbs converged to a price of from 0.5 to 1 guilder. The average annual rate of price depreciation for bulbs valued at more than 100 guilders (eight observations) was 38 percent, somewhat faster than the depreciation rate for tulip bulbs. For bulbs valued at 10–80 guilders, the annual price depreciation averaged 20 percent.

Modern Bulb Prices

Currently, new flower bulb varieties are also highly valuable. Typically, however, new varieties are reproduced in mass by the bulb's

³⁵ A speculation similar to that for tulips occurred from 1734 to 1739, leading to the production of reprints of Gaergoedt and Waermondts as a warning against unconstrained financial contracting. Table 4 indicates the magnitude of the price declines for a few of the more expensive bulbs during the hyacinth mania. The price decline to as low as 10 percent of 1735 prices in some cases was of similar magnitude to the 1637 crash for common tulip bulbs.

developer and marketed at relatively low prices only when a large quantity of bulbs has been produced. Hence, prices for prototype bulbs are usually unavailable. In the few cases in which a prototype bulb does change hands, transactions prices are not announced. Information provided by officials at the Bloembollencentrum in Haarlem indicates, however, that new varieties of “very special” tulip bulbs currently sell for about 5,000 guilders (\$2,400 at 1987 exchange rates) per kilogram. A small quantity of prototype lily bulbs recently was sold for 1 million guilders (\$480,000 at 1987 exchange rates). Such bulbs can now be reproduced rapidly with tissue growth techniques, so they also would be marketed at relatively low prices.

VI. Was This Episode a “Tulipmania”?

I now examine whether the evidence demands a mania interpretation for the tulip price movements. First, I will dispose of two nagging issues: (1) the absence of descriptions of economic distress in accounts of the period not engaged in antispeculative moralizing³⁶ and (2) the claims that the disappearance of renowned bulbs or their extreme price declines over long time periods signal the lunacy of the event. Next, I will isolate the aspect of the speculation for which the evidence provides no compelling explanation, the trading in common bulbs in the period from January 2, 1637, to February 5, 1637.

It is not difficult to understand why general economic studies of this period take little notice of “economic distress” arising from the speculation. Since the longer-term price rise occurred only in the rare bulbs, no significant agricultural resources were devoted to expand their cultivation.³⁷ Also, since the spectacular price rise in the common bulbs occurred only after the bulbs were in the ground in September 1636, rises in these prices could also have had little effect on the allocation of resources during 1636–37. To the extent that the speculation had any impact, it can have had an effect only through

³⁶ Economic histories of the important events and institutions in the Netherlands during this period are detailed, but they hardly mention the tulip speculation. For example, *The Cambridge Economic History of Europe*, vols. 4 and 5 (Rich and Wilson 1975, 1977), does not mention tulips, though the seventeenth-century Dutch are the leading players in these narratives. The period is characterized as a sequence of Dutch commercial and financial triumphs, and economic distress seems not to have materialized in the Netherlands until after the Thirty Years’ War ended in 1648. Cooper (1970, p. 100) does mention the tulip speculation in one sentence as an example of the speculative proclivity of the Dutch during this period. Schama (1987) provides a detailed discussion of the events based primarily on Posthumus and Krelage, but he does not depart from the standard interpretation of the mania.

³⁷ Krelage (1946, p. 498) states that all florists in Haarlem maintained their gardens within the city walls until the second half of the eighteenth century. Gardens could be small since concentrations of large numbers of identical flowers were not valued highly, unlike current fashion.

the distribution of wealth. Little wealth was actually transferred, however; the fees paid out by buyers in the colleges must have evened out over the course of many transactions. Also, after the collapse, only small settlements were required, and of these few were made. Even the period of uncertainty about the percentage of settlement required could have had little impact: people with little credit to begin with would not have been affected by a cutoff of credit until the contracts were straightened out.

That the valuable tulips of 1634–37 later either disappeared or became common is typical of the market dynamics for newly developed bulb varieties, as indicated by price patterns for eighteenth-century tulip and hyacinth bulbs and for modern bulbs. As the bulbs propagate, their prices naturally fall with expanding supply; however, the original bulb owner's bulb stock increases. The discounted value of bulb sales can easily justify extremely high prices for the unique bulb of a new variety. Even the magnitudes of prices for valuable bulbs and their patterns of decline are not out of line with later prices for new varieties of rare bulbs. Single bulbs in the eighteenth century commanded prices as high as 1,000 guilders. In this context, the 1,000–2,000-guilder price of *Semper Augustus* from 1623 to 1625 or even the 5,500-guilder price of 1637 does not appear obviously overvalued.

The only facet of the speculation for which an explanation does not emerge from the evidence is the 1-month price surge for common bulbs in January 1637, when prices rose up to twentyfold. After February 9, 1637, the first price observation for a common bulb, the *Witte Croonen*, is available only in 1642.³⁸ Table 1 contains the price data for ½ pound of this bulb. From February 1637 to 1642, the price depreciated at an annual rate of 76 percent. As an eighteenth-century benchmark rate, I have used 17 percent per year, the average rate of depreciation of all bulbs priced between fl 10 and fl 71 in table 3. Under the assumption that, after February 1637, *Witte Croonen* depreciated at this benchmark rate, the price must have collapsed in the crash to 5 percent of its peak price to have attained a 1642 price of fl 37.5. Thus *Witte Croonen* prices rose by about 26 times in January 1637 and fell to one-twentieth of their peak value in the first week of February. The eighteenth-century benchmark pattern of price depreciation, however, would have justified a peak price of fl 84, so the January price is not out of line.

³⁸ Claims that prices dropped to less than 10 percent of peak values after the crash must have originated in the officially proposed 3.5 percent contract settlement fee. This did not necessarily reflect the true price decline but simply provided a means of relieving buyers of most of their losses. Since they never cite a specific transaction price (none exists from trades immediately after the crash), I presume that authors citing massive price falls inferred them from the percentages proposed for contract buy-outs.

That a precipitous price decline for common bulbs occurred is confirmed by observations on Switsers in figure 5. The peak price for this bulb of 0.17 guilders per *aas* was attained on February 5, the apparent peak of the market. Data from notarized contracts on February 6 and 9 indicate a sudden decline to 0.11 guilders per *aas*. This represents a substantial decline from prices in the first five days of February, but it still substantially exceeds the prices attained on January 23 and is not of the same order of magnitude as the collapse indicated above for Witte Croonen.

Since already valuable bulbs rose by no more than 200–300 percent over a longer duration, the increase and collapse of the relative price of common bulbs are the remarkable feature of this phase of the speculation. Even if detailed, day-to-day information about market events for this period were available, we would be hard-pressed to find a market fundamental explanation for these relative price movements. It is clear that the colleges generated these prices, although they are echoed in some written contracts. As noted earlier, the college futures markets suffered from a lack of internal control over the nature of contracts, which might have encouraged a speculation of this sort. These markets consisted of a collection of people without net worth making ever-increasing numbers of “million-dollar bets” with each other with some knowledge that the state would not enforce the contracts.

VII. Conclusion

An observation that the tulipmania predisposes economists to advance bubble theories of asset pricing provides the point of departure of this study. If small strata of particular episodes underpin the belief that bubbles may exist, it is desirable to undertake a detailed study of these events, most of which have not been examined from the perspective of market fundamental theories of asset pricing, to assure that other reasonable explanations have not been overlooked.

Probably, economists will never form a consensus that a bubble has affected prices in a particular modern market because of the overwhelming clutter of available data and alternative theories. Flood and Garber (1980), Hamilton and Whiteman (1985), and Hamilton (1986) have demonstrated the impossibility of distinguishing empirically between hypotheses that asset price dynamics are driven by a rational speculative bubble and that researchers have not adequately measured the future market fundamentals anticipated by market participants. More generally, data will not distinguish between a claim that market participants suffer from some mania because behavior does not conform to the prediction of some researcher’s theory and a claim that the theory is flawed or misspecified. Because of this observational

equivalence, economists who take a position in the debate over the existence of bubbles are making a commitment that cannot be based on the analysis of experience.

I have aimed to investigate the nature of the market and of the environment during the tulipmania. While lack of data precludes a solid conclusion, the results of the study indicate that the bulb speculation was not obvious madness, at least for most of the 1634–37 “mania.” Only the last month of the speculation for common bulbs remains as a potential bubble, although the nature of the market, the contractual commitments, and the surrounding events are unclear enough that one could seriously embrace one side of the fundamentals versus bubble dispute only on the basis of strong prior beliefs.

I suspect that careful study of other purported bubbles will lead to similar conclusions. Ironically, theories of rational asset pricing do not generally preclude bubbles. A precondition for the existence of a rational bubble is the belief that a bubble can exist. The ancient examples usually cited may not themselves have been bubbles. Yet if market participants now believe that these historical events prove the existence of bubbles, rational bubbles can emerge in asset markets.

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