The Tulipmania Legend

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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 asset markets, especially futures 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 commodity or other asset markets. While the tulip speculation and other examples of "speculative manias" such as the South Sea and Mississippi Bubbles seem to emerge primarily at the birth of new markets, this observation provides no comfort. Economists cannot infer that their theories of rational asset pricing will predict accurately at crucial moments. Because economic systems continuously generate new speculative markets or recombinations of old markets, events like the tulipmania indicate that outbreaks of speculative mania may appear at any time.

Economists have placed numerous historical and contemporaneous episodes in the "bubble" category. For example, Kindleberger (1978) catalogues a long sequence of financial panics and manias and provides a descriptive pathology of their dynamics. Recently, Shiller (1986) and West (1985) have interpreted stock market behavior as potential bubbles or fads, and economists studying exchange rate determination such as Dornbusch (1983), Krugman (1985), Meese (1986), and Frankel and Froot (1986) have argued that recent market values of the dollar may have been driven by a speculative bubble.

However, Flood and Garber (1980) demonstrated the impossibility of distinguishing empirically between a hypothesis that asset price dynamics are

driven by a speculative bubble and a hypothesis 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 are suffering from some mania because behaviour does not conform with the prediction of some researcher's theory and a claim that the theory is flawed or mis-specified. Because of this observational equivalence, economists who take a position in the debate over the existence of bubbles are making a commitment which cannot be based on the analysis of experience.

Yet, there appear to be examples of speculative activity so wild that interpreting them as generated by market fundamentals strains the limits of credulity. The 17th century Dutch tulipmania always appears as a favorite example, even providing a synonym in our jargon for a speculative mania.[2] While other examples of speculative manias contain elements of money creation which conceivably may have been transformed into anticipated market funda- mentals, the tulip speculation occurred in a commodity market that was seemingly disconnected from the regular credit and monetary system in the Netherlands. Also, as a non-essential agricultural commodity, the tulip could be reproduced rapidly and without limit, should its relative price increase. Since market fundamental prices under any reasonable contingency should not have attained recorded levels, the tulipmania has been inter- preted as providing prima facie evidence that speculative manias can impinge on market prices.

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[2] The Mississippi and South Sea Bubbles are the other two examples which 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".

We should recall that the belief that bubbles can happen is necessary in rational expectations models for bubbles to exist. However, the tulipmania has primed our beliefs that unrestricted markets can and have generated detrimental speculative manias, making it more likely that a sizeable body of economists will occasionally embrace the "bubble hypothesis" in debates about whether bubbles have emerged in other episodes. Though it has been decisive in establishing our priors, our knowledge of the Dutch tulip speculation is murky at best, arising perhaps from a few anecdotes in Mackay (1852) or in a few scattered prices from other authors. No researcher has generated a systematic times series of the various bulb prices or even put together a coherent story of how the markets worked or of the nature of the financial contracts that materialized. Posthumus (1927,1929) and Krelage (1942, 1946) make the closest approaches but even they did not organize the data that they gathered in a manner useful for understanding the dynamics of the market prices.

In this paper, I will describe both the spot and future tulip markets that emerged during the speculation and construct a data set consisting of time series of prices and trading weights for many of the varieties of bulbs in the markets. The paper is divided into 10 sections. I present in section ii) the traditional tulipmania legend, along with a little history of thought on its sources in section iii). In section iv), I include a brief political and economic history of the 17th century Netherlands to provide a background. In section v), I describe the nature of both the spot and future tulip markets, focusing on how the reproductive cycle of the tulip itself determined behavior in these markets. For this discussion, I rely primarily on Posthumus (1929) and Krelage (1942, 1946). In section vi), I describe the

data sources for tulip prices and the nature of the data. In section vii),
I analyze the time series of 17th century tulip prices. Since the data are
too limited to construct "market fundamentals", I simply examine the movement
of prices for a variety of bulbs. In section viii) I examine the post-col-
lapse behavior of prices, reporting 18th century price data for both tulip
and hyacinth bulbs. I compare the pattern of price declines for initially
rare 18th century bulbs to that of 17th century bulbs. In section ix) I use
the evidence to address the question of whether the 17th century tulip
speculation is clear evidence of the existence of a speculative mania or
bubble. Section x) contains concluding remarks.

ii) The Legend

     Descriptions of the tulip speculation always are framed in a context of
doubt about how the Dutch, usually so successful and careful in their
speculations, could be caught in such an obvious blunder. Modern references
to the episode depend on the brief description in Mackay (1852). His tale
consists of a short description about the origin of the tulip market. The
tulip entered Western Europe from Turkey only in the middle of the 16th
century and was immediately embraced by the wealthy as a beautiful and rare
flower commanding high prices. The market was for durable bulbs, not
flowers. As in so many markets of the time, the Dutch dominated the market
for tulips, even devoting substantial agricultural lands to its cultivation.
The bulbs commanding high prices produced unique, beautifully patterned
flowers; common tulips were sold at much lower prices.

     Beginning in 1634, non-professionals entered the tulip trade in such
numbers that other activities were neglected. Prices of individual bulbs

reached enormous levels, e.g. a single Semper Augustus bulb was sold at the height of the speculation for 5500 florins=2200 U.S. gold dollars = 33,000 1986 dollars (2.5 florins = 1 gold dollar). However, neither the sources of these bulb prices nor the dates on which they are observed are listed in descriptions such as Mackay's.

Granted that some tulip prices were high, that valuable resources were allocated to the tulip trade, and that large numbers of common people entered the speculation, the raconteur's next step in relating the legend and the lunacy of the event consists of a sequence of anecdotes about sailors' mistakenly eating valuable bulbs or ignorant English travellers' experimenting with them by peeling off their layers.[3] Also, some wild barter transactions for acquiring rare bulbs are related so that the monetary expenditure may be translated into units of goods more meaningful for the modern reader.

The story-teller then shifts the tale to the final spasm of speculative frenzy when large amounts of foreign funds entered the country to join in the speculation and people from all classes hurriedly liquidated other assets to participate in the tulip market. Finally and inexplicably, the frenzy terminated; and, overnight, bulbs could find no buyers at 5% of their previous prices, creating a long term economic distress. However, no evidence of post-collapse transactions prices of the rare bulbs is included in the story. Only prices from bulb sales from 60 years, 130 years or 200 years after the collapse are cited as indicators of the magnitude of the

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[3]   One should note the implausibility of a Dutch businessman's leaving a highly valuable bulb lying about for a loutish sailor to eat for lunch or for a presumptuous English experimenter to dissect.

collapse and of the obvious mis-alignment of prices at the peak of the speculation.

iii) A History of Thought Diversion

Chroniclers of the tulip speculation take for granted that it was a mania, selecting and organizing the evidence to emphasize the irrationality of the market outcome. The current version of the legend seems to arise from Mackay's description, although he devotes to it a scant seven pages of text.[4] P.T. Barnum's (1865) description of the episode is directly plagiarized from Mackay without attribution.[5] At one point, Mackay cites Beckmann (1846) as a source, but most of his description is plagiarized from Beckmann with only a few minor wording changes and no credit to Beckmann.[6]

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[4] Shiller (1996) and Malkiel (1985) cite Mackay in their discussion of the effect of crowd psychology on asset prices. Claiming that he relies primarily on Mackay, Malkiel discusses extensively option contracts for bulbs which traded in the speculation. However, Mackay does not mention options. While options in shares of the East Asia Company were commonly traded on the Amsterdam exchange, none of the sources that I have found mention options in tulips, treating only the trade in futures contracts. Thus, Malkiel does not reveal his source for his discussion of tulip options.

[5] Wirth (1858) adds little that was not presented in Mackay.

[6] Beckmann, the original source of the two anecdotes referred to in the previous section, cites Blainville (1743) as his source for the Englishman story. A careful reading of Blainville turns up only a one sentence report that a tulip speculation occurred from 1634-37 in what is otherwise a baroque travel log of Haarlem. Indeed, Blainville's description of his travels through Holland was a diary of a tour made in 1705, seventy years after the speculation. For the sailor story, Beckmann mentions that the incident occurred while John Balthasar Schuppe (1610-1661) 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 embellishes both stories, cites Blainville as the source for both, presumably without having researched beyond Beckmann.

Beckmann is much more scholarly, carefully providing the source of each of his statements. Beckmann read the dialogues between Gaergoedt and Waermondt (1637) (hereafter G&W), and Munting's (1672, 1676) discussions of this episode, among others, for information about the functioning of the markets and for sales prices.[7] G&W is a series of three anonymously written pamphlets in dialogue form providing details about the markets and numerous prices of various bulbs, taken mostly from the final day of the speculation. Munting was a botanist who wrote a 1000 folio volume on numerous flowers. Though Mackay claims that the volume was devoted to the tulipmania, only the six pages devoted to tulips discuss the episode.[8] All the price data described in Munting can be found in the G&W dialogues, so we must conclude that this is Munting's (uncited) primary source. Thus, the current version of the tulipmania legend, to the extent that it is based on scholarly work, follows a grapevine of hearsay fanning out from the G&W dialogues.

A more careful and ignored line of research seems to have 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 W&G dialogues. Most of his price data comes from W&G but he also explores records left by notaries of tulip contracts from this time. However, Solms-Laubach was a botanist who simply described some of the events of the speculation without analysis.

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[7]   Among other authors cited was Ricard (1722) who spent one-half page in vaguely describing the high tulip prices and the collapse.

[8]Mackay obviously recorded Beckmann's reference to Munting without examining the Munting text.

Posthumus (1927, 1929, 1934), the only economist in this literature, extends the available data by compiling and reproducing more of the notaries' contracts. However, most of his discussion again depends on price information in the G&W dialogues. He does add a long list of tulip prices from a single auction in the final days of the speculation. Since many of the prices in G&W are also on this list, it provides a key confirmation of the validity of the prices in the G&W dialogues. Finally, Krelage (1942, 1946) provides an extensive description of the markets, though his prices for the speculation period also seem to come from G&W. Krelage (1946) does provide extensive tulip price lists from sales in 1708 and 1709 and a 1739 bulb catalogue. In addition, he compiles a time series of prices for a large variety of hyacinth bulbs during the 18th and 19th centuries. The hyacinth replaced the tulip as the fashionable flower for two centuries until the resurgence of the tulip at the end of the 19th century. Indeed, a large hyacinth speculation (hyacinthmania) and crash occurred in 1735-39. Assuming Krelage's data provide a pattern of price evolution for any newly developed fashionable flower, we can use them to interpret the 17th century tulip price developments.

iv) A Political and Economic Background[9]

The introduction of the tulip market into the Netherlands and the Tulipmania occurred in the midst of the Eighty Years War of Independence between the Dutch and the Spanish. Spanish possession of the Low Countries had arisen through marriage; both the old Burgundian possessions in the Low

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[9] The discussion or political and economic history is based on the Cambridge Economic History of Europe, Vols. IV and V, Braudel (1979), Vol. 3, Attman (1983), and the New Cambridge Modern History of Europe, Vol. IV.

countries and Spain had been melded with Habsburg territories in Central Europe in this manner. In trying to centralize and make organizational sense of this amalgamation of territories, the Habsburgs attempted to impose administrative reforms which initiated the Dutch rebellion in 1567. This war was waged continuously, with Spain using the Spanish Netherlands (Belgium) as a base to attack the United Provinces until The Twelve Years Truce was arranged in 1609. The Spanish were completely thwarted in their attempts to subjugate the Netherlands, which consolidated its territory and eventually seized control of most of international shipping. During this phase of the war, the English and Dutch were in alliance, a facet of which was the defeat of the Spanish Armada in 1588.

In 1618, the Thirty Years War broke out in Europe, aligning the Hapsburgs and the Empire, including the Spanish, on the Catholic side against various Protestant powers in Central and Eastern Europe. As the last total war in Europe until the 20th century, the Thirty Years War was particularly destructive of the populations and economies of Central Europe.[10] With the expiration of the Twelve Years Truce in 1621, the Spanish-Dutch Eighty Years War revived as a continuing offshoot of the Thirty Years War and did not finally terminate until the general peace of 1648. In every year of the war, the Dutch fielded armies as large as 100,000 men during campaigning seasons and supported large fleets, though the population of the Netherlands was no more than 1.5 million. The Dutch provided much of the strategic planning and finance for the Protestant effort, along with France negotiating and finan-

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[10] The map from Rich and Wilson (1967), Vol. IV, p. 42 indicates the population declines to the east of the Netherlands in this period.
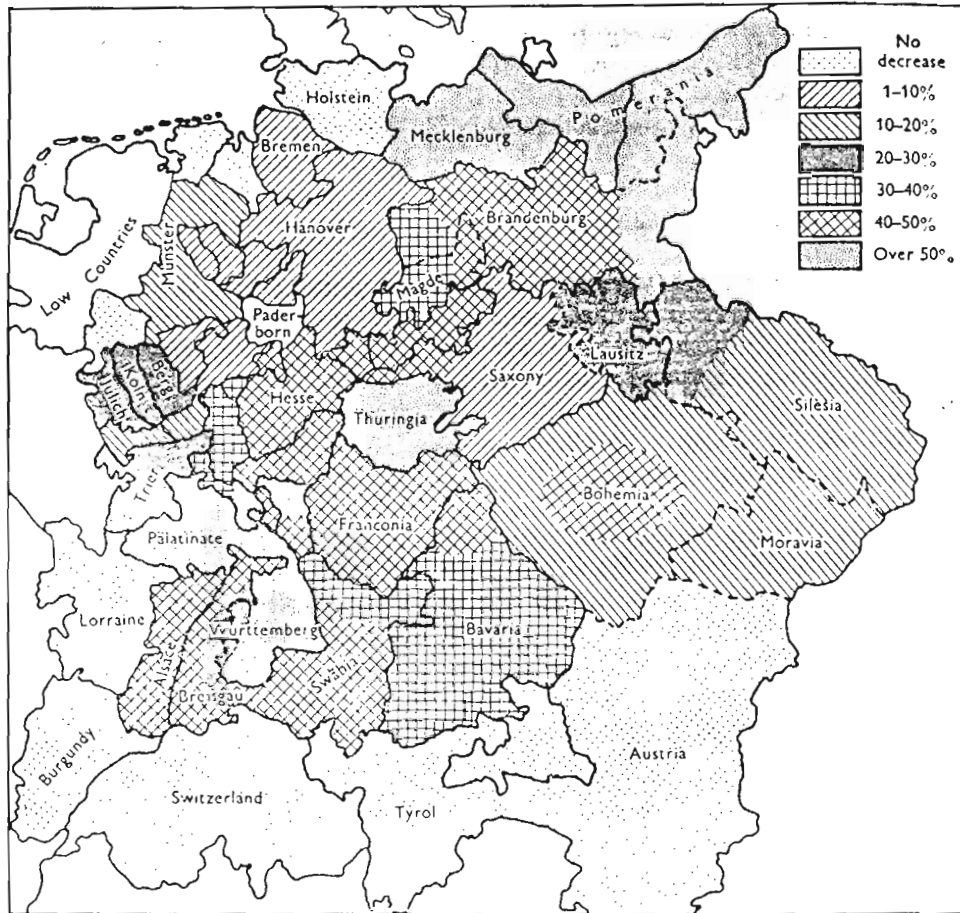
Population decrease in the Holy Roman Empire during the Thirty Years War.
(After G. Franz.)

cing the successive interventions of Denmark and Sweden on the Protestant side in the 1620's and 1630's.

From 1620-45, the Dutch established near monopolies on trade with the East Indies and Japan, conquered most of Brazil, took possession of the Dutch Caribbean islands, and founded New York. In 1628, the Dutch West India Company captured in a Caribbean naval action the entire year's output of silver and gold from Spain's American possessions, amounting in value to 11.5-14 million florins.[11] In 1635, the Dutch formed a military alliance with Richelieu's France, which eventually placed the Spanish Netherlands in a precarious position. In 1639, the Dutch completely destroyed a second Spanish Armada of a size comparable to that of 1598. As an outcome of the war, the Spanish ceased to be the dominating power in Europe, and the Netherlands, though small in population and resources, became a major power center because of its complete control over international trade and international finance. The Dutch were to 17th century trade and finance as the British were to 19th century trade and finance.

Of course, this period was not one of uninterrupted triumph. Notably, in the years 1634-1637, the Dutch suffered several setbacks. From 1635-37, the bubonic plague ravaged the Netherlands, killing 17193 people in Amsterdam alone in 1636 (1/7 of the population).[12] In July, 1634, the Empire completely defeated Swedish forces in the Battle of Nordlingen, forcing a treaty

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[11] See Attman(1983), p. 35.

[12] The plague had marched westward with the dynamics of the armies in Germany starting in 1630. See Prinzing (1916) on the epidemics of the Thirty Years War and the accompanying map for the extent of the population reductions in Germany. It also caused 14582 deaths in Leiden in 1635 (33% of the 1622 population). Plague also broke out from 1623-5, 1654-5 and 1663-4, killing in Amsterdam one-ninth, one eighth, and one-sixth of the population, respectively. See Cooper (1970), p. 76.

on the German Protestant principalities in the May, 1635 Peace of Prague and releasing resources for the war against the Dutch. Along with the growing war-weariness in the Netherlands, these events forced France to enter the Thirty Years War militarily with the Dutch alliance in 1635. Initially unprepared, the French suffered major setbacks, culminating in an Imperial invasion of northern France in August, 1636. The war did not again turn in favor of the Dutch until the capture of the important fortress of Breda in October, 1637.

The expansion of Dutch political power depended on the rapid development of the Dutch economy. The Netherlands was a largely urbanized society engaged in manufacture, trade and finance; the rest of Europe consisted of peasant societies. The major Dutch industries were shipbuilding, fisheries, transport, textiles and finance. During the 17th century, most transport ships in European merchant fleets were built by the Dutch, and the Dutch merchant fleet outnumbered the fleets of all the other maritime nations of Europe combined. The Dutch dominated transport in grains, precious and common metals, salt and other bulk goods; and as an entrepot the Netherlands provided a natural location for European markets in all major commodities.

Sophisticated finance mechanisms evolved with the establishment of the commodity markets. Amsterdam became the dominant market for short and long term credit; and markets in stocks, commodity futures and options materialized early in the 17th century.[13] Trading of national loans of many countries centered in Amsterdam, as did a market in the shares of joint stock companies. The East India Company, founded in 1602, gradually gained control

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[13] See Penso de la Vega (1688) for a description of the variety of securities and the sophistication of market manipulation on the Amsterdam exchange.

over East Asian trade and consistently paid out large dividends. To the West India Company, founded in 1622, was given the right to undertake ventures in the Western Hemisphere. Interest rates on Dutch markets were remarkably low; for example, the East India Company paid no more that 5% on advances during the 17th century.

Thus, at the time of the tulip speculation, the Netherlands was a highly commercialized country with well-developed and innovative financial markets and a large population of sophisticated traders. Its participation in innumerable risky ventures had proven so successful that the era is considered the golden age of the Netherlands.

Though economic histories of the important events and institutions in the Netherlands during this period are detailed, they hardly mention the tulip speculation. For example, The Cambridge Economic History of Europe's volumes IV, The Economy of Expanding Europe in the 16th and 17th Century, and V, The Economic Organization of Early Modern Europe do not mention tulips, though the 17th 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 Year's War.[14]

v) The Tulip and the Tulip Markets

To form an understanding of the tulip markets requires some information about the nature of the tulip. A bulb flower, the tulip can propagate through seeds or through buds or outgrowths which form on the mother bulb.

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[14] 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.

Properly cultivated the outgrowths can directly reproduce another bulb. Each bulb, after planting, eventually disappears during the growing season; the original bulb is replaced by a clone, the primary bud which is now a functioning bulb, and a few secondary buds by the end of the season. Asexual reproduction through buds, the principal propagation method, produces an annual increase in bulbs at a maximum rate of from 100% to 150% in normal bulbs.[15]

A bulb produced directly from seed requires seven to twelve 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.[16] In June, bulbs can be removed from their beds but must be replanted by September. Therefore, spot trading in bulbs must occur during this period unless it also involves transfers of land.

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. Examples of these patterns can be found in the Figure 1 for the Viceroy, the Semper Augustus, and the Gouda. The pattern imposed on a particular flower cannot be reproduced through seed propagation; seeds will produce bulbs unaffected by the virus which yield a common flower. These bulbs may themselves eventually "break" at some unknown date but into a pattern which may not be remarkable. However, a particular pattern can be reproduced by cultivating the bulb outgrowths into new bulbs.

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[15] See Mather (1961), p. 44.

[16] Hartman 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 one year.

1. VISEROY.   2. SEMPER AUGUSTUS.   3. GOUDA.

Figure 1

As another effect, the mosaic virus makes the bulb sickly and reduces its rate of reproduction. Although 17th century florists thought that breaking was a normal stage in the maturing process of breeder bulbs (the stock of bulbs affected 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 3 buds. Smith (1937), p. 413, notes 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.[17] Van Slogteren (1960) claims that the mosaic virus may cause total loss of a plant or a 10-20% reduction in propagation rates.

The high market prices for tulips passed on to economists through the tulipmania legends were prices for particularly beautiful broken bulbs, presumably admired because they fit the baroque tastes of the time. 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 2 centuries of European cultivation were diseased. Broken bulbs fell from

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[17] However, almost all the 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 gems of the tulip speculation as Admirael Liefkens, Admirael 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 1630's as common flowers except at the height of the speculation. Even these bulbs are grown only by collectors currently.

fashion only in the 19th century.[18] 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".[19] Though it is now known that the mosaic virus is spread by aphids, methods of encouraging breaking were not well-understood in the 17th century. G&W suggested grafting half a bulb of a broken tulip to half a bulb of an 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.[20]

Though agricultural commodities, broken tulips could be reproduced only relatively slowly; thus, movements in their relative prices would not be moderated through rapid supply responses. The demand for the bulbs arose from the same forces that drives demand for rare and beautiful objects in any society of rapidly increasing wealth. It is not more remarkable that particularly rare bulbs which the tastes of the times had classified as beautiful should command high and rising prices than that diamonds or Old Masters paintings should command such prices.[21] Thus, the Semper Augustus, reputedly the most valued of the tulips, with only a few existing bulbs, was valued greatly for years before the tulipmania, as indicated in Chart I.

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[18] The tulip itself was eclipsed in fashion in the 18th century by the hyacinth. See Doorenbos (1954), pp. 1-11.

[19] Mather (1961), pp. 100-1.

[20] D'Ardene (1760), pp. 198-217, devotes a chapter to breaking in tulips, shedding little light on methods to encourage breaking.

[21] This was the very period in which the Dutch and Flemish schools flourished, the products of which commanded high contemporaneous prices from the same wealthy classes who also so admired the beauty of the tulip.

Nor should economists be surpised that a speculative market for rare bulbs might materialize and generate large price fluctuations because of its thinness. The surprising feature of the tulipmania was the spread of speculation to the market for common bulbs and the enormous price rises experienced in this market in the last months of the speculation.

The market for all bulbs was limited to professional growers until 1634, but participation encompassed a more general class of speculators by the end of 1634.[22] Rumors that demand for bulbs was rising in France apparently drove the speculation.[23]

Market participants could make many types of deals. The rare flowers were called "piece" goods, and particular bulbs were sold by their weight. Typically, the heavier bulbs had more outgrowths and therefore represented a collection of future bulbs. The weight standard was the "aas", about 1/20 of a gram. (Some idea of the bulb size associated with a given weight can be gained from Figure 2.) For example, if a Gouda of 57 aasen were sold for a given price, the sale contract would refer to a particular flower planted at a given location. Once markets developed in common bulbs, they were sold in standardized units of 1000 aasen or 1 pound (9728 aasen in Haarlem, 10240 aasen in Amsterdam). Purchase contracts for "pound" goods would not necessarily 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

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

[23] In France, it became fashionable for women to array quantities of fresh tulips at the top of their gowns. Fashionable men vied with each other to present the most bizarre flowers to eligible women, thereby driving up the demand for rare flowers.
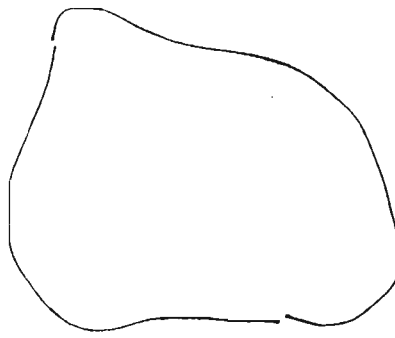
5 1 gram of 1062 azen.   1 gram of 20 azen.

Figure 2
Tulip Sizes

bulbs. The outgrowths could not be delivered immediately, as 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 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 one-half penny (1 penny = 1 stuyver = 1/20 florin) out of each contracted florin to sellers up to a maximum of 3 florins (1.20 U.S. gold dollars) for each deal for "wine money". Of course, to the extent that a trader ran a balanced book over any length of time, these payments 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 are that the contracts were

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

not marked to market, required no margin deposits to guarantee compliance, and consisted of commitments of individuals rather than of an exchange.

It is unclear which date was designated as the settlement date; presumably, it was some date after the bulbs could be dug up in June. However, settlement may have occurred earlier. No bulbs were delivered under the deals struck in the new futures markets in 1636-37 prior to the collapse. It is also unclear how the settlement price was determined. Beckmann (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 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 (p. 442)]. This seems to imply that no one arbitraged the spot and futures markets. To go long 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 require that the future purchaser have substantial capital or access to sound credit; substantial risk of non-compliance with the deal in the futures market would undermine 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.

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 ace 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 aces and per pound.

vi) The 17th Century Tulip Price Data

Table 1 contains price data for various tulips. For each type of bulb, the observations are ordered by date; and they include the price paid, the weight in aas of the bulb, the price per aas, and the data source. I have gathered the data from different sources of uneven reliability.

Some sources are marked with numbers to indicate the numbering of notarized contracts reported by Posthumus in Economisch-Historisch Jaarboek (1927, 1934). Since these were carefully drawn contracts sworn before notaries, they probably are the most reliable data, representing serious transactions which did not occur in the colleges. Also, many are dated before the peak of the speculation in January-February, 1637. Presumably, the contracts drawn from June-September were for spot delivery. The delivery dates for the winter contracts are unclear. A few contract prices reported in Krelage (1946) are labelled as "Krelage-46-p482".

Next in order of reliability are the bulbs labelled "Children", which I have taken from Economisch-Historisch Jaarboek (1927). These bulbs are taken from a price list labelled "List of some tulips sold to the highest bidder on February 5, 1637, in the city of Alkmaar. These tulips were sold to the benefit of the children of Mr. Wouter Bartelmiesz at a total amount of Fl. 68,553." A facsimile of this list is also reproduced in Krelage (1946), p. 488. Again, the delivery date and terms of payment are not clear from the

available information. Also, the February 5 date seems at odds with the collapse date, which G&W claim occurred on February 3. However, as recorded auction prices, the list represents some actual transactions.

Lower in order of reliability are the numerous prices reported in G&W. G&W is in the form of a long and moralistic dialogue between Gaergoedt (Greedy Goods) and Waermondt (True Mouth) about the nature of the markets and the price dynamics during the speculation. The third dialogue "Prijsen der Bloemen" presents a list of about 250 bulb transactions, including prices and weights, but it does not report the dates of the sales. Fortunately, since a great deal of overlap appears between the G&W prices and the "Children" prices, the author of G&W must have had access to the "Children" list in constructing the G&W list. Thus, I used the February 5 date of the "Children list to date the reported prices in the G&W list. including those G&W flowers not reported in the "Children" list. Also, finding many of the G&W flowers listed among verifiable transactions generates some confidence that the G&W author did not simply make up the prices reported in the third dialogue.

In discussing the rapidity of price movement during the speculation, G&W present the prices of twenty bulbs observed at two different times in the speculation, claiming the earlier prices were taken from 4 to 6 weeks prior to the later prices for each bulb. However, they do not indicate the dates on which the later transactions occurred. Fortunately, most of the later transactions for these bulbs are among the bulbs in the "Children" list or in the extensive G&W list described above. Since these bulbs are the only "time series" reported in G&W, it is important to include them. Thus, I have presumed that the later transaction for each bulb occurred on February 5,

1637 and that the earlier transaction occurred on January 2, 1637, five weeks earlier. This explains why so many January 2-February 5 pairs appear in the list in Table 1.

Finally, the list contains several transactions listed in Munting and in Krelage (1942) which I could not find among the above sources. Unfortunately, Krelage reports the price per aas involved in particular transactions and not the price and weight of the transacted bulb.

vii) Some Characterization of the Data

To a great extent the price list is a blend of apples and oranges. I cannot separate the prices determined in the colleges, in which bankruptcy constraints seem not to have been imposed, from those which may have been more seriously binding on the transactors. Also, I cannot separate the spot from the futures deals, although all transactions after September, 1636 must have been for future delivery. One natural way to separate these 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 trading 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.

In Chart 2 through Chart 19, I depict the "time series" for florins/aas that I have been able to reconstruct for various bulbs. The last observations for each series (except for the Switsers) falls on February 5, 1637. For that date there are usually several price observations for each flower, but their order of appearance in the charts has no meaning. In particular, the charts 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.

The bulbs that can be included among "piece" goods are Admirael Liefkens, Admirael van der Eyck, Gouda, Semper Augustus, and Viceroy. Among these, the Gouda can be considered a standard, since we have the longest price series for this bulb, starting at the beginning of the speculation. The bulbs that can be included among the "pound" goods, i.e. bulbs trading in 1000 aasen or pound lots are Admirael de Man, Centen, Coorenaerts, Gheele ende Roote van Leyden, Groote Geplumiceerde, Le Grand, Macx, Nieuwburger, Oudenaerden, Switsers, and Witte Croonen.[25] Others are more difficult to classify, encompassing different deals in which either odd weights or standard weights appear.

Generally, the pound goods sold at much lower prices per aas than the piece goods. However, in the last few months of the speculation, their prices increased much more rapidly than did those of the piece goods. Prices of Coorenaerts, Gheele ende Roote van Leyden, Le Grand, Macx, Admirael de Man, Oudenaerden, Switsers, and Witte Croonen rose up to twenty-fold within one month. Over a much longer period, the prices of the piece goods doubled or perhaps tripled.

The Gouda series presents an opportunity to split deals for long term future delivery from either spot or near term future delivery within the class of dealers in rare bulbs. Several of the deals for Goudas are obviously for outgrowths, e.g. the deals for weights of 1,4, and 7 aasen. In Charts

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[25] Gheele ende Roote van Leyden, Gheele Croonen, and Witte Croonen apparently were not broken tulips, though they were multi-colored. However, it is not clear whether the other 'pound good" tulips were broken. I have not come across descriptions of their characteristics.

16 and 17, I have split the series for the Gouda into prices for bulbs above 100 aasen (No Outgrowth) and prices for bulbs below 100 aasen (Outgrowth). For the large bulbs, the growth rate of price is not as spectacular as that for the small bulbs from November, 1636 onward. Note, however, that the total payments for the small bulbs is much smaller than for the large ones, in spite of the high price/aas.

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, the buyer would be given the right to reject the deal on payment of 10% of the sale price to the seller. 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 whatever price the authorities eventually determined for contract settlement. The effect of this decision was to release the growers to market the bulbs which would emerge in June. After this decision, the disposition of further settlement becomes murky, though Posthumus (pp. 446-7) 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% of the contract price.[26]

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[26] Even the pre-collapse legal status of the futures contracts was unclear. Early price manipulation and bear raids in East India Company shares led to legal bans on short sales 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

viii) 18th Century Tulip and Hyacinth Prices

No prices are available from the period immediately after the collapse
of the speculation. A gap of about 70 years in tulip price data arises in
all sources after the collapse.[27] Remarkably high prices are available only
for much later periods, and these are an order of magnitude lower than those
quoted during the speculation. Beckmann (p.30) cites prices from later
periods in England, e.g in 1769 a Don Quevedo sold for 2 lb. 2 s. = 23
florins. Mackay claims that in 1800, tulips often sold for 15 guineas (165
florins) and that in 1835 a bulb called Miss Fanny Kemble yielded 75 pounds
(825 florins) at auction. By 1800, the names of the spectacular bulbs of the
Dutch tulip speculation such as Gouda and Semper Augustus were no longer
mentioned.

Krelage (1946) reproduces price lists from two auctions on May 17, 1707
in the Hague (p. 542) and on May 16, 1708 in Rotterdam (p. 541). 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 reports that at the auction at The Hague a tulip called
Veldmaarschalk Averqercq sold for 321 florins while a Schoon Aethiopia sold

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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.

[27] 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 and
Roote van Leyden, Admirael van Enchuysen, Brabanson, Senecours, Admirael de
Man, Coorenaerts, Jan Gerritz, Gouda, Saeyblom, Switsers, Parragon Lietkens,
and Semper Augustus.

for 195 florins. In Rotterdam, a bulb called L'imperiale sold for 336
florins.

Krelage (1946) also reproduces a 1739 Haarlem price catalogue 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 .1 florins. In Table 2, I report prices for these bulbs
for January 2, 1637, February 5, 1637 and 1739. Even starting in January,
1637, before the peak of the speculation, the price decline is remarkable.
Prices fall to levels of 1%, .5%, .1%, or .005% of their January, 1637 values
in a century. Also noteworthy is the convergence of prices of all indivi-
dually 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 the 1739 price list. While this was not a period known for a
tulip speculation or crash, prices display the same pattern of decline.
Presumably, bulbs appearing on an auction list were rare, possibly recently
introduced varieties which commanded relatively high prices.[28] By the time
they appeared on a general catalogue, they had become relatively common.
Again, in 32 years prices declined to 3%, .25%, .35%, or .04% 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 florin prices as the valuable bulbs of 1637.

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[28] None of the bulbs on the 1739 list carried a price greater than 8
florins, 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.

Thus, we have a pattern in the evolution of prices of newly developed, fashionable tulip bulbs. The first bulbs, presumably 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 18th century. Thus, a non-commercial purchaser must have either valued the ephemeral beauty of the rare flower at a rate of several florins per year if he did not propagate the bulb greatly. Alternatively, he may also have valued the prospect of both an ever-increasing quantity of beautiful flowers together with an increase in the capital value of an expanding bulb supply.

As further evidence of this standard pattern in bulb prices, I now turn to the market for hyacinths. Krelage supplies prices of hyacinths during the 18th and 19th centuries. Hyacinths replaced tulips at the start of the 18th century as the fashionable flower, and once again a large effort arose to innovate beautiful varieties. A speculation similar to that for tulips occurred from 1734 to 1739.[29] 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 10% of 1734 prices in some cases was of similar magnitude to the 1637 crash.

More generally, Krelage provides long price series in more normal times for many hyacinths after their introduction. In Table 5, I have selected the price patterns for bulbs carrying particularly high prices at the time of

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[29] The speculation led to the production of reprints of S&W as a warning against unconstrained financial contracting.

introduction. Note that the pattern is similar to that for prized tulips in the 17th and 18th century. Within three decades, prices of even the highest priced bulbs usually fell to 1-2% of the original price. Both originally highly priced and inexpensive bulbs converged to a price of from .5 florins to 1 florin.

ix) Was there a tulipmania?

I now examine whether the evidence demands a mania interpretation for the tulip price movements. First, I will dispose of some nagging issues: 1) the absence of descriptions of economic distress in accounts of the period not engaged in anti-speculative moralizing; 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 trades in common bulbs lasting from January 2, 1637-February 5, 1637. Only for this facet of the speculation might one reasonably invoke a bubble hypothesis, though I suggest some alternatives.

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 in the rare bulbs, it is doubtful that significant agricultural resources were devoted to expand their cultivation. 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. Thus, to the extent that the speculation had any impact, it can

have had an effect only through the distribution of wealth. However, little wealth was actually transferred; 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 be affected by a cut off 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 18th century tulip and hyacinth 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 magnitude of prices for valuable bulbs (before January, 1637) does not seem far out of line with later prices for new varieties of rare bulbs. Single bulbs in the 18th century commanded prices as high as 1000 florins. In this context, the 1200-2000 florin price of Semper Augustus from 1612 to 1625 does not appear unusually high.[30] This was the dawn of the Dutch bulb market before full knowledge of the life cycle of bulb price dynamics had been attained. In addition, bulb prices may have fallen because of a change in fashion in desirable flowers. Tastes may have swung to new varieties or species, as in the fashion shift from tulips to hyacinths.

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[30] Semper Augustus prices increased by 250% over the 1625 price at the peak of the speculation to 5500 florins.

The only facet of the speculation for which an explanation does not
emerge from the evidence is the one-month price surge for common bulbs in
January, 1637. Prices of common bulbs rose up to twenty-fold, collapsing in
the first week of February to less than 5% of their peak prices, i.e. to
somewhat below their pre-January prices. The magnitude of the collapse
remains unclear, because of the lack of availability of immediate, post-col-
lapse market prices. Since already valuable bulbs may have risen 200-300% in
this speculation, the relative price increase of common bulbs is the remar-
kable feature of this phase of the speculation.

Even if detailed, day-to-day information about market events for this
period were available, one would be hard pressed to find a market fundamental
explanation for these price movements. It is clear that the "colleges"
generated these prices, although they are echoed in some written contracts.
The college futures markets suffered from a lack of internal control over the
nature of contracts which might encourage a speculation of this sort. First,
they received little external credit, as the large financial institutions and
the wealthy did not participate in the speculation. Second, no control was
exercised over the gross or net position of the participants, and no margin
was required. These markets consisted of a collection of people without
equity making ever-increasing numbers of "million dollar bets" with each
other. Third, the contracts were not marked to market; and a single
exchange did not take one side of each contract. Therefore, individuals
might establish enormous gross positions while maintaining a small net
position.

However, imperfect restriction of the market does not explain why the
speculation began. For explanations based on market fundamentals, we must

turn to intellectual speculation. One possibility lies in changing tastes for unique varieties and in changing technologies for producing broken bulbs. If the market sensed increased demand for rare varieties, the value of the lottery ticket represented by an unbroken bulb might increase. However, this explanation leaves unresolved the increase in the price of common bulbs relative to valuable bulbs. If innovations in the art of bulb breaking materialized, increasing the probability that an unbroken bulb would break, the unbroken bulb stock would increase in value. The prospect of more future broken bulbs would reduce the value of already broken bulbs. With these explanations, a rise of both the relative price of common bulbs and the money price of rare bulbs would require a sudden belief in taste shifts and shifts in "breaking" technology. The price crash would require a reversal of those beliefs within one month, a farfetched combination of events.

The only important events external to the bulb market from 1634-37 were the plague outbreak and the bad news in the war against Spain. Up to 1/7 of the population of the major cities was wiped out in the plague of 1635-37, and Spanish and Imperial armies were concentrating their attacks on the Netherlands and France. On both counts, the population of the Netherlands faced a high probability of imminent death from 1635-37, coincident with the tulip speculation, and a decline in the probability thereafter. Although these events may be false clues, it is conceivable that a gambling binge tied to a drinking game and general carousing may have materialized as a response to the death threat. Lacking is an explanation of why this loss of morale took the form of a game centered around tulip speculation. Also, descriptions of the episode, notably that of G&W, fail to mention the plague or the military situation.

x) Conclusion

An assumption that the tulipmania episode 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 with modern tools, to assure that other reasonable explanations have not been overlooked. Probably, economists will never agree that a bubble has affected prices in a particular modern market, because of the overwhelming clutter of available data and alternative theories. Similarly, it is likely that careful study of purported historical bubbles will cast doubt on whether they represent speculative manias.

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 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 dispute only through religious conviction. 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 bubble is the belief that a bubble can exist. The ancient examples usually cited may not themselves have been bubbles. However, if market participants believe that these historical events prove the existence of bubbles, bubbles can emerge in asset markets.

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Table 1
TULIP PRICES, WEIGHTS, AND DATES

	DATE	TULIP	PRICE	WEIGHT	PRICE/AAS	SOURCE
1	01-Jun-36	Admirael Liefkens	6.6	1	6.6000	18
2	05-Feb-37	Admirael Liefkens			11.8000	Krelage, p. 49
3	05-Feb-37	Admirael Liefkens	4400	400	11.0000	G&W
4	05-Feb-37	Admirael Liefkens	1015	59	17.2034	Children
5	02-Jan-37	Admirael de Man	15	130	0.1154	G&W
6	02-Jan-37	Admirael de Man	90	1000	0.0900	G&W
7	05-Feb-37	Admirael de Man	250	175	1.4286	G&W
8	05-Feb-37	Admirael de Man	800	1000	0.8000	G&W
9	05-Feb-37	Admirael de Man	175	130	1.3462	G&W
10	05-Feb-37	Admirael van Enchuys	5400	215	25.1163	G&W
11	05-Feb-37	Admirael van Enchuysen			25.0000	Krelage, p.49
12	05-Feb-37	Admirael van Enchuys	900	8	112.5000	G&W
13	05-Feb-37	Admirael van Hoorn	230	1000	0.2300	G&W
14	05-Feb-37	Admirael van Hoorn	200	440	0.4545	G&W
15	01-Dec-34	Admirael van der Eyc	80	80	1.0000	7
16	01-Dec-34	Admirael van der Eyc	66	20	3.3000	7
17	27-Jul-36	Admirael van der Eyc	2.5	1	2.5000	17
18	05-Feb-37	Admirael van der Eyc			4.5000	Krelage, p49
19	05-Feb-37	Admirael van der Eyc	1620	446	3.6323	Children
20	05-Feb-37	Admirael van der Eyc	1045	214	4.8832	Children
21	05-Feb-37	Admirael van der Eyc	710	92	7.7174	Children
22	05-Feb-37	Anvers	905	1000	0.9050	Children
23	05-Feb-37	Anvers	1000	1000	1.0000	G&W
24	05-Feb-37	Anvers	930	1000	0.9300	Children
25	05-Feb-37	Anvers	900	1000	0.9000	Children
26	05-Feb-37	Anvers Gemeene	405	387	1.0465	G&W
27	01-Dec-36	Bleyenburch (Laeten)	350	4 tuli	ERR	57
28	28-Dec-36	Bleyenburch (Laeten)	120	104	1.1538	65
29	05-Feb-37	Blijenburger (Vroege)			3.5000	Krelage, p. 49
30	05-Feb-37	Blijenburger (Vroege	1300	443	2.9345	Children
31	05-Feb-37	Blijenburger (Vroege	900	171	5.2632	Children
32	05-Feb-37	Brabanson	835	346	2.4133	Children
33	05-Feb-37	Brabanson	1010	542	1.8635	Children
34	05-Feb-37	Brabanson Bol	975	524	1.8607	Children
35	05-Feb-37	Bruyne Purper	2025	320	6.3281	Children
36	05-Feb-37	Bruyne Purper			10.3000	Krelage, p.49
37	05-Feb-37	Bruyne Purper	1100	50	22.0000	G&W
38	05-Feb-37	Bruyne Purper	1300	60	21.6667	G&W
39	05-Feb-37	Butterman	263	563	0.4671	Children
40	05-Feb-37	Butterman	250	246	1.0163	Children
41	05-Feb-37	Butterman	405	400	1.0125	Children
42	10-Jul-12	Caers op de Candelae	24		ERR	3
43	05-Feb-37	Casteleyn	1000	1000	1.0000	Children
44	05-Feb-37	Casteleyn (Tournay)	705	1000	0.7050	Children
45	05-Feb-37	Casteleyn (Tournay)	355	150	2.3667	G&W
46	05-Feb-37	Casteleyn (Tournay)	800	1000	0.8000	G&W
47	02-Jan-37	Centen	40	1000	0.0400	G&W
48	22-Jan-37	Centen	380	3000	0.1267	32
49	05-Feb-37	Centen	400	1000	0.4000	G&W
50	05-Feb-37	Centen	4300	10240	0.4199	G&W
51	02-Jan-37	Coorenaerts	60	1000	0.0600	G&W
52	22-Jan-37	Coorenaerts	220	1000	0.2200	32
53	05-Feb-37	Coorenaerts	550	1000	0.5500	G&W

TULIP PRICES, WEIGHTS, AND DATES

	DATE	TULIP	PRICE	WEIGHT	PRICE/AAS	SOURCE
54	05-Feb-37	Coorenaerts	4800	10240	0.4688	G&W
55	05-Feb-37	Duckewinckel	210	1000	0.2100	G&W
56	05-Feb-37	Duckewinckel	300	700	0.4286	Children
57	05-Feb-37	Fabri	180	510	0.3529	
58	05-Feb-37	Fabri	240	600	0.4000	G&W
59	05-Feb-37	Fama	605	130	4.6538	Children
60	05-Feb-37	Fama	700	158	4.4304	Children
61	05-Feb-37	Fama	440	104	4.2308	Children
62	02-Jan-37	Generalissimo	95	10	7.5000	G&W
63	05-Feb-37	Generalissimo	900	10	90.0000	G&W
64	02-Jan-37	Gheele Croonen	24	10240	0.0023	G&W
65	05-Feb-37	Gheele Croonen	1200	10240	0.1172	G&W
66	09-Dec-36	Gheele ende Roote va	260	578	0.4498	Krelage, p. 73.
67	02-Jan-37	Gheele ende Roote va	46	515	0.0893	G&W
68	02-Jan-37	Gheele ende Roote va	100	1000	0.1000	G&W
69	05-Feb-37	Gheele ende Roote va	700	1000	0.7000	G&W
70	05-Feb-37	Gheele ende Roote va	140	400	0.3500	G&W
71	05-Feb-37	Gheele ende Roote va	550	515	1.0680	G&W
72	05-Feb-37	Gheele ende Roote van Leyden			0.5800	Krelage, p.49
73	05-Feb-37	Gheele ende Roote va	235	240	0.9792	G&W
74	12-Nov-36	Ghemarm. de Goyer	70	357	0.1961	Krelage, p.73.
75	05-Feb-37	Ghemarm. de Goyer	250	1000	0.2500	G&W
76	01-Dec-34	Gouda	45	30	1.5000	7 & Krelage, p.49
77	01-Dec-35	Gouda	2.1	1	2.1000	24
78	29-Aug-36	Gouda	3.75	1	3.7500	20
79	25-Nov-36	Gouda	446	66	6.7576	30
80	09-Dec-36	Gouda	600	400	1.5000	35
81	12-Dec-36	Gouda	520	48	10.8333	Solms-Laubach p.8
82	02-Jan-37	Gouda	20	4	5.0000	G&W
83	29-Jan-37	Gouda	100	7	14.2857	33
	05-Feb-37	Gouda			5.06	weighted average
84	05-Feb-37	Gouda	1165	160	7.2813	Children
85	05-Feb-37	Gouda	635	63	10.0794	Children
86	05-Feb-37	Gouda	1015	125	8.1200	Children
87	05-Feb-37	Gouda	3600	1000	3.6000	Munting & G&W
88	05-Feb-37	Gouda	1330	187	7.1123	Children
89	05-Feb-37	Gouda			7.5000	Krelage, p. 49
90	05-Feb-37	Gouda	1500	244	6.1475	Children
91	05-Feb-37	Gouda	765	82	9.3293	Children
92	05-Feb-37	Gouda	1165	156	7.4679	Children
93	05-Feb-37	Gouda	225	4	56.2500	G&W&30
94	05-Feb-37	Grebber			2.6000	Krelage, p. 49
95	05-Feb-37	Grebber	1485	523	2.8394	Children
96	05-Feb-37	Grebber	615	95	6.4737	Children
97	29-Sep-36	Groote Geplumiceerde	140	2000	0.0700	28
98	12-Jan-37	Groote Geplumiceerde	300	2000	0.1500	G&W
99	05-Feb-37	Groote Geplumiceerde	300	400	0.7500	71
100	05-Feb-37	Groote Geplumiceerde	280	1000	0.2800	Children
101	05-Feb-37	Groote Geplumiceerde	300	1000	0.3000	G&W
102	05-Feb-37	Jan Gerritez	734	1000	0.7340	G&W
103	05-Feb-37	Jan Gerritez	210	263	0.7985	Children
104	05-Feb-37	Jan Gerritez (Swijme	210	925	0.2270	Children
105	05-Feb-37	Jan Gerritez (Swijme	51	80	0.6375	Children
106	05-Feb-37	Jan Symonsz	180	480	0.3750	G&W

TULIP PRICES, WEIGHTS, AND DATES

	DATE	TULIP	PRICE	WEIGHT	PRICE/AAS	SOURCE
107	05-Feb-37	Jan Symonsz	100	150	0.6667	G&W
108	05-Feb-37	Jan Symonsz	170	500	0.3400	Children
109	05-Feb-37	Jan Symonsz	180	1000	0.1800	G&W
110	05-Feb-37	Jan Symonsz	140	1000	0.1400	Children
111	05-Feb-37	Lack van Rhijn	430	1000	0.4300	G&W
112	05-Feb-37	Lack van Rhijn	160	500	0.3200	Children
113	05-Feb-37	Landtmeter	175	71	2.4648	Children
114	05-Feb-37	Landtmeter	365	277	1.3177	Children
115	05-Feb-37	Lanoys	500	1000	0.5000	Children
116	05-Feb-37	Lanoys (Lions otte)	550	1000	0.5500	G&W
117	18-Dec-35	Latour	27	16	1.6875	9
118	05-Feb-37	Latour	390	450	0.8667	G&W
119	16-Jan-37	Le Grand	90	122	0.7377	Krel-46-p482
120	22-Jan-37	Le Grand	21	185	0.1135	32
121	24-Jan-37	Le Grand	480	1000	0.4800	31
122	05-Feb-37	Le Grand	500	350	1.4286	Children
123	05-Feb-37	Le Grand	780	1000	0.7800	G&W
124	24-Jan-37	Macx	12	400	0.0300	31
125	03-Feb-37	Macx	400	2000	0.2000	75
126	05-Feb-37	Macx	300	1000	0.3000	Children
127	05-Feb-37	Macx	300	1000	0.3000	Children
128	05-Feb-37	Macx	390	700	0.5571	G&W
129	05-Feb-37	Monassier	830	510	1.6275	Children
130	05-Feb-37	Monassier	920	542	1.6974	Children
131	06-Jan-37	Nieuwburger	125	425	0.2941	65
132	05-Feb-37	Nieuwburger	500	1000	0.5000	G&W
133	05-Feb-37	Nieuwburger	390	495	0.7879	G&W
134	05-Feb-37	Nieuwburger	235	500	0.4700	Children
135	05-Feb-37	Nieuwburger	430	1000	0.4300	Children
136	05-Feb-37	Nieuwburger	180	495	0.3636	G&W
137	01-Dec-36	Oudenaerden	600	10240	0.0586	57
138	02-Jan-37	Oudenaerden	70	1000	0.0700	G&W
139	22-Jan-37	Oudenaerden	1430	5120	0.2793	32
140	30-Jan-37	Oudenaerden	2200	4864	0.4523	Krel-46-p482
141	05-Feb-37	Oudenaerden	600	1000	0.6000	G&W
142	05-Feb-37	Oudenaerden	370	450	0.8222	Children
143	05-Feb-37	Oudenaerden	530	1000	0.5300	Children
144	05-Feb-37	Oudenaerden	510	1000	0.5100	G&W
145	05-Feb-37	Oudenaerden	5700	10240	0.5566	G&W
146	05-Feb-37	Parragon Liefjes	500	200	2.5000	Children
147	05-Feb-37	Parragon Liefjes	730	348	2.0977	Children
148	05-Feb-37	Parragon Liefjes	705	300	2.3500	Children
149	17-May-33	Parragon Schilder	50	1 Bulb		34-2
150	05-Feb-37	Parragon Schilder	1615	106	15.2358	G&W
151	05-Feb-37	Parragon van Delft	650	294	2.2109	Children
152	05-Feb-37	Parragon van Delft	605	354	1.7090	Children
153	05-Feb-37	Parragon van Delft	500	123	4.0650	Children
154	05-Feb-37	Petter	900	800	1.1250	G&W
155	05-Feb-37	Petter	730	1000	0.7300	Children
156	05-Feb-37	Petter	705	1000	0.7050	Children
157	05-Feb-37	Petter	730	1000	0.7300	G&W
158	05-Feb-37	Rotgansen	805	1000	0.8050	Children
159	05-Feb-37	Rotgansen (Violette	725	1000	0.7250	Children
160	05-Feb-37	Rotgansen (Violette	375	500	0.7500	Children

TULIP PRICES, WEIGHTS, AND DATES

	DATE	TULIP	PRICE	WEIGHT	PRICE/AAS	SOURCE
161	18-Dec-35	Saeyblom van Coningh	30	7.5	4.0000	9
162	05-Feb-37	Saeyblom van Coningh	320	220	1.4545	G&W
163	05-Feb-37	Saeyblom, beete	1000	1000	1.0000	G&W
164	05-Feb-37	Schapesteyn	235	95	2.4737	Children
165	05-Feb-37	Schapesteyn	375	246	1.5244	Children
166	05-Feb-37	Schilder	218	1000	0.2180	G&W
167	05-Feb-37	Schilder	40	130	0.3077	G&W
168	05-Feb-37	Schilder	1615	106	15.2358	Munting, Feb?
169	02-Jan-37	Scipio	800	1000	0.8000	G&W
170	12-Jan-37	Scipio	1500	1000	1.5000	28
171	05-Feb-37	Scipio	100	10	10.0000	G&W
172	05-Feb-37	Scipio	400	82	4.8780	Children
173	05-Feb-37	Scipio	2250	1000	2.2500	G&W
174	01-Jan-12	Semper Augustus	1200	1 bulb	ERR	Posthumus
175	01-Jul-23	Semper Augustus	1000	1 bulb	ERR	Krelage, p. 32
176	01-Jul-24	Semper Augustus	1200	1 bulb	ERR	Posthumus
177	01-Jul-25	Semper Augustus	2000	1 bulb	ERR	Krelage, p.33
178	05-Feb-37	Semper Augustus	5500	200	27.5000	Munting, Feb?
179	05-Feb-37	Senecours	105	1000	0.1050	Children
180	05-Feb-37	Senecours	140	1000	0.1400	G&W
181	05-Feb-37	Sjery Catelijn			4.7000	Krelage, p. 49
182	05-Feb-37	Sjery Catelijn	2610	619	4.2165	Children
183	05-Feb-37	Sjery Catelijn	1280	206	6.2136	Children
184	02-Jan-37	Switsers	60	10240	0.0059	G&W
185	15-Jan-37	Switsers	120	9728	0.0123	34
186	22-Jan-37	Switsers	280	10240	0.0273	32
187	23-Jan-37	Switsers	385	10240	0.0376	Krelage, p.51
188	01-Feb-37	Switsers	1400	9728	0.1439	75
189	03-Feb-37	Switsers	6000	40960	0.1465	38
190	05-Feb-37	Switsers	1800	10240	0.1758	G&W
191	06-Feb-37	Switsers	1100	10240	0.1074	34-6
192	06-Feb-37	Switsers	1060	10240	0.1035	34-5
193	09-Feb-37	Switsers	1100	10240	0.1074	40
194	05-Feb-37	Tournay Rijckers	315	525	0.6000	G&W
195	05-Feb-37	Tournay Rijckers	345	1000	0.3450	Children
196	05-Feb-37	Troyaen	400	165	2.4242	Children
197	05-Feb-37	Troyaen	720	470	1.5319	Children
198	05-Feb-37	Troyaen	500	252	1.9841	Children
199	05-Feb-37	Tulpa Kos	305	.485	0.6289	Children
200	05-Feb-37	Tulpa Kos	205	117	1.7521	Children
201	05-Feb-37	Tulpa Kos	300	477	0.6289	Children
202	05-Feb-37	Uytroep	700	440	1.5909	G&W
203	05-Feb-37	Uytroep	300	230	1.3043	G&W
204	05-Feb-37	Uytroep	730	1000	0.7300	G&W
205	05-Feb-37	Uytroep	705	1000	0.7050	Children
206	05-Feb-37	Uytroep	725	1000	0.7250	Children
207	02-Jan-37	Viceroy	3000	1000	3.0000	G&W
208	05-Feb-37	Viceroy	4203	685	6.1358	Children
209	05-Feb-37	Viceroy	3000	410	7.3171	Children
210	05-Feb-37	Viceroy	2700	295	9.1525	G&W
211	05-Feb-37	Viceroy	6700	1000	6.7000	G&W
212	10-Jul-12	Vlaems	450	38912	0.0116	4
213	05-Feb-37	Wit Purper Jorcen	475	148	3.2095	Children
214	05-Feb-37	Wit Purper van Busch	295	481	0.6133	Children

TULIP PRICES, WEIGHTS, AND DATES

	DATE	TULIP	PRICE	WEIGHT	PRICE/AAS	SOURCE
215	05-Feb-37	Wit Purper van Busch	245	315	0.7778	Children
216	05-Feb-37	Wit Purper van Busch	110	134	0.8209	Children
217	02-Jan-37	Witte Croonen	128	10240	0.0125	G&W
218	05-Feb-37	Witte Croonen	300	1000	0.3000	G&W
219	05-Feb-37	Witte Croonen	3600	10240	0.3516	G&W
220	05-Feb-37	Witte Croonen			0.2700	Krelage, p.49

TABLE 2

FLORIN PRICES OF TULIP BULBS COMMON TO 1637 AND 1739 PRICE LISTS

BULB	JAN.,1637	FEB., 1637	1739
1. Admirael de Man	20.	250.	.1
2. Gheele Croonen*	.41	20.5	.025
3. Witte Croonen*	2.2	61.5	.02
4. Gheele ende Roote van Leyden	17.5	187.	.2
5. Semper Augustus	2000. (7/1/25)	6290.	.1
6. Zomerschoon	NA	480.	.15

Note. To construct this table I have assumed a standard bulb size of 175 aas. All 1637 data in Table 2 are standardizations of entries in Table 1. The 1637 price for Zomerschoon is taken from the price list in G&W. The 1739 prices are from Krelage (1946).

*Sold in units of 100 bulbs.

TABLE 3
TULIP BULB PRICES, 1707 AND 1739

BULB	1707	1739
1. Triomphe d'Europe	6.75	.2
2. Premier Noble	409	1
3. Aigle Noir	110	.3
4. Roi de Fleurs	251	.1
5. Diamant	71	2
6. Superintendent	100 (1722)	.12

Source: Krelage (1946).

TABLE 4
HYACINTH PRICES (FLORINS) DURING THE HYACINTHMANIA

BULB	1734	1739
1. Staaten Generaal	210	20
2. Struijsvogel	161	20
3. Miroir	141	10

Source: Krelage (1946)

TABLE 5
HYACINTH PRICE PATTERNS

BULB	1716	1735	1739	1788	1802	1808
1. Coralijn*	100	12.75	2	.6	--	-
2. L'Admirable	100	-	1	1	--	-
3. Starrekroon	200	-	1	.3	-	.3
4. Vredenrijck	-	80	16	1.5	-	-
5. Koning Sesostris	-	100	8	1	1	-
6. Staaten Generaal	-	210	20	1.5	2	-
7. Robijn	-	12	4	1	1	.6

BULB	1788	1802	1815	1830	1845	1875
8. Comte de la Coste	200	50	1	.75	.5	.13
9. Henri Quatre	50	30	1	3	5	1
10. Van Doeveren	50	-	1	2	1.2	.75
11. Flos Niger	60	20	10	-	.25 (1860)	
12. Rex rubrorum	3	1.5	.3	1	.35	.24

Source: Krelage, pp. 645-55.

* Krelage (p. 645) notes that the Coralijn bulb originally sold for 1000 florins, though he does not include a year.

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Chart 1
Semper Augustus

Price/Bulb
(Thousands)

6

5

4

3

2

1

0

×

1612   1625   1637

Date

Chart 2
Switsers

0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01

Price/Aas

14-Jan-37 18-Jan 22-Jan 26-Jan 30-Jan 03-Feb 07-Feb-37

Date
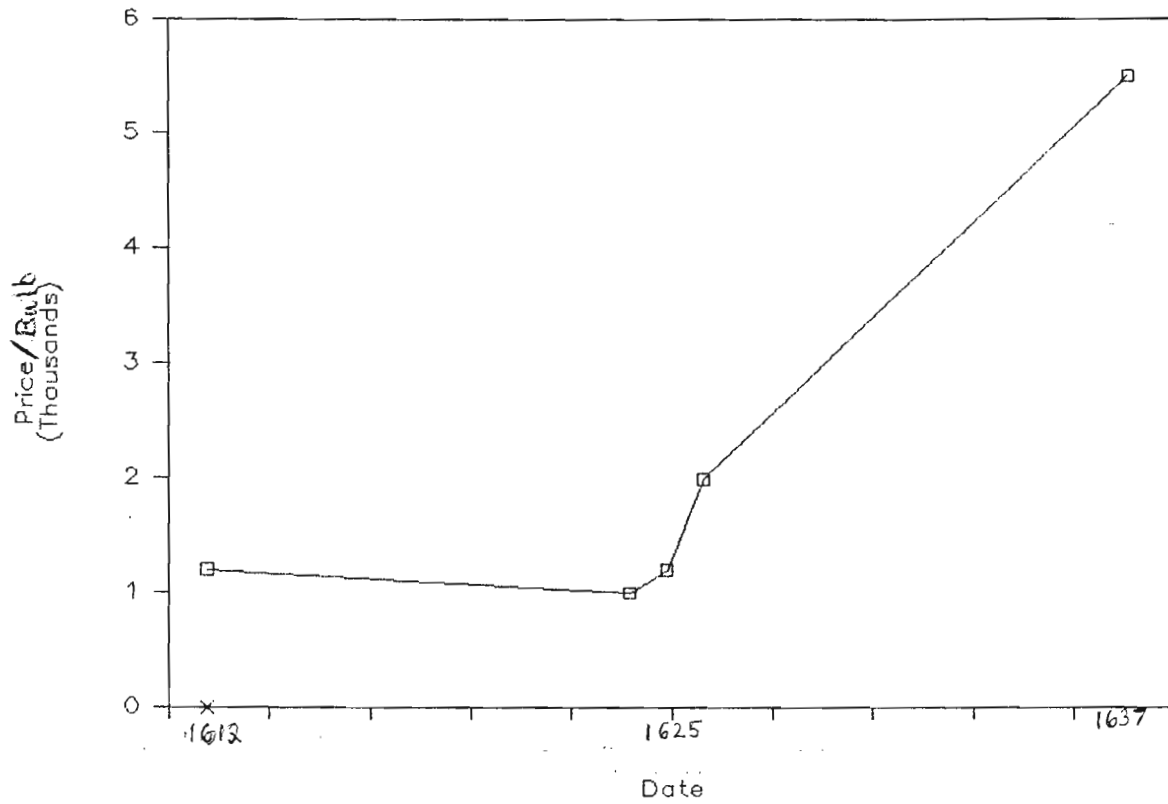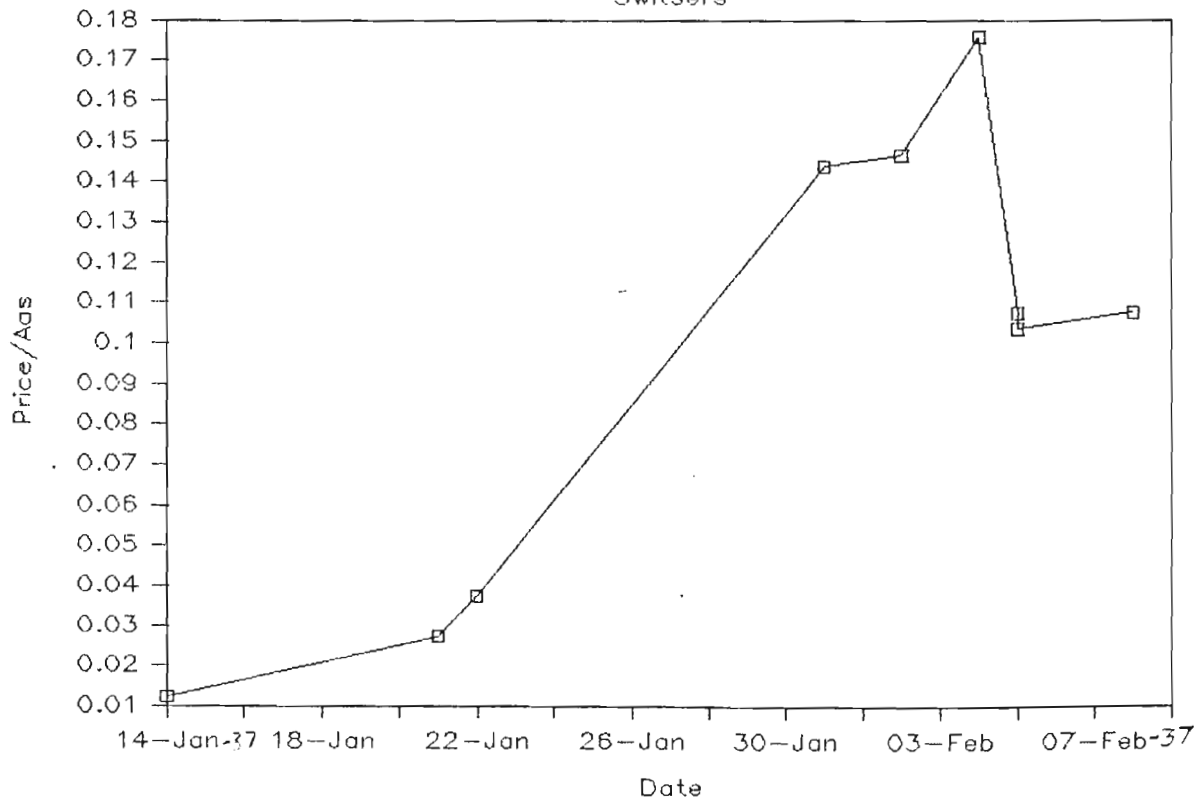
Chart 3

Viceroy
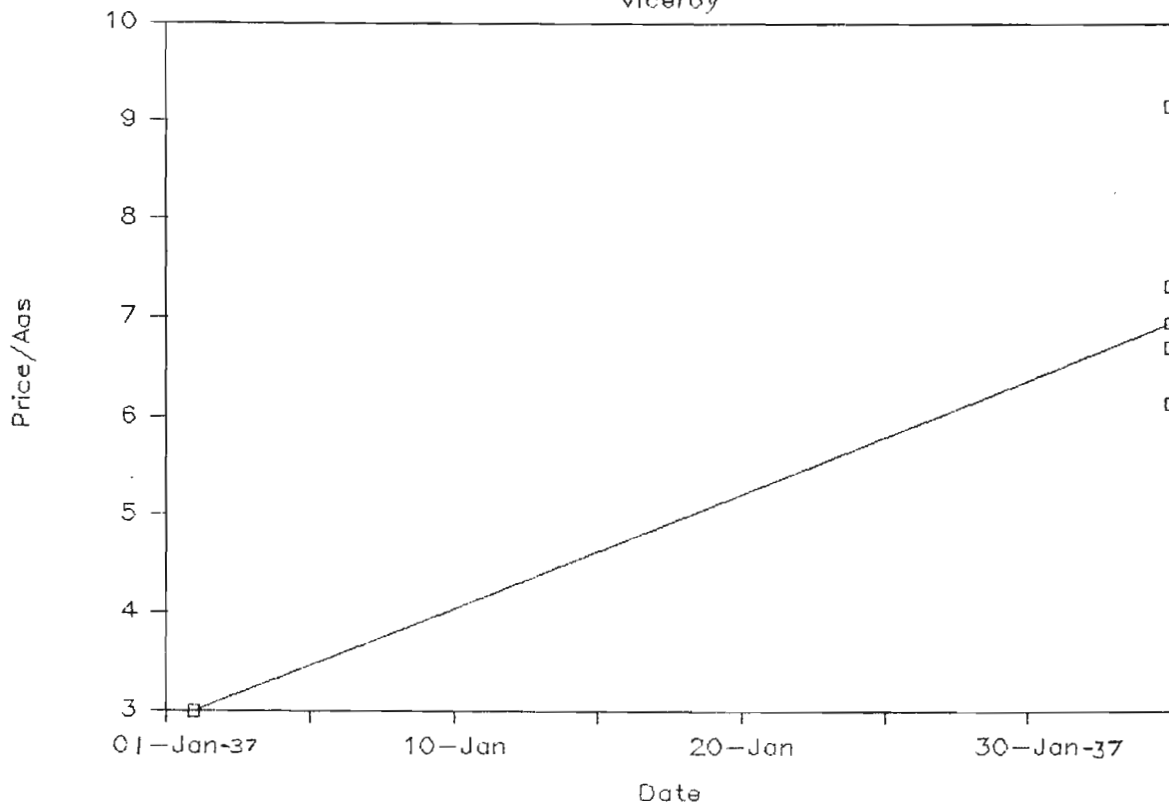
Chart 4

Witte Croonen
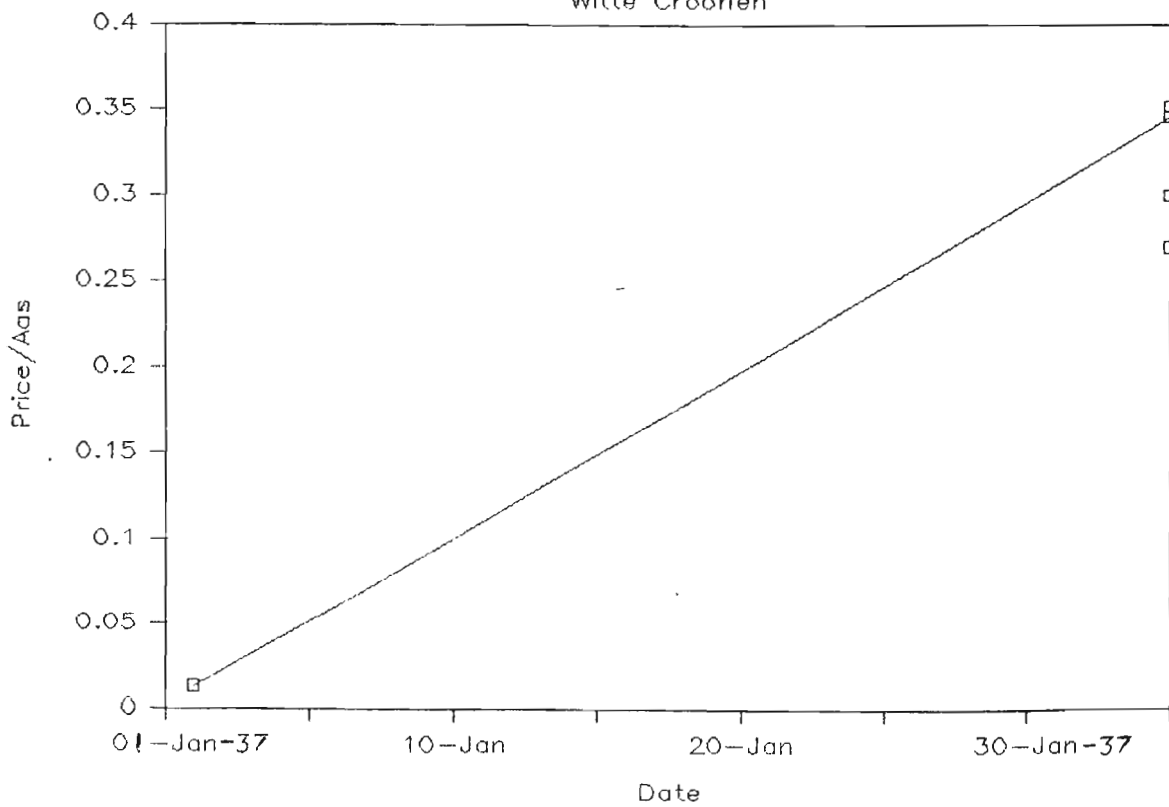
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Oudenaerden
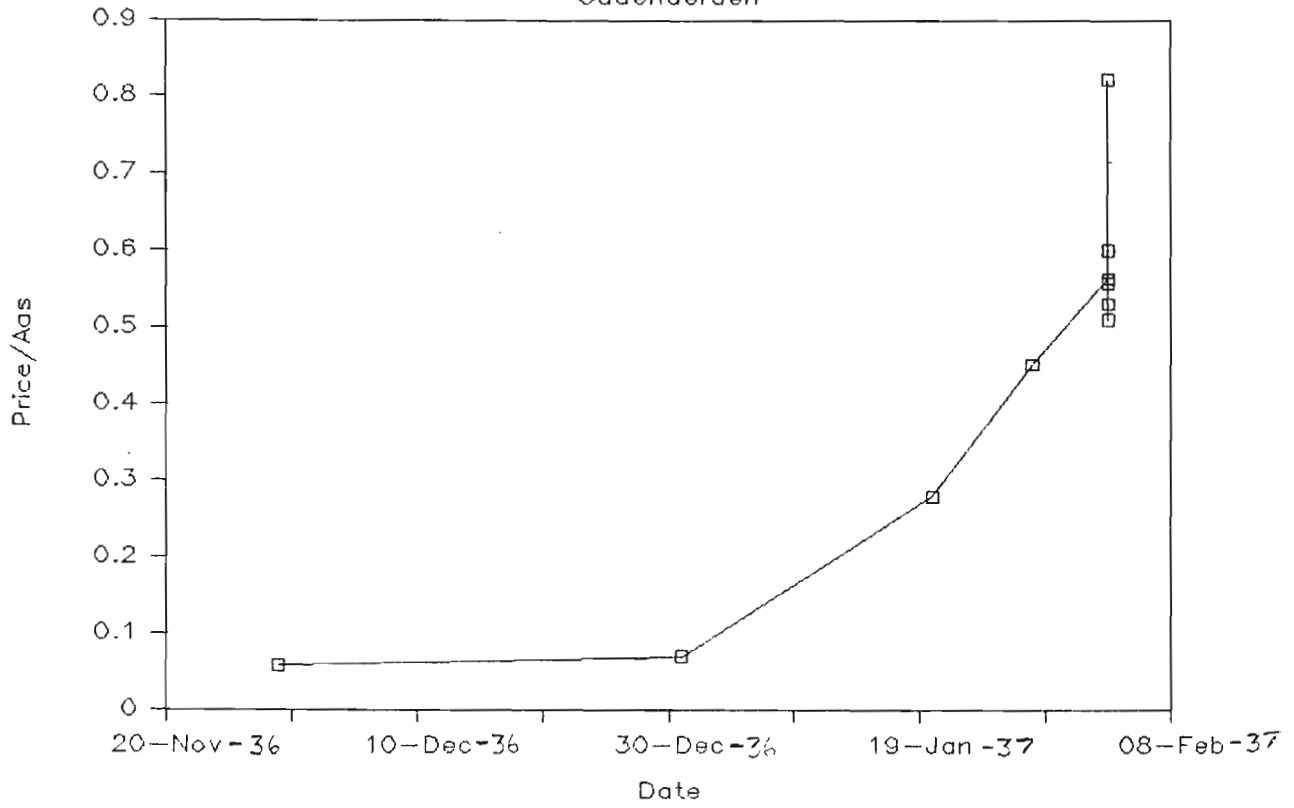
Chart 6
Scipio
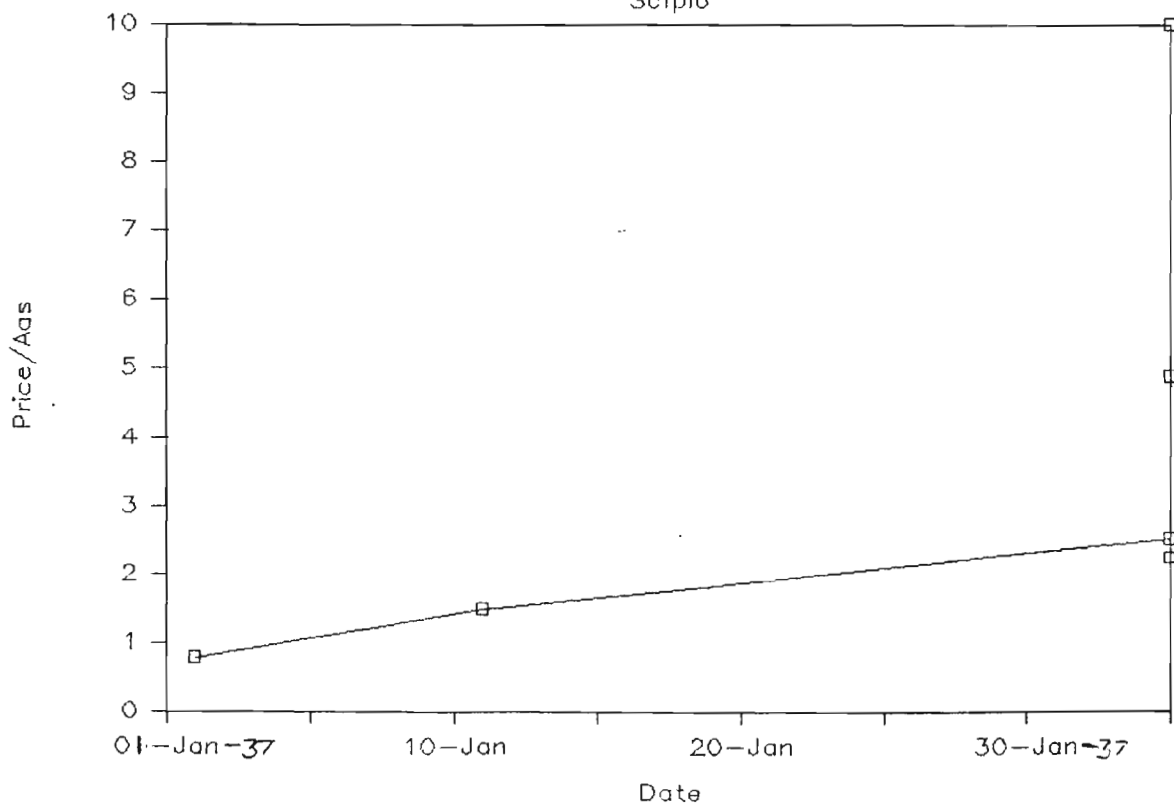
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Admirael de Man
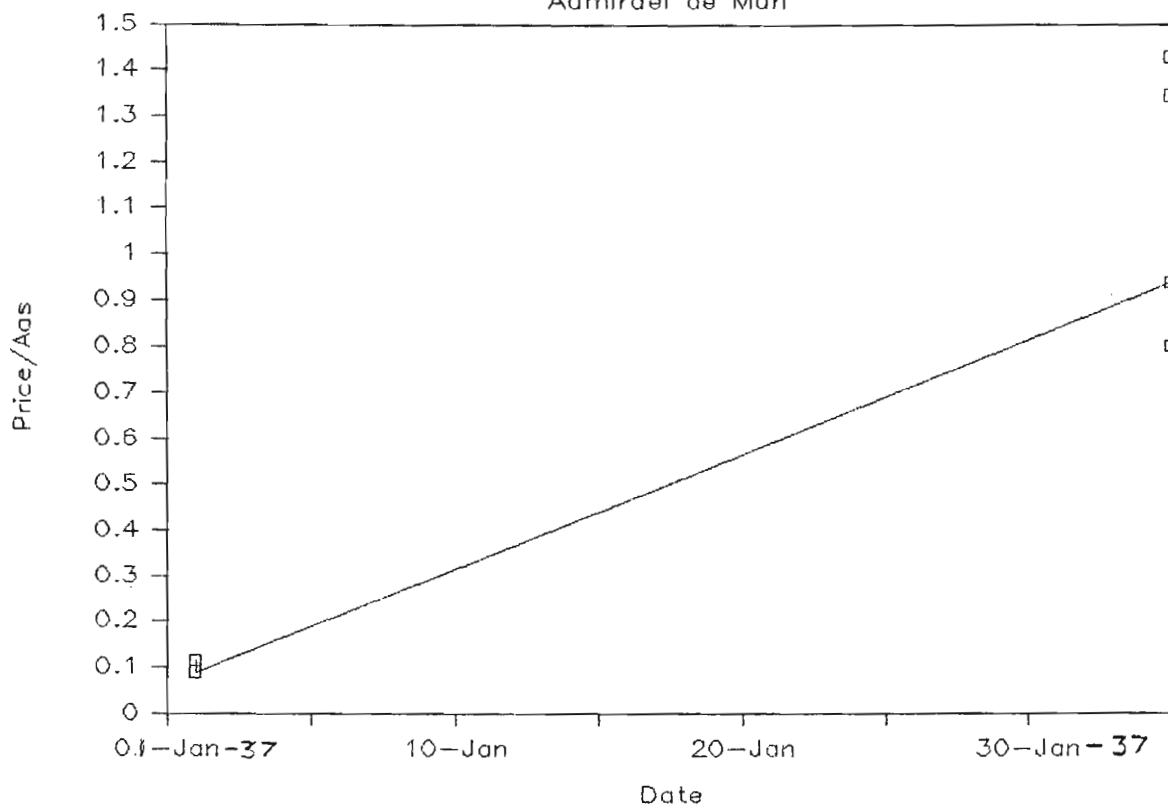
Chart 8

Nieuwburger
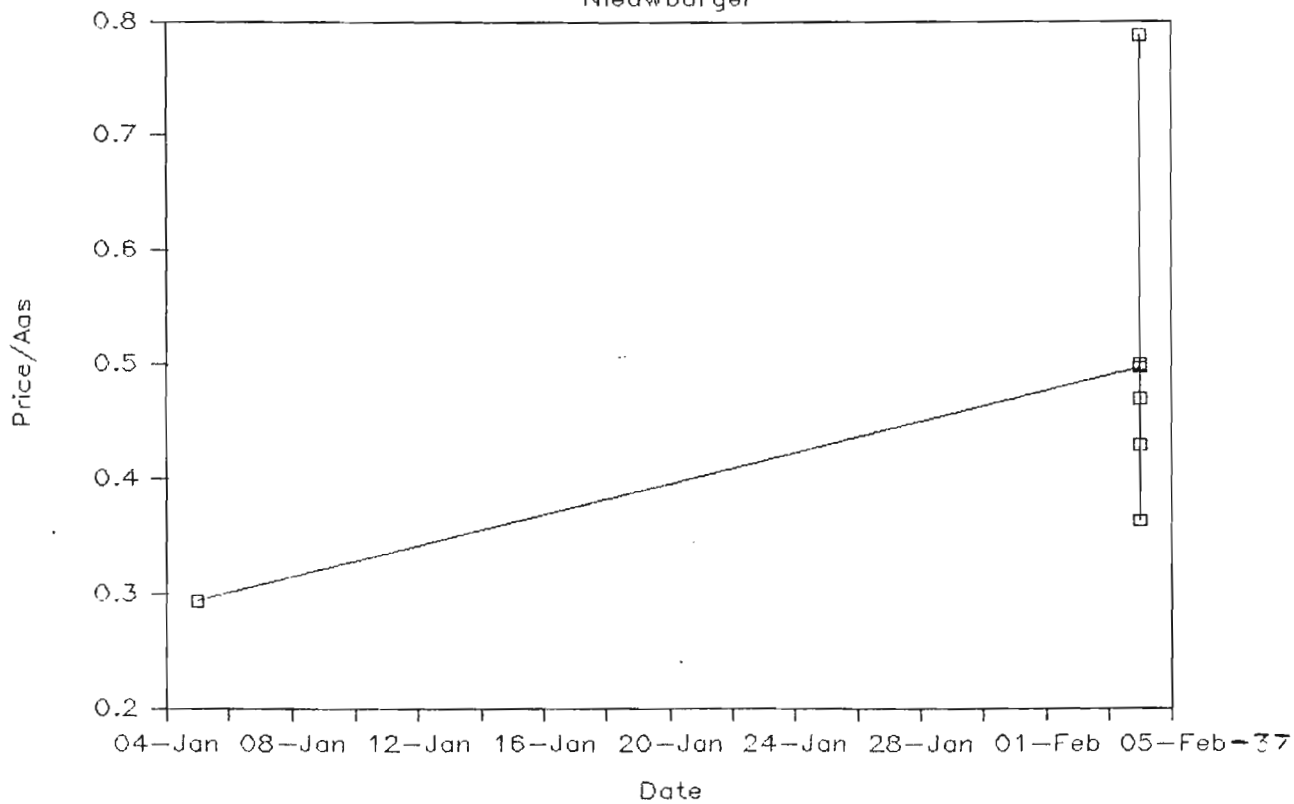
Chart 9

Admirael Liefkens
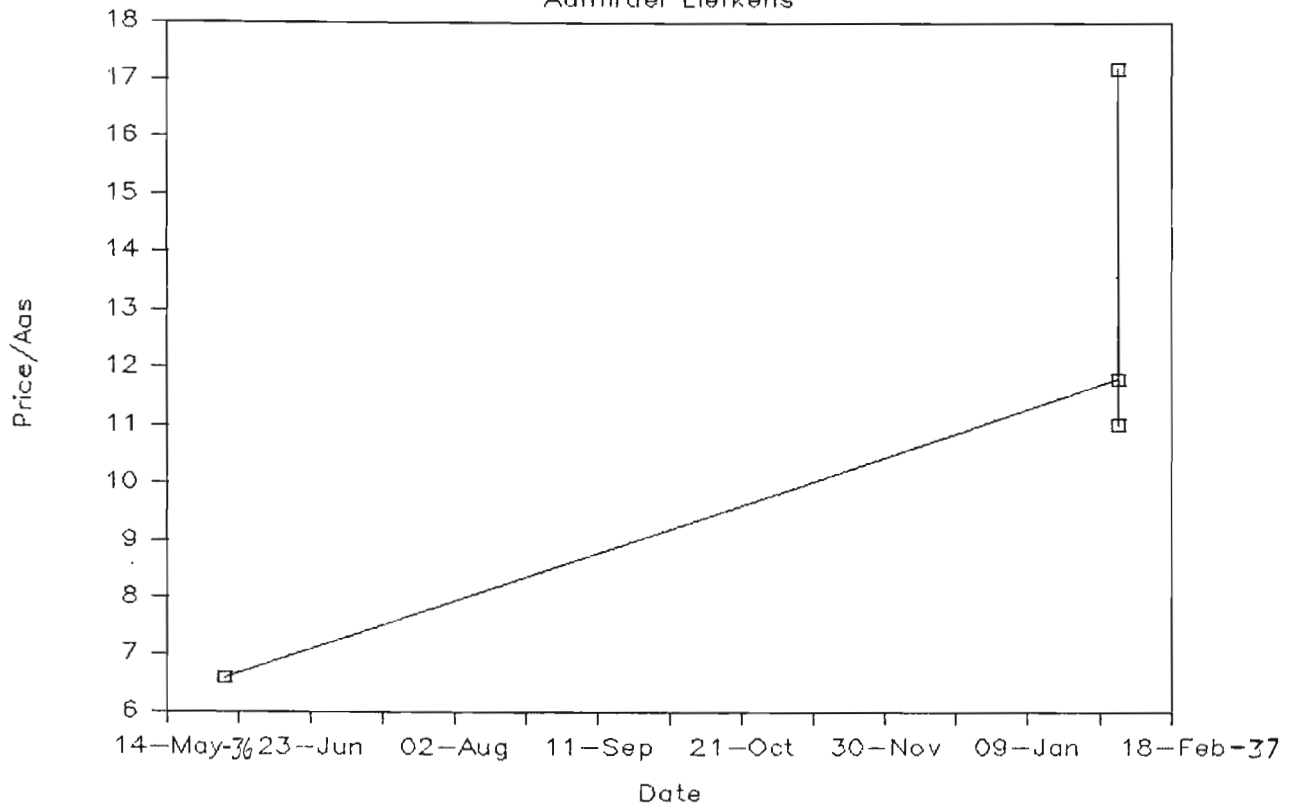
Chart 10

Macx
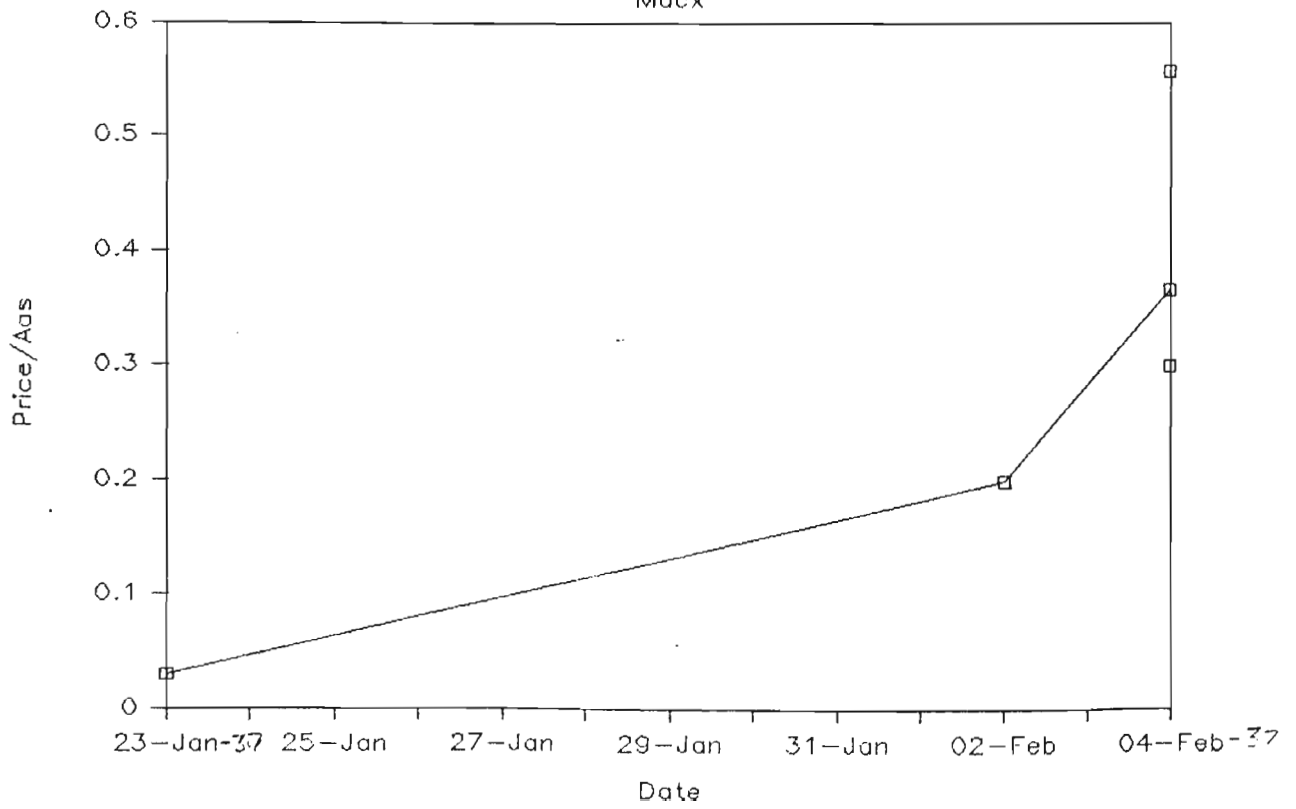
Chart 11

Groote Geplumiceerde
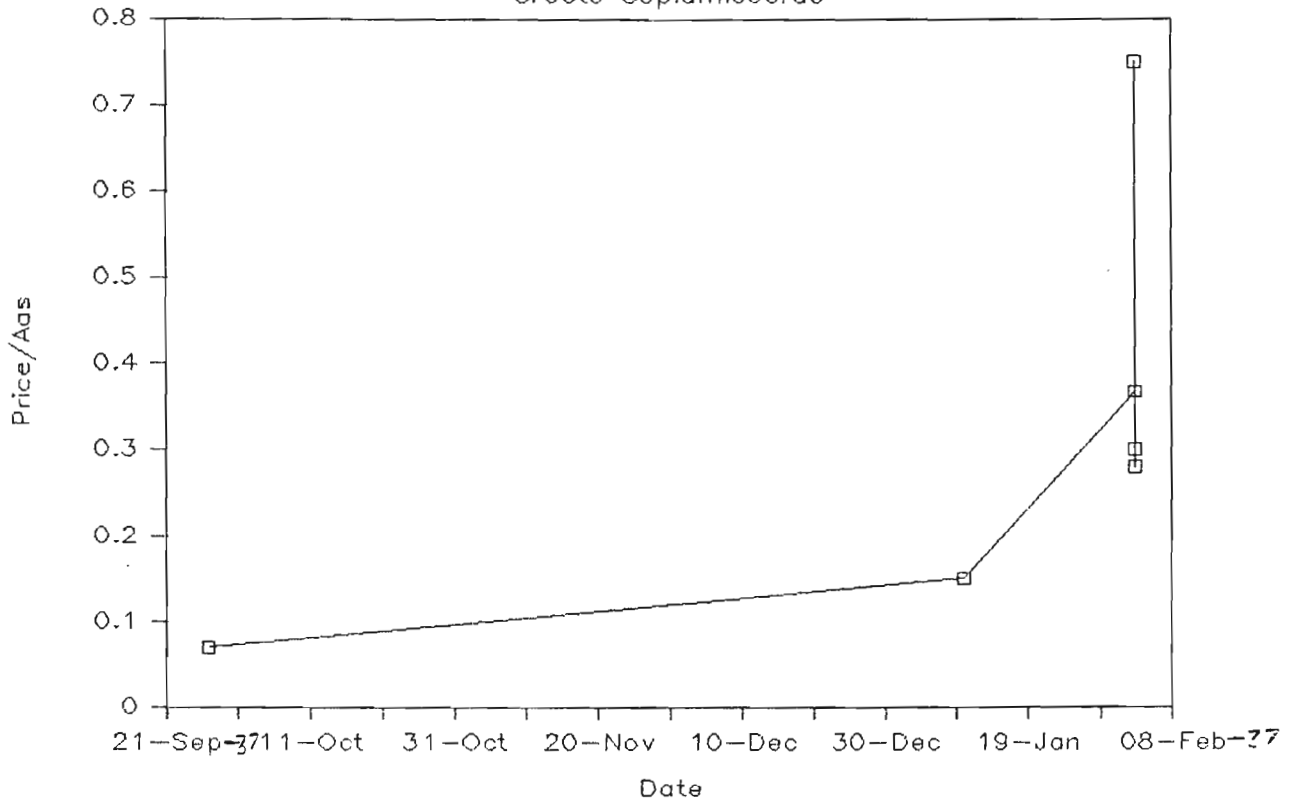
Chart 12

LeGrant
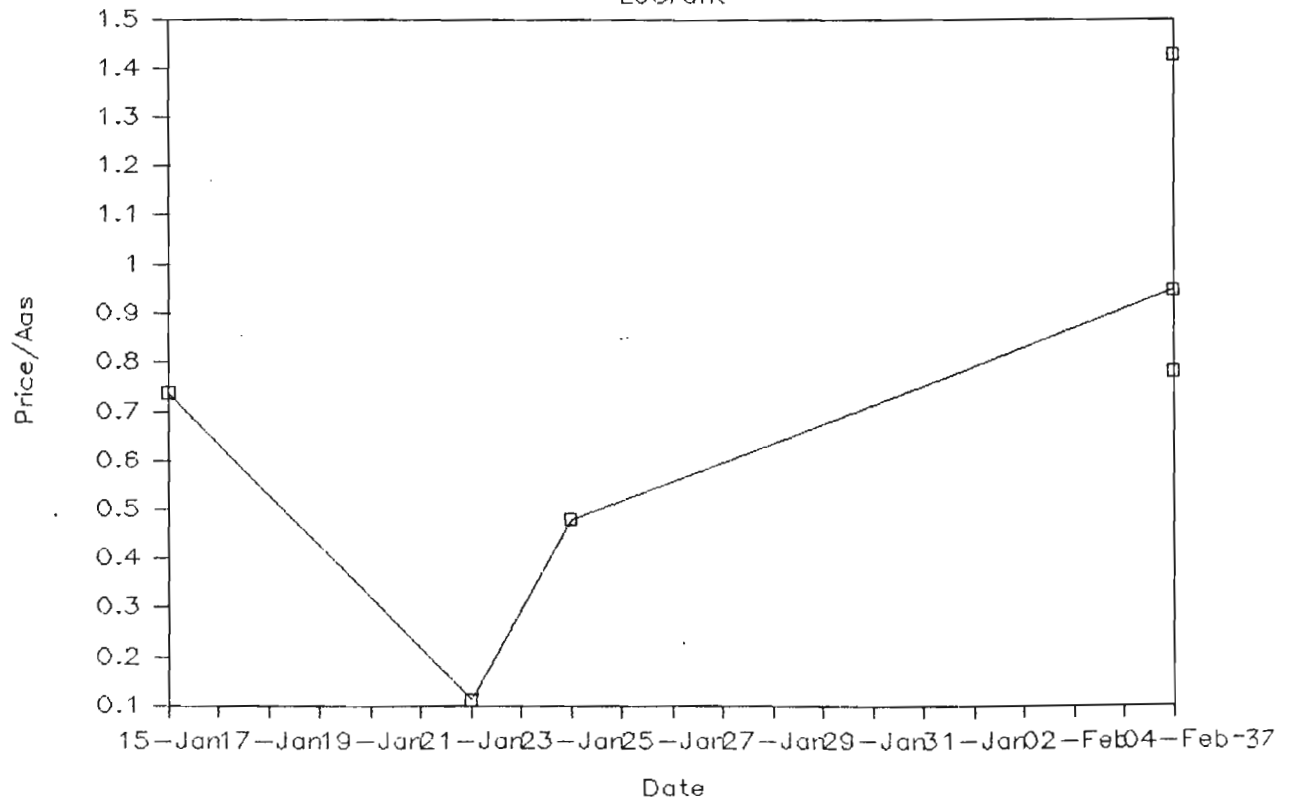
Chart 13

Coorenaerts
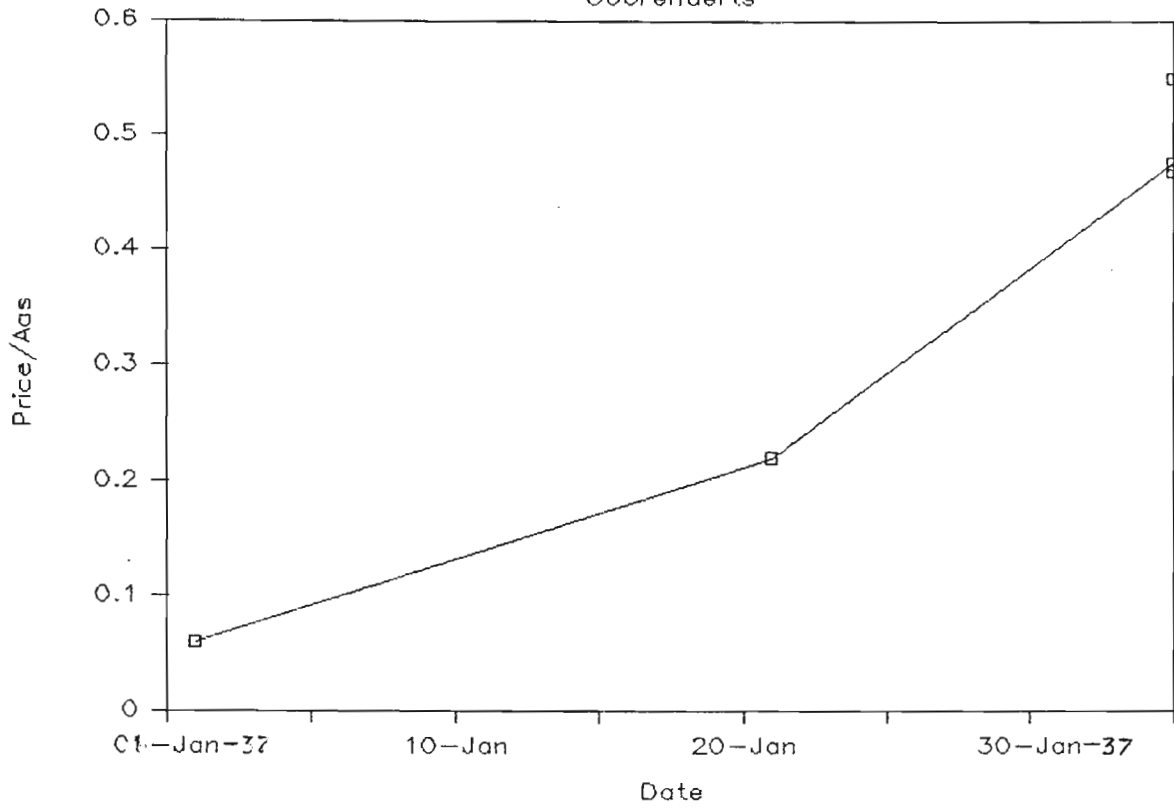
Chart 14

Gheele ende Roote van Leyden
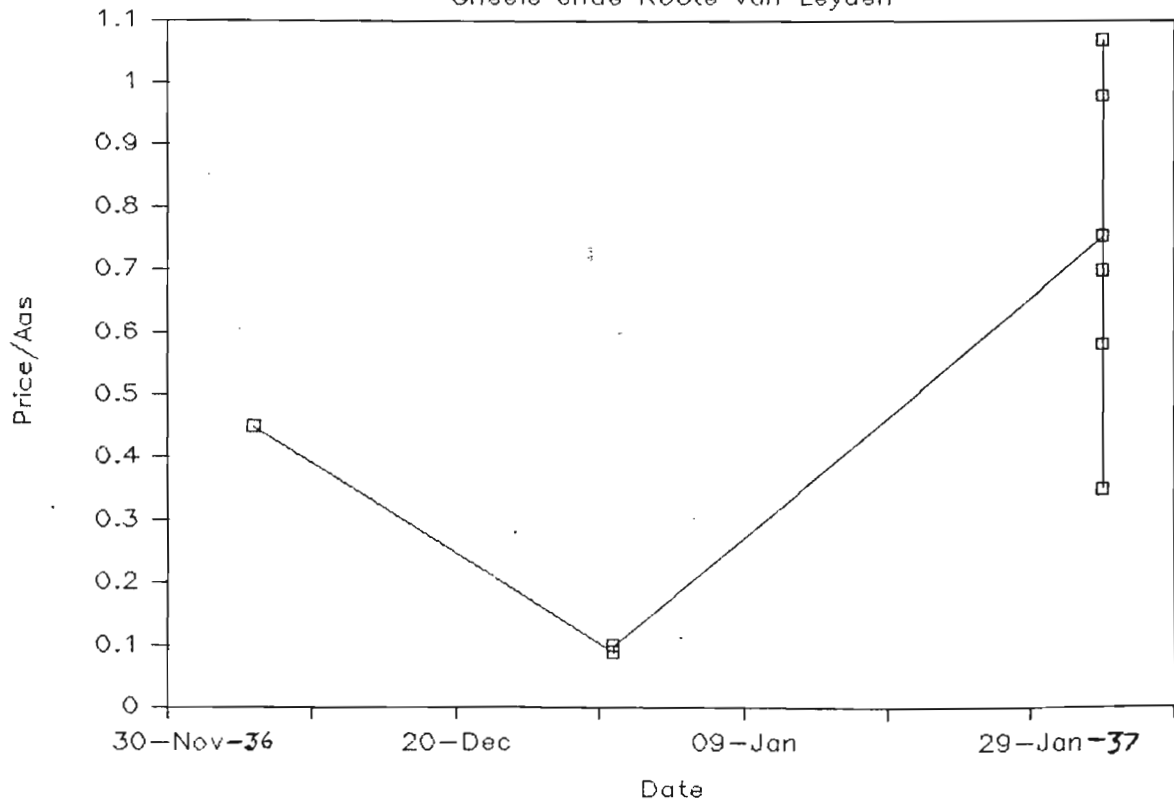
Chart 15

Gouda——All Bulbs
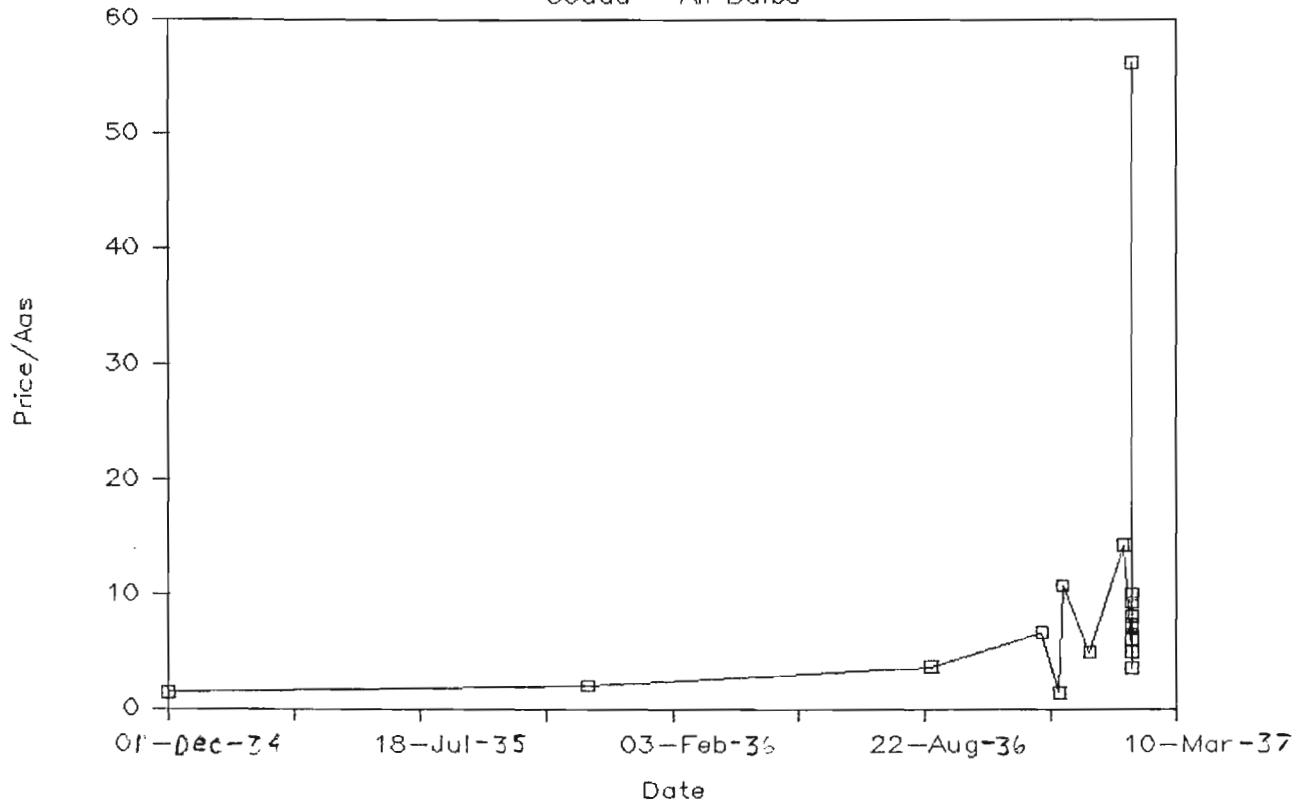
Chart 16

Gouda—— <100 Aas

Chart 17

Gouda-- >100 Aas

Price/Aas

30-Nov-36   20-Dec-36   09-Jan-37   29-Jan-37

Date

Chart 18

Admirael van der Eyck

Price/Aas

01-Dec-34   18-Jul-35   03-Feb-36   22-Aug-36   10-Mar-37

Date
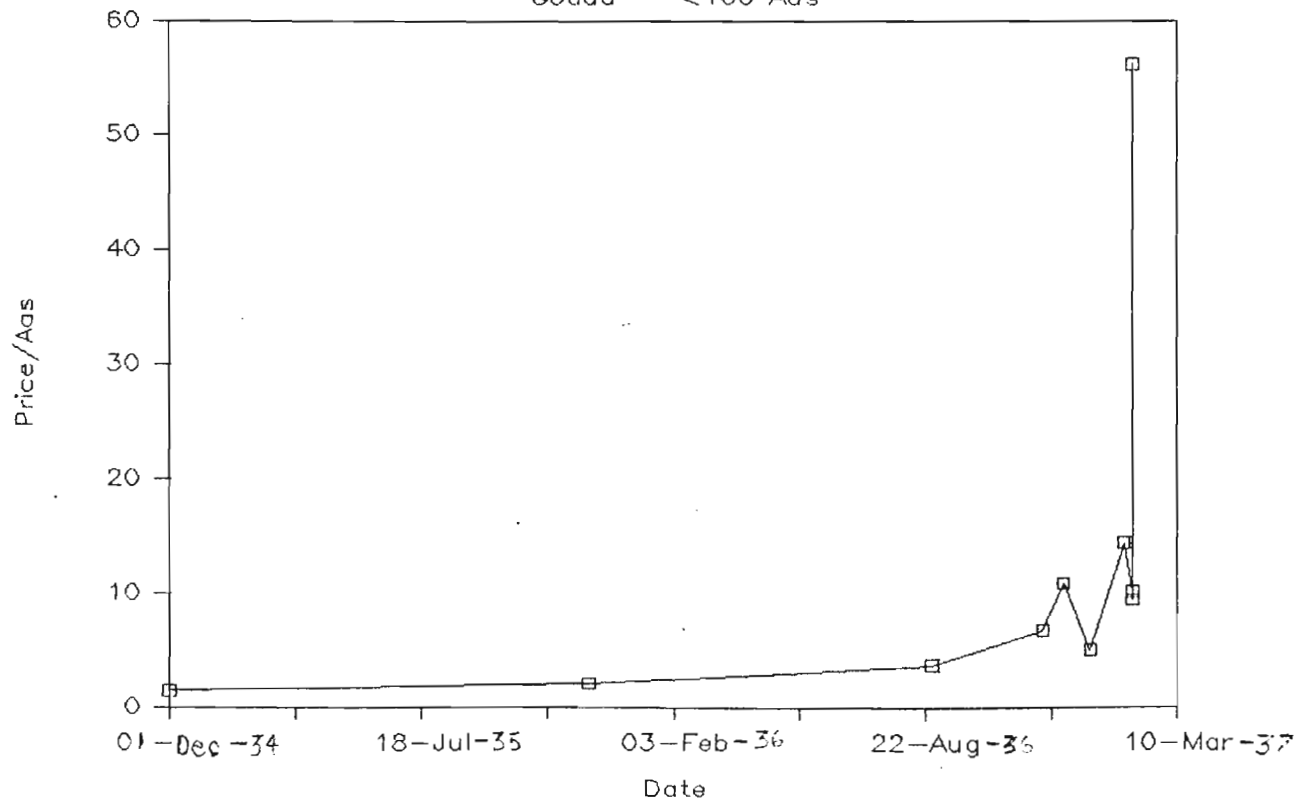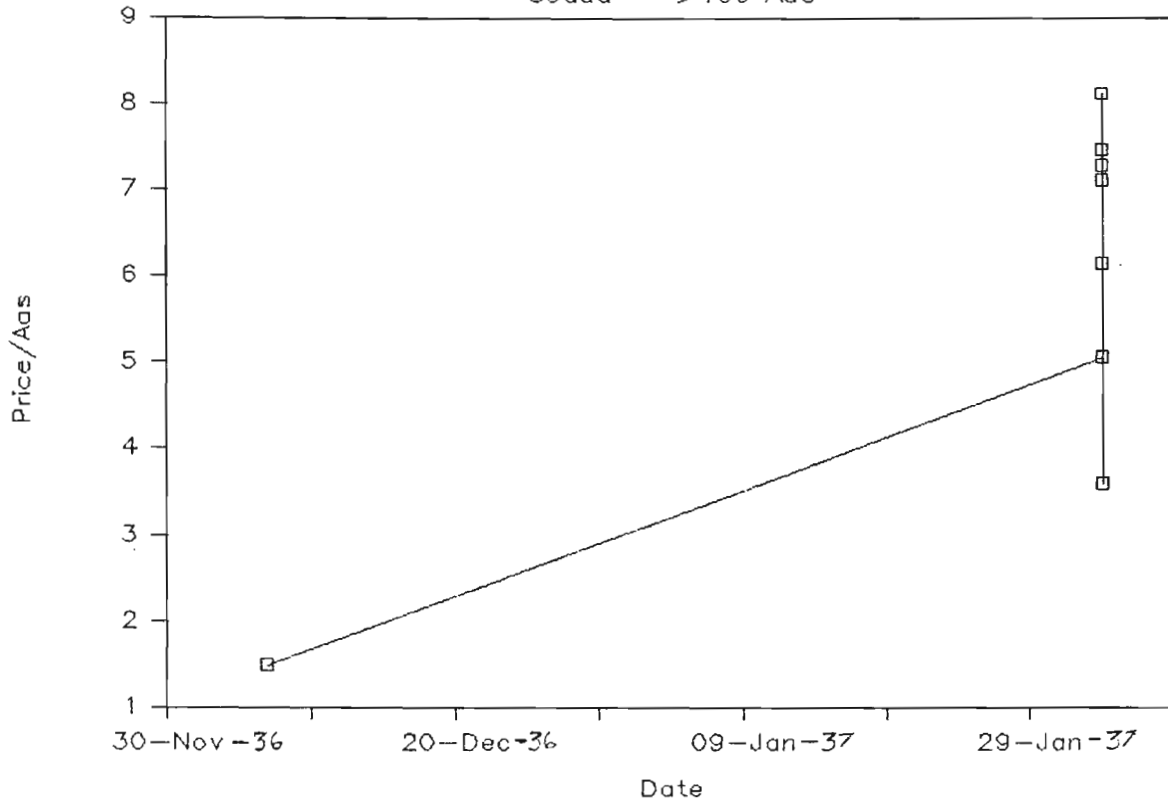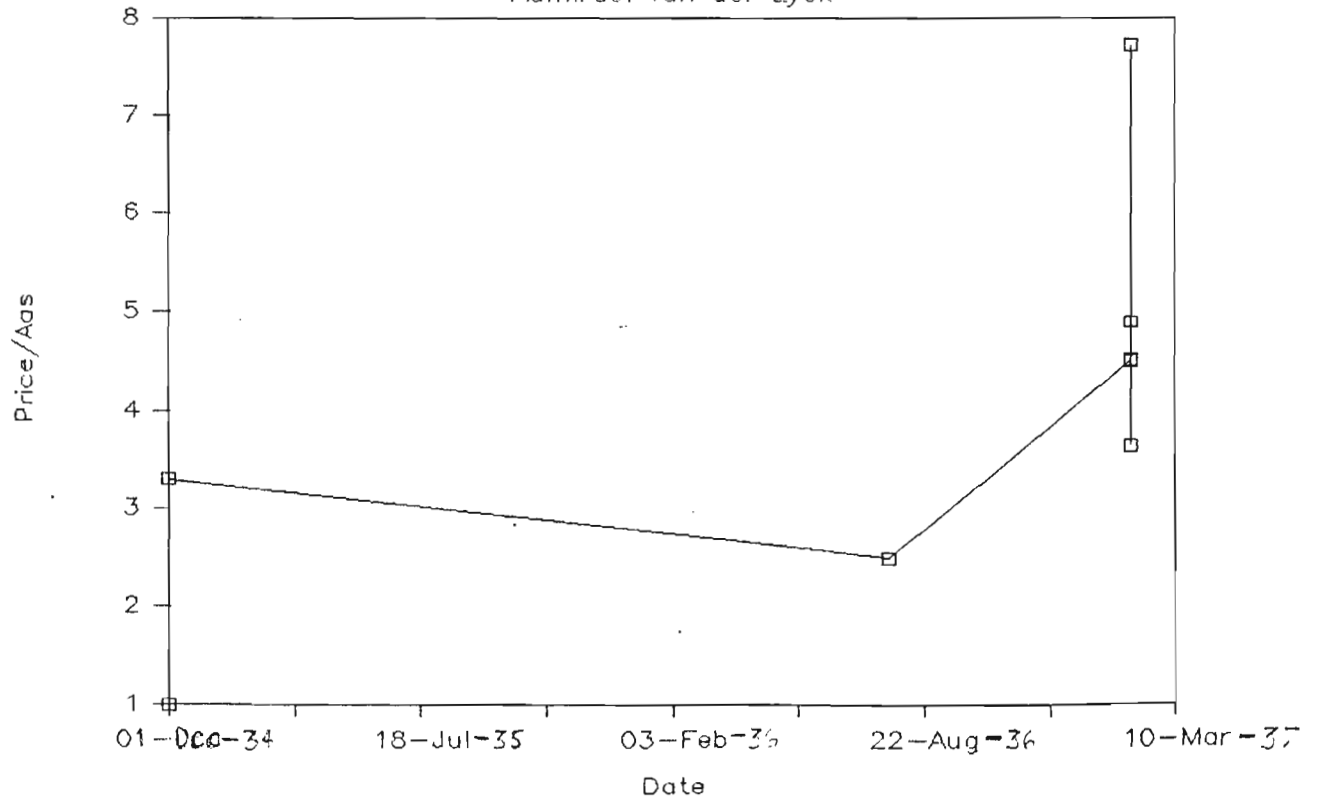
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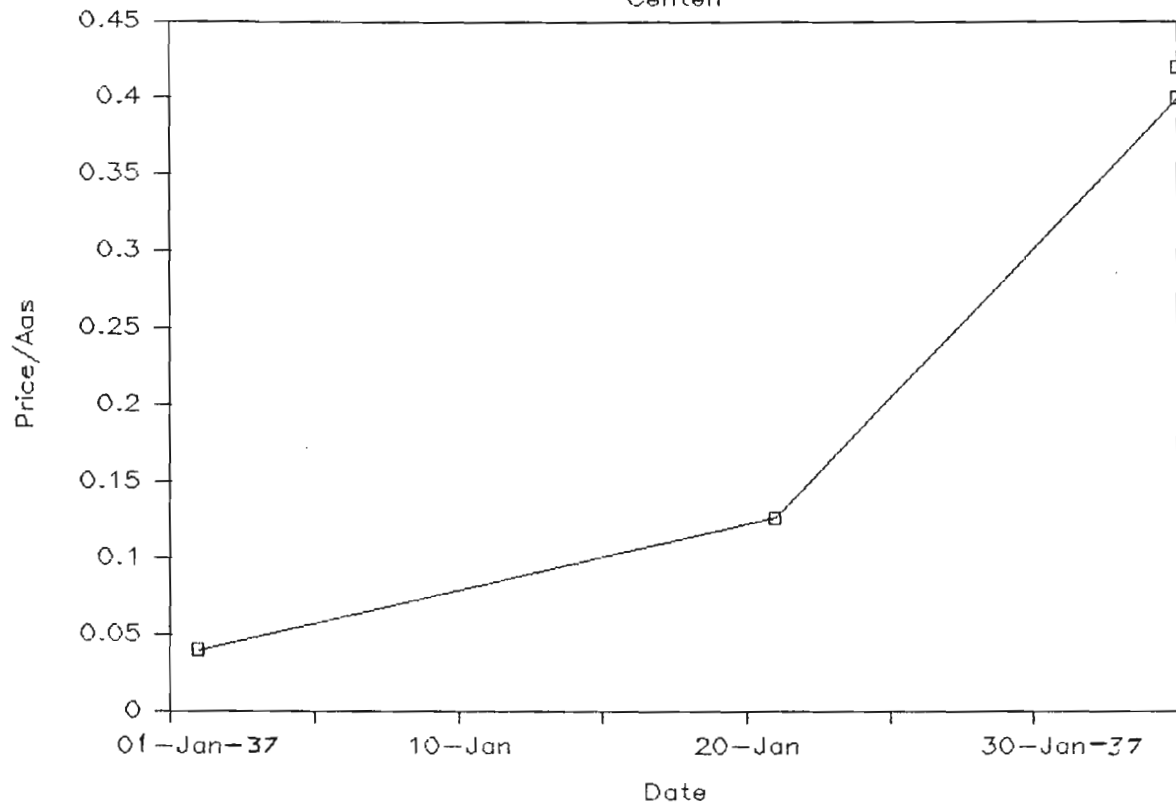
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