The Evolution of Technical Analysis

FINANCIAL PREDICTION FROM BABYLONIAN TABLETS TO BLOOMBERG TERMINALS

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To our mothers

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Introduction

Technical analysis—the forecasting of prices based on patterns in past market data—is something of a black sheep in modern economics. Some skeptics view it as kissing cousins with sleazy speculation or gambling, while others regard it as a relic that is only slightly more sophisticated than the reading of chicken entrails. Proponents of quantitative analysis, who take physics as the ideal model of how economic science ought to look, view technical analysis as antiquated and contrived in its very foundations. They demand mathematical proofs of its validity and dismiss as exception bias the strong betting averages and impressive bottom lines of successful technicians. We make it no secret, then, that we regard technical analysis as a legitimate and useful discipline, tarred by spurious associations and deserving of further academic study.

Some of this skepticism is understandable in light of the historical origins (and occasional abuses) of technical analysis. Many of its methods come down to us from the days before computers and the number-crunching-intensive theories they made possible, and not all of its methods have been thoroughly explored within the quantitative frameworks now available. Many terms and concepts in technical analysis can seem abstruse or outmoded; it is easy to see how a discipline that

involves eyeballing charts for patterns with names like "head and shoulders" and "cup with a handle" might seem at first blush more akin to astrology than science. However, many of these are merely heuristics developed in the precomputer age when calculating a simple statistic was a formidable task. For instance, the 10-day moving average became a fixture of technical analysis not because it was optimal, but because it was trivially easy to compute. Indeed, there are many such concepts in "classical" technical analysis that could benefit from quantitative reformulation.

Ultimately, however, both technical and quantitative analysis serve similar purposes: They both attempt to predict the future based on models of the past. One is statistical, the other is intuitive. Whereas a quant minimizes a sum of squared residuals to find the best-fitting line given the data, a technician estimates it by looking at the charts, searching for tell-tale patterns, and inferring the thoughts and feelings of other market players. Both approaches have merit. This is not to say that they are equal; clearly, quantitative methods have won hands down, dominating the investment industry because of their demonstrable value-added. But technical analysis is surprisingly resilient and persistent, and in some corners of the financial industry—such as the trading of commodities and currencies—it is still the dominant mode of analysis. This state of affairs suggests that technical analysis may have something to contribute, even to the most sophisticated quant. Fortunately, a slow but sure reconciliation is underway.

Though big strides have been made throughout history and in recent years toward developing a more systematic approach to technical analysis, technicians remain ostracized to this day. For evidence, look no further than the Financial Industry Regulatory Authority's official recognition of the Chartered Market Technician designation, which occurred only in 2005. Part of the reason is that technical analysis is often associated with the speculators, bear raiders, and market cornerers of previous eras. As Tony Tabell, a veteran technical analyst and an heir to the technical brokerage business founded by his father Edmund Tabell in the 1930s, explains:

> It's hard to visualize unless you've talked to people who were involved how difficult this was in the atmosphere of [the] 1930s and 1940s. The entire brokerage business was a basket case.

> Volume on the NYSE was under a million shares. This was the 1930s, the Great Depression, nobody had any money, and if they did, they were very leery about investing. Furthermore, technical analysis had been associated with the excesses of the 1920s. All of the various Securities Acts were designed to get rid of the manipulative market operations that had characterized the '20s. Since technical work to a great degree (certainly point and figure charts) had been originally conceived as a means of detecting pool operations, confessing that you were involved in technical work at that point was sort of equivalent to confessing that you were some kind of a low-level criminal. I saw some [of] this, because the remainder of this attitude was still kicking around when I started in the business in the 1950s, but I can imagine how incredible it must have been in the '30s and '40s.[1]

The efficient markets hypothesis (EMH), formulated in the writings of Samuelson (1965) and Fama (1965a,b; 1970), did not help much.[2] According to this theory, there are no patterns in market data that are exploitable through trading strategies. Ever since the advent of modern finance—a theory based on rational expectations and market efficiency—technical analysis has been dismissed in academic circles as a mathematical impossibility. As Princeton University economist Burton Malkiel concluded in his influential book *A Random Walk Down Wall Street* (1973), "under scientific scrutiny, chart-reading must share a pedestal with alchemy."

As we recount the premature obituaries for technical analysis, it is worth noting as an aside that recent research has not only documented departures from the EMH—in the form of cognitive biases such as overconfidence, overreaction, loss aversion, and herding—but has also included new theoretical underpinnings for technical analysis and the empirical validation of certain technical patterns and indicators.

Malkiel's lumping of technical analysis with alchemy is not entirely coincidental, for here we come across another historical reason for the field's questionable reputation—technical analysis was used in conjunction with astrology since the earliest times. The ancient Babylonians would methodically record, often intraday, the prices of various commodities, but they would also assign those same commodities to

the astrological regions of Pisces and Taurus, depending on whether they were bullish or bearish. Similarly, in addition to the very logical lists of weights, measures, and exchange rates recorded in medieval merchant manuals, they also often contained lengthy astrological appendixes and advised their readers to buy, sell, or begin anything when they were in the region of Virgo. Yet another example is provided by Christopher Kurz, a sixteenth-century Antwerp trader, who claimed to be able to forecast prices of commodities up to 20 days in advance using his technical trading system based on back-tested astrological signals.

Such close links between technical analysis and astrology are naturally a cause for suspicion and skepticism today. But for our ancestors, astrology was a way of life, applied to wide-ranging areas of human endeavor including warfare and medicine. It was no coincidence that Christopher Kurz doubled as a political astrologer—he is known for having forecasted the extinction of the papacy, among other things—while Thales of Miletus, one of the Seven Sages of ancient Greece, made meteorological predictions based on movements of the stars and planets. That societies would base their operations in part on astrology sounds absurd today, but interestingly, if we view astrology as a random number generator of the precomputer age, its prevalence becomes more understandable. Then, as now, forecasting—financial and otherwise—was a business of probabilities. Just as computer-generated random numbers are part of today's statistical forecasting models—for example, the commonly used Markov Chain Monte Carlo method for constructing Bayesian forecasts—astrology may be thought of as a random input in ancient forecasting models.

The evolution of technical analysis did not take place in isolation. The growth of markets provided one stimulus for its development. In ancient Babylon, simply writing down commodity prices on clay tablets was sufficient for tracking market action, but with the advent of financial exchanges, the need for visualizing market data became evident. By the 1830s, price charts emerged and soon became so prevalent that people like William Stanley Jevons and James Wyld made their livelihoods from producing sophisticated charts and selling them to various offices.

Speculation provided another stimulus. Though speculation and technical analysis are not synonymous, they do share a certain awareness of market psychology and of the forces of supply and demand. It was precisely when speculative techniques were ripe that technical analysis became more concrete, such as on the Dojima Rice Exchange in seventeenth-century Japan, where the legendary trader Munehisa Homma developed the "candlestick" charting method to be able to visualize open, high, low, and closing market prices over a certain period, and formulated his version of technical analysis, which remains popular to this day.

Despite the distance created by continents and thousands of years, the market wisdom of Charles Dow, the father of modern technical analysis, is astonishingly similar to that of his earliest predecessors, including the ancient Athenian practice of using price level as an indicator of market sentiment, Homma's rotation of Yang and Yin (bullishness and bearishness), and the emphasis in late imperial China on "the ultimate principle," which is that "when goods become extremely expensive, then they must become inexpensive again."[3] Such similarities reveal technical analysis as a truly universal phenomenon and highlight how deeply ingrained it is in human psychology to reason in technical terms in order to ride and reinforce the trends, as was the case with the humble tulip bulb during the 1633–1637 tulip mania in Amsterdam. As de la Vega put it, "for on this point we are all alike: when the prices rise, we think that they fly up high and, when they have risen high, that they will run away from us."[4] As long as humans, not robots, make the markets, bubbles and crashes will be a reality. This is an especially important lesson in the wake of the 2007–2009 global financial crisis, a time when many fundamentals have crumbled and in some spheres of financial practice there has been nothing left to work with other than technical analysis.

In this book, we present a broad, largely nontechnical historical survey of technical analysis, tracing its roots and evolution from ancient times through the medieval and modern eras. While neither of us is a practicing technical analyst or "technician," as they prefer to be called, we have been fascinated by this strange craft for many years, and this volume is the outgrowth of our own attempt to make sense

of the discipline. As outsiders, we hope to bring a somewhat different perspective that can bridge the gap between academia and the technical analysis community. Our previous book, *The Heretics of Finance*, contained interviews with leading technicians in which they described their art in their own words. In this volume, we take a more expansive view and search for the origins of technical analysis throughout history.

This endeavor was more challenging than we anticipated because, in many cases, the historical evidence of technical analysis is indirect, and many ideas were not fully developed by their originators. This is not surprising since, in the past, the concept of technical analysis as a separate discipline did not exist; rather, it was entangled with the intuitive, sometimes whimsical, and rarely systematic way of buying and selling practiced by speculators, bankers, and merchants. Hence when we say that merchants were the liberators of the independent human spirit and the driving force behind the progress of world civilization, we mean technicians, too. It was they who put an end to solely monastic education and the use of Latin in business and private life, and who initiated lay education in the Middle Ages. It is no coincidence that some of history's great scientists were also engaged in investing, their market experiences often motivating their scientific contributions (Fibonacci being but one example). Sapori once said that medieval merchants "traced for individuals and peoples of all times to come the only way that leads to a full realization of humanity."[5] We hope this book will convey the same for technical analysts across all eras.

Chapter 1

Ancient Roots

Although there is no direct evidence of technical analysis from ancient civilizations, scattered indirect evidence can be uncovered in early market practices. Bearing in mind that technical analysis is not merely a toolbox of head-and-shoulder-like patterns and MACD-like indicators—as many think of it today—but rather the use of past prices to forecast future ones in the most general sense, we find evidence of it in Babylonian price records, Greek market sentiment assessments, and Roman seasonality patterns. Our predecessors not only followed market prices but also made conscious attempts to measure supply/demand imbalances in price data and react to them for their profit, often combining their insights with "data" from fundamental nature or astrology. It should come as no surprise that in ancient times technical forecasting methods were inextricably linked with and in some cases arose from trading and speculation; hence in this chapter we review them side by side.

The Beginnings

People trade. During the late preceramic Neolithic, which is when the settled village life began and plants and animals were domesticated, the settlers from the Jordan Valley engaged in exchange of local resources—such as salt, bitumen, and sulfur—with nomads, as well as in the long-distance trade of obsidian, and domesticated wheat and sheep with the Central Anatolian Plateau and the Zagros-Taurus arc (a mountain range situated between Europe, Asia, and the Levantine corridor to Africa).[1] In the ceramic phases of the Neolithic, settlers formed agricultural villages in the Zagros Valley while nomadic herders established encampments in the higher elevations. Although there is no evidence of markets in the Zagros during the sixth millennium B.C., the villagers traded grain, flour, fruit, vegetables, and crafts for the nomads' butter, wool, lambskins, and livestock. Long-distance trade expanded too, to include a variety of new materials such as alabaster, marble, cinnabar, wood, limestone, greenstone, and iron oxides.[2] In the later ceramic phases of the Neolithic, around 5000 B.C., villages became highly specialized, and towns or temple centers, possibly equipped with markets, came into being. Long-distance trade flourished like never before, spanning a distance of 1,500 miles and a striking variety of raw materials.[3]

During the early Bronze Age, specifically in the twenty-fourth century B.C, Sargon the Great established the first Mesopotamian empire with its capital at Agade and with the city's temple serving as the center of the empire's economic life. The merchant officially worked for the temple and pursued his private entrepreneurial activities on the side. As political power became more secular, the merchant's domain extended to the palace as well.[4] Sumerian epic literature, including the *Epic of Gilgamesh*, abounds in the allusions to the commercial realities of this period.[5] After the fall of the last one of these empires, the Third Dynasty of Ur, at around 2000 B.C., numerous and decentralized city-states emerged, each ceremonially headed by its own king but in reality run by the merchants. The same merchants established trading colonies in Anatolia, such as the famous *karum* Kanesh.[6] In the ensuing Old Babylonian period, trade was in the

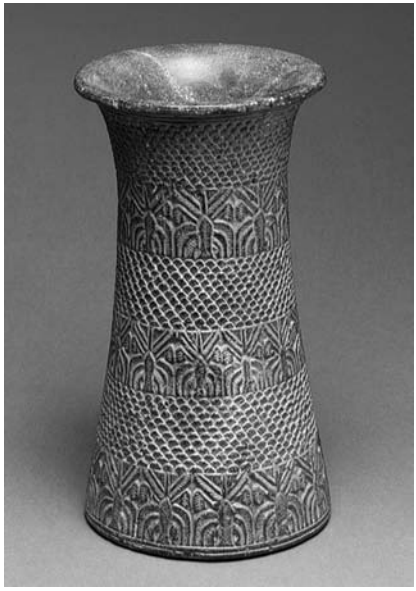
hands of so-called *takamaru* whose role encompassed that of merchants, brokers, merchant bankers, money lenders, and government agents. *Takamaru* dealt in slaves, foodstuffs, wool, timber, garments, textiles, grain, wine, metals, building materials, and cattle and horses. They would either do the trading themselves or loan money to others to go on trading journeys for them.[7]

The Late Bronze Age was characterized by a rigid political structure, and all trading activities were controlled by the palace.[8] In the Iron Age, political power became decentralized and the large palace-towns of the Bronze Age were replaced by numerous, diffuse settlements extending to previously unpopulated areas. Needless to say, both overland and sea trade benefited enormously. As a result, merchants became more free, both in their business activities and in their physical movement. An Iron Age merchant was no longer a palace official who pursued his own profit as a sideline; he was active mainly for his own profit, and stimulated not by royal order but by perceived market advantages.[9]

Nowhere was the focus on getting rich so pronounced as in ancient Babylon, an early hotbed of commercial innovation. For example, ancient Babylonians established a system of weights and measures, formalized business deals by introducing contracts written on clay tablets and signed by the parties involved, and invented limited partnerships where one partner would raise capital at home while the other would travel for business. Accumulation of wealth was important not just for kings and temples, but also for private individuals such as the famous Murashu family, who were wealthy bankers from Nippur of the fifth century B.C. In fact, it was at this time that trading evolved to the point of a profession—a trader acted as a middleman or a broker and dealt in products he did not produce.[10] It is under such conditions that technical analysis came into being in ancient Babylon.

Before drawing parallels between ancient Babylonian practices and modern-day technical analysis, we must first verify that prices in those times were not fixed and controlled by the prevailing rulers, but rather were determined in the market through the interaction of buyers and sellers.

First of all, the existence of markets in ancient Mesopotamia is well established. Not unlike today, the word "street" was associated with the market; for example, Sumerian tablets from the second millennium



Chlorite vase with alternating bands of mountain-like motifs and date palm trees, the Gulf region or southern Iran ca. 2700–2350 B.C. Vessels in the same style are found throughout the ancient Near East, evidence of the region's flourishing long-distance trade.

Source: Image copyright © The Metropolitan Museum of Art/Art Resource, NY.

Clay tablet with a seal impression, Mesopotamia ca. 3100–2900 B.C. Commercial record-keeping was widespread in ancient Mesopotamia. This tablet records the distribution of grain by a large temple. The seal impression depicts a man with two dogs on a leash hunting for boars.

Source: Image copyright © The Metropolitan Museum of Art/Art Resource, NY.

document the existence of the *sūk shimātim* or "commercial street" and note that *sāchiru* (peddlers, retailers) were selling goods on the "street."[11] The Old Babylonian term *bīt machīri* "seems to refer to the stall of a merchant . . . small in size . . . and adjacent to other stalls."[12] As markets evolved from ad hoc gatherings to more established fixtures of civic life, so did the words that described them: The Akkadian term machiru, which initially had the abstract meaning "price, market value" and "commercial activity," acquired the concrete meaning "marketplace" by the beginning of the Old Assyrian and Old Babylonian periods.[13]

Moreover, literally thousands of documents from Assyrian trading stations in Anatolia record price fluctuations. For example, one trader reporting about the high price of Babylonian textiles states, "if it is possible to make a purchase which allows you a profit, we will buy for you."[14] Evidence from the third millennium B.C. suggests that prices of barley fluctuated widely. One shekel of silver at different times purchased 10, 20, or 120 quarts of barley, and based on prices, one could then distinguish between *mu-he-gal-la* or a good growing season and *mu-mi-gal-la*, a bad one.[15] Further evidence suggests that price increases were directly linked to increases in demand. When numerous merchants seeking to buy copper arrived in Anatolia, an Anatolian trader knew the impact this would have on the price of copper and wrote to his associate: "Within the next ten days they will have exhausted its [the palace's] copper. I shall then buy silver [that is, sell copper] and send it to you."[16] Prophets, too, recognized that increases in supply would lower market prices: When the ninth-century prophet Elisha forecasted the lifting of the Syrian siege, she also noted that "tomorrow about this time a measure of *soleth* [fine wheat flour] shall be sold for one shekel, and two measures of barley for a shekel in the games of Samaria."[17]

Ancient Babylon

One of the great legacies of ancient Babylon is the trove of clay tablets on which they inscribed their myths, laws, and records. For example, a large number of tablets, some dating back as far as the second millennium B.C.,

pose textbook-like interest rate problems and provide their solutions.[18] In another corpus of tablets, ancient Babylonians kept diaries of astronomical observations and prices of various commodities in the city for almost four centuries. Although the earliest known diary dates back to 651 B.C., it is commonly believed that most of the diaries originated between 747 and 734 B.C., during the reign of Nabonassar. The two earliest diaries, written in 651 and 567 B.C., covered 12 months each.[19] Later diaries spanned various lengths of time, ranging from days, weeks, months, or even years. A typical full-sized diary covered either an entire Babylonian year or the first half of it.[20]

Slotsky characterizes the Mesopotamian records of the market values of commodities as an old and continuous tradition that spanned not only astronomical diaries but also literary works and commemorative establishments.[21] To illustrate her point, she points to the Old Babylonian royal inscriptions that listed "ideal" commodity prices in order to "propagate the image of a prosperous reign."[22] Among her other examples are the Laws of Ešnunna and the Hittite Law Code, both of which specified legal prices for various commodities. Other sources of commodity prices include the Chronicle of Market Prices as well as literary texts such as the *Coronation Prayer of Assurbanipal* and the *Curse of Agade*.[23]

The basic unit of money was the shekel of silver, and prices were quoted as the amount of commodity that one shekel could buy. For example, one diary records the following price quotation: "This month, the equivalent for one shekel of wrought silver was barley, 2 *pān* 4 *sūt* 3 *qa*."[24] Continuously throughout the centuries, the diaries document the values of the same six commodities—barley, dates, mustard/cuscuta, cress/cardamom, sesame, and wool—a testament to their importance in ancient Babylon. As Slotsky explains:

> All six commodities were staples. Barley, dates, sesame, and wool were in widespread use since earliest times and for millennia maintained their economic role as units of payment and exchange. Mustard/cuscuta and cress/cardamom grew to become commodities of great significance, especially in the first millennium, because of their popularity in the Mesopotamian diet and their widespread use in medicine. All were of domestic

> origin, all were storable, and all were raw materials from which other basics were derived.[25]

During the four hundred years of their production, the layout of the diaries did not change much. They typically start with a title, which specifies the time range covered by the diary, such as, "Diary from month I to the end of month VI of year 23 of Arses, who is called King Artaxerxes."[26] Longer diaries were produced by compiling shorter ones, and hence are divided into several distinct sections. For example, a half-year diary is divided into six or seven sections, each section corresponding to a lunar month. At the beginning of each section a scribe would record his observations of the first signs of visibility of the new moon. He would devote the body of the section to a detailed description of the moon's progress among the Normal Stars and planets during that month. He would also provide supplementary information regarding weather, comets, meteors, eclipses, equinoxes, and solstices. Toward the end of the section he would give an account of the last signs of visibility of the moon. Finally, the concluding passage would consist of the planetary positions data, the market values of the six commodities, and the water levels of the Euphrates. Sometimes, some historical notes relating to earlier months or years would be included in the conclusion.[27]

Choosing the Stocks

Now let us consider the parallels between Babylonian diaries and contemporary technical analysis. The very fact that the diaries documented the values of the same six commodities throughout centuries has some semblance to modern practices. First of all, some of the classic technical analysis manuals advise carefully choosing a small number of stocks on which to focus your attention. For example, according to Gartley, "a few well-chosen charts, religiously studied, can be of far greater use in making decisions to buy and sell stocks, than a large portfolio including several hundred stocks, which receive only casual attention."[28] Second, technical analysis teaches one to follow the chosen stocks over a long period of time. As Schabacker puts it, "understanding of the technical action of any stock or group of stocks can

come only from long study of actual market action and market history."[29] By following the same six commodities over a period of four hundred years, ancient Babylonians did just that.

Diaries as a Form of Charts

To describe the ancient Babylonian custom of recording market quotations, Slotsky writes that they "were charted regularly so that fluctuations during each month of the year could be noted."[30] However, as an example of this charting practice, she gives not a graphical chart but the following statement: "until the 15th, 5½*qa*; the 16th and the 17th, 5 *qa* one-fourth and half of one-fourth."[31] Nevertheless, her labeling of the astronomical diaries as a form of charts is valid. Careful reading of Schabacker's work, which happens to be "among the most influential ever written on the technical side of the market," suggests that he would agree with this statement.[32] According to Schabacker, while a chart "may take many different forms and may be adapted in such forms to many various codes of important market factors . . . from a general standpoint . . . [it] is merely the visible record of stock market action over a period of time."[33] And a visible record of market quotations is what the Babylonian diaries undeniably were. Gartley, another one of the "illustrious names in the field of technical analysis,"[34] suggests that a chart's "primary function is to provide accurate factual data."[35] The diaries certainly provided this function. As Slotsky puts it, "To anyone who has dealt intensively with the analysis of the diaries' market data, there can be little doubt that these prices were real market values."[36]

Time Scale and Volatility

In his classic text *Stock Market Theory and Practice*, Schabacker wrote that "there are daily charts, weekly charts, monthly charts and even yearly charts."[37] He added that "the smaller the time period charted individually the more flexible the chart will be, and therefore the more valuable in tracing minor past habits and actions."[38] This would imply that higher volatility calls for a smaller time period, so that minor fluctuations can be more effectively traced. Schabacker's advice is remarkably similar to the practices of ancient Babylonian scribes. These scribes

would adjust the frequency with which they recorded the market quotations in the astronomical diaries according to the level of market volatility. When volatility increased, "instead of the regular quotation at the end of each month, there might be quotations for the beginning and end of the month; the beginning, middle, and end of the month; ranges of days; or even daily."[39] When fluctuations became even more rapid, "the smallest changes would be charted."[40] For example, on a particularly volatile day, prices would be reported twice a day, both in the morning and in the afternoon.[41]

Blank Spaces

"Some charts are lined for every day in the year," wrote Schabacker, "but this means that holidays leave a blank space which distorts the chart picture."[42] Just like technical charts, astronomical diaries report "interruptions or suspensions of commodity sales . . . on explicit dates in designated places."[43] Sometimes these interruptions are confined to a single commodity. For example, one diary notes that "the 25th and 26th day, the sale of barley was cut off,"[44] while another one notes that the "[trade in bar]ley was interrupted in the streets of Babylon."[45] Other times interruptions affected several commodities: "The sale of barley and everything else was cut off in the streets of Babylon until the 5th."[46]

Forecasting with Omens

The Babylonians' celestial omen corpus records their attempts to forecast the cultivation, yield, and storage of various commodities, as well as the behavior of their market prices.[47] This forecasting was astrological in nature. For example, Slotsky notes that the flourishing of the dates and mustard/cuscuta crops "was assigned to the astrological region of Pisces when the 'benefic' planets were dim and the 'malefic' planets were bright."[48] On the other hand, "sesame was assigned to the sign of Taurus, but when the 'malefic' planets were bright and the 'benefic' planets dim, it fell into the region of Pisces." Among the six commodities, barley, dates, and sesame are mentioned most frequently in the celestial omen corpus.[49] For example, omens concerning barley include