4.1 Introduction

Standardisation is a continuous process and occurs at different economic levels. Two major examples of this process in our era are the Euro and the GATT treaty. Europe is at present heading towards one single European Currency Unit while at the same time many nations in the world are implementing the GATT treaty to facilitate the flow of manufactured goods between one country and another. Nowadays, standardisation is usually applied to industrial procedures. This industrial standardisation is of no assistance for the pre-industrial period examined in this book. Nevertheless, the process of standardisation consists of successive stages and is in economic terms related to the sequence of commoditisation that was presented in section 1.7. I am particularly interested in the transition from stage 4 to 5, the progress from reciprocal and other basic mechanisms of transfer to the exchange of commodities through the market mechanism by quantification. This is accomplished by weights and measures and these represent early standards. It will be established in this chapter that in central Italy this mechanism of quantification is correlated to the workshop mode of production.2

Standardisation is a universal economic concept and it can be applied to the pre-industrial 18th century AD3 as well as to prehistoric times. Braun for example, has discussed the high degree of standardisation of valuables during the Hopewell phase of exchange in the North American Midlands around the first centuries AD.4 Its development is described in terms of increasing population densities, expansion of exchange activities, subsistence intensification, decreasing mobility and gradual nucleation into larger villages that contain between 50 and 100 people. Standardisation as well as imitation occurred at the level of highly crafted goods such as small ceramic jars and bowls with Geometric and zoomorphic designs, carved stone pipes, copper earspools, copper panpipes and ceramic figurines. The stylistic standardisation of valuables has been the subject of various analytical and speculative explanations. Standardisation of valuables was either due to a single, relatively unified mechanism of transaction among the participating regions or to the existence of a few highly productive artisans. Other explanations elaborated ideas such as travelling artisans or shared symbolisation of positions of authority. According to Braun, all these explanations have considerable weaknesses. He presents an interpretation that incorporates the concept that standardisation of valuables is a 'consequence of certain basic characteristics of communication networks typical of peer polity interaction. The key, in this instance, is to recognise that the stylistic phenomena occurred during a

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1 Cottrell mentions an inscription above the study while he describes Schliemanns' mansion in Athens. This inscription refers to a philosophical principle of Pythagoras. Geometry is considered to be harmony as well as a condition for knowledge. Knowledge of geometry is knowledge of the nature of things. I refer to Thom and Huffman for a discussion of this principle in Pythagorean philosophy: Thom 1995, 174-7, 186-91; Huffman 1993, 54-77, 193-9.

2 In this chapter I discuss measures and units which is one aspect of standardisation. I refer to Rice for an examination of standardisation of materials such as ceramics: Rice 1991. According to Rice, this concept is closely related to specialisation of crafts and as such was a component of my previous chapters. For example, Rice mentions that 'Specialization for elites is likely to be distinguished in terms of skill and/or resources, and specialization/intensification for "commoners" is likely to emphasize production to create high-volume/low-value goods.' Rice 1991, 266. This process is in fact illustrated in Figures 15 and 16, Chapter II. Devaluation and mass production is associated with the transition from luxury to subsistence goods which is one of the main topics in chapters II and III.

3 Johnson 1993, 334, 352.

4 Braun 1986, 117, 126.
period of residential nucleation, reduced mobility, and increasing supralocal exchange activity, and therefore of increasing intralocal and supralocal interaction and communication.5

Many of the explanations and features that were described by Braun such as travelling artisans, settlement nucleation, increasing trade, peer polity interaction etc., are also encountered as characteristics of developments in central Italy from 800 BC onwards. However the level of economic growth in central Italy is not compatible with that of the Hopewell phase of exchange. The Hopewell phase of exchange represents a society that consists of developing small villages of at the most 50 to 100 inhabitants while in central Italy by 600 BC a range of emerging towns is encountered with, occasionally, thousands of residents. This difference in scale and level of basic economic conditions has consequences such as the tendency towards an exchange mechanism that required regulation. The rate of standardisation in central Italy indicates the introduction of a metrological system in line with the advance of craft specialisation and the workshop mode of production.

The principles of standardisation are defined at present by the International Organisation for Standardisation (ISO) in Geneva.6 Some of these principles can be applied to central Italy for the period 800 to 400 BC. A selection of the relevant principles includes:

a. Standardisation is essentially an act of simplification as a result of a conscious effort of society. It is not only a reduction of present complexity but aims at the prevention of unnecessary complexity in the future;
b. Standardisation is a social as well as an economic activity and should be promoted by the mutual cooperation of all concerned. This requires propaganda and public relations in order to obtain this cooperation. The effect of standardisation can be appreciable only if standards are implemented;
c. The mere publication of a standard is of little value unless it can be implemented;
d. Standards should be reviewed at regular intervals and revised as necessary. The interval between revisions will depend on particular circumstances.7

These principles can be transferred to the region and period examined in this study. For example, principle a. might illustrate that measures were implemented as an act of simplification due to increasing demand and exchange activities. Axiom b. represents the mutual cooperation between indigenous people and foreign traders. Principle c. could exemplify the implementation of measures at ports of trade and emerging local markets while principle d. could rationalise the existence of various measures in central Italy once local and regional markets developed. Another illustration of the revision of standards recorded in principle d., is the continuous modification of early Roman coinage during the 3rd century BC.8

I will relate the principles of standardisation to increasing trade and to the workshop mode of production. This mode of production is a consequence of the raised demand for commodities, the local adoption of new technologies and of the development of regional and local markets. These changes were embraced with enthusiasm in central Italy during the Orientalising Period. To me, this means that the social structure was advanced enough to accomodate and even to direct the transition to an early market mechanism that is characterised by quantification. These transformations account for the origin of metrological systems in central Italy.

The measures that are examined are weights, units of capacity and linear quantities. The search for early measures is complicated by several factors. In general, measures in antiquity were less accurate than in our present time. When units were applied for practical purposes, this inaccuracy could increase. Furthermore, there are some

5 Braun 1986, 122.
6 Sanders 1972.
7 Sanders 1972, 12-3.
physical shortcomings. Metal weights corrode and this affects their original mass whereas measures of capacity which were made of earthenware, shrink as a result of firing in the kiln. Shrinkage that is caused by firing also affects an examination of units of length that is based on data from terracotta roof systems. In addition, profit motives obscure the search for standard units. For the sake of earnings, merchants and shopkeepers meddled with measures. Measures of weight and capacity which were used on markets in antiquity, could deviate widely from the official value and content of fixed measures. In the above I have commented on the inaccuracy of measures in antiquity though it is essential to recognise that the precision of quantification entails both theory and practice. As such, principle a. of standardisation is illuminating because standardisation is theoretically based on the concept of simplification as well as on the concept of complexity. Measures were in theory reliable. The two ancient scales from Satricum and Chiusi, which will be examined in section 4.2, suggest relatively precise, fixed weights. Evidence from measuring rods records this accuracy. From a collection of archaeological measuring rods and from mathematical deductions carried out on the oldest concrete measuring rod that is preserved, the Nippur cubit, Rottländer calculated that ancient units of length only vary within margins of 0.2 %. The accuracy of measuring devices deviates from the precision that is obtained when units were employed for exchange activities. This contrast between theory and practice complicates the perception of early metrological systems. However the main difficulty concerning early measures is the dearth of evidence. The limited evidence for measures from the primary sites of central Italy indicates an incomplete adoption of metrological systems during the period 800 to 400 BC. Nevertheless, the few data that are available, record that quantification was practised during exchange activities. Measures were employed in central Italy in proto-historical times, from the 7th century BC. Those who have labelled the early use of measures before historical confirmation, a fantasy, deny history its own history. A historical process such as the implementation of units and standards has to mature in any culture and it is obvious that during this developing stage, the actual evidence is limited. Besides, a metallic unit is clearly implied by the Twelve Tables that are dated around 450 BC. In the Tables fines are recorded in asses to be taken as weights of bronze and not of coins. The account given of the early measures in this chapter resembles the reading of the alphabetic graffito from Osteria dell'Osa. These five letters which are dated to 770 BC and which at present predate the earliest known inscription from Greece, cannot be translated. It has been suggested that these letters indicate a stage in the adaptation of the Phoenician alphabet for the Greeks on Ischia since at Pithekoussai both Greeks and Easterners were living together during the 8th century BC. It is unfortunate that we cannot make out the message of these letters but it cannot be denied that they are letters and symbols which convey meaning. The analogy between these letters and early measures is that a discussion of protohistoric measures of weight, capacity and length is bound to be hypothetical. The actual evidence is limited because it debates the origin of what in later times, becomes a historical mechanism. The evidence is destined to be restricted during the initial stages of quantification by measures.

In order to substantiate aspects of standardisation in central Italy, I will first present the early evidence for units of weights, volume and length that are known from later historical sources. Secondly, I describe a reconstruction of a local system of quantification for Marzabotto. The evidence for weights derives from a limited number of sites and is presented in combination with its archaeological context.

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9 cf. Pernice 1894, 10-1; Lang and Crosby 1964, 39-57.


11 Pink 1938, 10-1; Houben personal communication.


13 cf. Ross Holloway 1994, 112, 167. I also refer to Ridgway who recently discussed the meaning of these letters as well as their archaeological context: Ridgway, 1996.
4.2 Weights

Weight was applied as a measure of quantity as soon as materials became available of sufficient value to make precision desirable.\(^{14}\) The exchange in metals in particular, required precision. In central Italy only a limited number of pre-Roman weight-standards have been published. These include:

- Chianciano, weighing 250 g.
- Chiusi, weighing 214-212 g. (deduced from balance)
- Chianciano, weighing 212 g.\(^{15}\)

The units of weight from Chiusi and Chianciano imply a standard of circa 212 g. However their archaeological contexts are far from conclusive which makes it difficult to date the evidence precisely. For example, the balance discovered at Chiusi was found in a cistern, the content of which was labelled Etruscan (Fig. 64).\(^{16}\)

This section on weights expands the corpus of pre-Roman weights and reviews aspects of pre-monetary exchange mechanisms that were based on metallic weight standards. Since I found most of the early evidence on measures at the Latin site Satricum, I will start by discussing the evidence from this settlement in detail. Two metallic weight standards and a pair of scales were found at the site. The first of these weights corresponds to the so-called Roman-Oscan pound and was excavated in a settlement context that is dated to the second half of the 7th century BC.\(^{17}\) The second weight corresponds to the so-called Campanian pound and was found in the oldest votive deposit, votive deposit I, dated between the 8th and 6th centuries BC (Fig. 65). In the same votive deposit a pair of scales was found which, because of its dimensions, can be described as a jeweller’s balance (Fig. 66).

\(^{14}\) Renfrew 1972, 408-12.

\(^{15}\) Crawford 1985, 16.

\(^{16}\) Notizie degli Scavi 1883; Gamurini 1889.

\(^{17}\) This context is depicted in Figures 67 to 70.
The use of weight-standards at *Satricum* is closely linked to some activities of a proto-urban centre such as trade and local production of artefacts. I have recorded that iron artefacts and pottery were manufactured in the settlement from the 7th century BC.\(^{18}\) It is likely that at *Satricum* other metals were processed as well. A close parallel to this situation occurs in *Pithekoussai* where an Euboean weight-standard was excavated in the metal-working quarter dated to the early 7th century BC.\(^{19}\)

The designation of standards of weight as fixed metallic monetary units is considered to be the most important stage in the early history of money.\(^{20}\) A discussion of this important stage for Italy and Rome is hampered by the lack of known weights. Unfortunately no reference book for pre-Roman Italian weights is available. This is even more unfortunate taking into consideration the long-lived tradition in early Rome of transactions *per aes et libram*, by bronze and scales, a procedure for transferring commodities by weighing pieces of bronze in a pair of scales, which continued well into the Republican period even though the Greek colonies in South Italy had adopted coinage centuries before.

The views of numismatists on early Italian weight standards tend to be polemic. The discussion is mainly theoretical since, as stated above, actual weights with conclusive contexts are scarcely available. I present two lead weights from *Satricum* which correspond to the average weight of two later Roman coins; the *Roman-Oscan* pound for the cast Prow Aes coins and the *Campanian* pound for the heavy Apollo series.

Weight 1 (Fig. 65 a) is a *Roman-Oscan* pound that was excavated at *Satricum* and dated to the second half of the 7th century BC. It is identified as a unit by its embossed mark. It is a lead weight with an iron hook for suspension and a single embossed iron mark. It has a conical body with a slightly concave base and a convex top. It weighs about 267 g. and was somewhat damaged in antiquity due to scratching. Moreover, it has lost some of its original weight through corrosion.\(^{21}\) Taking this into consideration the closest parallel for this weight is the *Roman-

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\(^{18}\) See sections 2.6.1 and 3.6.2.

\(^{19}\) Buchner 1979, 135.

\(^{20}\) Crawford 1985, 19.

\(^{21}\) cf. Hitzl 1992, 244.
The second weight (Fig. 65 b), which is on display in the Villa Giulia Museum in Rome, was found during the excavations at the turn of the century in votive deposit I. This deposit is dated between the 8th and 6th centuries BC. It is a lead weight with a copper alloy ring for suspension. It has an elongated, conical body, tapering towards the top and in section it is slightly octagonal. It is corroded and weighs about 340 g., which is close to the weight Haeberlin called the Italian pound and others the Roman-Attic/Campanian *mina* or pound, being about 341 g.\textsuperscript{23}

Of these two weight-standards, the *Roman-Oscan* pound is still debated. Scholars have either denied the existence of this weight unit\textsuperscript{24} or have taken a more pragmatic view stating that different weights for the pound existed in Italy.\textsuperscript{25} The second weight found at *Satricum*, the *Campanian* pound, seems not to be mentioned anymore. However it appears to confirm the view that different weights existed for the pound.

The third object from *Satricum* which relates to weighing and weights is a pair of scales (Fig. 66). It was also found in votive deposit I. It is made of copper alloy and consists of chains of small rings and a bar. The bar is incised on one side with ten parallel lines and three hatched crosses, one of which appears incomplete. The other side is incised in the middle with one line. Though the incisions on the extreme right of the bar are difficult to read

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\textsuperscript{22} Haeberlin 1909, 31-6.

\textsuperscript{23} Haeberlin 1909, 82; Pink 1938, 11.

\textsuperscript{24} Thomsen 1957, Vol. II, 22-33.

\textsuperscript{25} Crawford 1985, 1-6, 15.
and are represented in an arbitrary fashion, they indicate a subdivision of weights to be measured in ten units while the hatched crosses are positioned, approximately at a quarter, a half and three quarters. The balance from Satricum has a design that suggests the use of an equipoise. On the right arm of the balance an equipoise was moved in order to obtain an equilibrium. The position of the equipoise indicates the difference in weight of the objects in the scales. Similar balances are reported for the measurement of the specific weight of gold and silver. The actual scales are missing though I located a pan from votive deposit I which is suitable for this balance, in the store rooms of the Villa Giulia Museum (Fig. 66). The scales would have hung on four chains of small rings since one of the chains divides into two. The other chains of the balance are incomplete. The dimensions of the balance make it only suitable for measuring small quantities. Thus, this pair of scales was intended for measuring the weights of precious metals or materials. In this context it is interesting to mention several small lead weights found at Satricum by the excavation team of the University of Amsterdam. These small square or rectangular lead cubes were discovered in a disturbed context. They are provisionally interpreted as stray finds from the refuse of votive deposit I that were discarded by the excavators who worked at Satricum at the turn of the century. Details of these smaller weights from Satricum still await publication.

The balance and weight no. 2 (Fig. 65 b) were both found during the excavations at the turn of the century. They are mentioned in the field-reports of the objects that were discovered in votive deposit I during February 1896 and are listed amongst fibulae, small copper alloy figurines and some scarabs. The presence of weights in sanctuaries is not uncommon in antiquity since religious institutions probably vouched for the value and content of fixed measures. This custom is reflected in Rome where weight standards were kept in the Temple of Jupiter Capitolinus. Thus, it is not surprising to encounter units of measurement in temple precincts. For example, among the weights found at Olympia, three copper alloy weights are known to correspond with the weight of 1, 1/2 and 1/4 mina of Aeginetan standard. The widespread custom of consecrating weight standards at sanctuaries also occurs at Francavilla Marittima in southern Italy. At this site, a remarkable silver weight was found which was dated to the 6th century BC. Zancani Montuoro suggested that this weight was dedicated at the temple by the Sybarites in order to vouch for the value of their coins.

Discussion of early weights has attracted much attention from scholars from different fields. One of the topics debated is the introduction of these measures. Crawford suggests that a state-designated metallic monetary unit existed at Rome from the middle of the sixth century BC, while Peruzzi argues on linguistic grounds that the Latins used standard weights from the 8th century BC. The weight units that are presented in this section are the

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26 Ibel 1908, 51, 61.

27 I thank drs. M. Gnade and Dr. D.J. Waarsenburg for this information and their permission to mention these finds.

28 cf. Hitzl 1996. He describes weights which were found at Olympia while presenting evidence for the involvement of priests in the emission of these weights: Hitzl 1996, 101-4.

29 Kisch 1966, 150.


32 Crawford 1985, 21.

33 Peruzzi 1985, 39-63. The existence of systems of weights in Italy prior to the 8th century BC cannot be excluded. Negroni Catacchio catalogued two stone objects from Sorgenti della Nova dated to the late Bronze Age which are tentatively interpreted as weights: Negroni Catacchio 1995, 384. The stones have holes for suspension and one has a similar form as the Roman-Oscan pound that was discovered at Satricum. Unfortunately Negroni Catacchio does not report the weight of both stone artifacts. It is suggested that both objects could have a ritual connotation. See for example, the exceptional collection of stones some of which with holes, that were found in the 6th century BC deposit at the Comitium in Rome: Bartoloni 1989-1990, 756-7. Unfortunately the weight of these 130 pebbles is not documented. Bartoloni presents some interpretations for these stones but she does not include the option that they could represent weights such as the river pebbles from Marzabotto.
result of archaeological research and indicate their introduction during the period of the formazione della città, the Orientalising Period, that is from 720 to 580 BC. With this introduction of measures of weight in Latium Vetus, I do not propose a sudden introduction of commercial exchange based on a market system with prices fixed according to supply and demand. Other exchange mechanisms must have dominated. Therefore reciprocal exchange based on social relationships and equivalence rather than profit and loss, or redistributive exchange based on redistribution of products which were collected by a central power, may have existed for diverse commodities and services side-by-side with market exchange.\textsuperscript{34} For Latium Vetus and Etruria the role of gift-exchange of prestigious goods between members of the 'upper-class' has been stressed, though this can never account for all forms of exchange during the period discussed.\textsuperscript{35} I consider that the Satricum weights may indicate an Italian exchange mechanism based on commercial exchange with fixed correlations for the value of different metals. These weights show that market mechanisms existed in central Italy at least from the middle of the 7th century BC. A fixed correlation was calculated on the basis of copper alloy and silver coins of the 3rd century BC according to which a quantity of 273 g copper alloy, that is the as of ten ounces, was worth two scruples, that is 2.2 g silver.\textsuperscript{36} Whatever the ratio silver to copper might have been during the second half of the 7th century BC, the unit of 273 g was employed at Satricum at an early date.

\textbf{Fig. 67. Satricum, square B 18, deposition of pottery and metals in between recent ploughed furrows.}

\begin{itemize}
  \item see section 4.5.
  \item \textsuperscript{34} cf. Greene 1990, 46-8. Greene presents the main economic exchange mechanisms such as reciprocal, redistributive and market exchange.
  \item \textsuperscript{35} cf. Bartoloni 1989, 201-2; Anzidei et alii 1985, 220.
  \item \textsuperscript{36} Burnett 1989, 34.
\end{itemize}
Fig. 68. Satricum, metal artefacts which were excavated in square B 18.

In the remainder of this section on weights, I will first present the archaeological context in which the weights were found because of its significance on the interpretation. Secondly, information from other sites with similar circumstances will be examined in order to integrate the Satricum weights into the commercial exchange mechanism of the 7th century BC.

The development of Satricum can be divided into two stages. In the first stage of approximately 830 to 600 BC, the settlement consisted of huts that were grouped around a sacred water basin. After a destruction and levelling of the site around 600 BC, the second stage began. This stage was characterised by temples and houses on stone foundations. The last temple of Satricum was destroyed around 500 BC and was not rebuilt although life on the site continued.37 By 500 BC, Satricum had lost its economic significance and was of mere local importance.

In 1991 the excavation of an area south of the temple (Fig. 49, square B18 on the excavation plan) yielded a

consistent metal and pottery concentration that included the above mentioned Roman-Oscan pound. Stratigraphically the material was found to lie between ploughed furrows (Fig. 67). The metal concentration included a copper alloy vessel, bowl, bracelet and fibula (Fig. 68) as well as iron axes and knives (Fig. 69).\textsuperscript{38} Moreover a piece of raw, unworked iron was discovered.\textsuperscript{39} The associated pottery was bucchero, a black burnished carinated impasto bowl, fragments of a stand of impasto rosso, impasto jars and an impasto amphora decorated with a double spiral (Fig. 70). The lead weight with the embossed iron mark was excavated near these objects which can all be dated to the second half of the 7th century BC. Most of the objects were found next to, or on top of, each other (Fig. 67) and no other material was found in this part of the excavations. Some vessels were fairly complete which is unusual for a settlement context. This implies some sort of deposition. I interpreted one of the vessels found with the weight, as a measure of capacity.\textsuperscript{40} The objects were excavated in an area of about 2 m\textsuperscript{2} and were 50 cm below the ground surface. In fact their preservation was quite unusual, since they were found in between ploughed furrows. These furrows are the result of ploughing with a steam-driven plough apparently used on the acropolis around 1929.\textsuperscript{41} The objects were found in the settlement area of the excavation though the general context is not yet known because of the ploughing. However the direct context in which the weight was found, can be identified. Apart from the implication of a deposition, the weight was excavated together with raw iron and square socketed iron axes. The raw iron may have been imported though the axes were most likely produced locally, since iron smithy-slags from the 7th century BC were excavated in the settlement.\textsuperscript{42} Besides, similar axes were found in votive deposit I which makes a total of ten square socketed iron axes excavated at Satricum. When compared with the number of iron axes from other sites in Latium Vetus from the same period, Satricum clearly stands out. From the presence of these axes in rich tombs, it is deduced that iron axes were still regarded valuable during the 7th century BC. Because of the large number of axes at Satricum and the attested iron production recorded by the iron slags and the piece of raw iron, it is assumed that iron socketed axes were produced at the site from the second half of the 7th century BC.\textsuperscript{43} Thus, the immediate context in which the weight was excavated, indicates trade in iron artefacts. The presence of some copper alloy objects in the same context makes it likely that copper alloy artefacts were also exchanged (Figs. 68 to 70). Another important indication is that the artifacts that were found with the weights (Figs. 68 to 70), indicate an indigenous framework since this context does not retain evident Levantine or Greek goods.

The development of the settlement at Satricum can be described as a faltering urbanisation process. To demonstrate this, I discuss two economic activities, exchange and local production, separately from many other aspects such as architecture and public works which also indicate urban development. Exchange of artefacts at Satricum is recorded by the quantity of imported goods, the weights and the balance. Judging from the distribution of imported goods in the three archaeological contexts of the site (sanctuary, necropolis and settlement), it is probable that trade was centered around the religious activities at the sanctuary. During the 7th century BC, goods from all over the eastern Mediterranean area changed hands at Satricum in what can be described as a centre of

\textsuperscript{38} The copper alloy bracelet in Figure 68 is identical, though larger, to two bracelets in tomb 652 at Pithekoussai. This tomb is provisionally dated to the late Geometric II period and contained besides the bracelets, 22 fibulae, another bracelet and a scarab. A girl was buried in this tomb.

\textsuperscript{39} It may be that the original context was disturbed since the bracelets are too large and the fibulae too numerous to have been worn by the girl. See: Buchner and Ridgway 1993, 630-5. For my comments on the metal objects from Pithekoussai, I refer to section 3.6.1.

\textsuperscript{40} See section 3.6.2.

\textsuperscript{41} See section 4.3.

\textsuperscript{42} See section 3.6.2.

\textsuperscript{43} Maaskant-Kleibrink 1992, 8. The furrows contained much charcoal from charcoal-firing that was carried out on the acropolis during the last century. The carbon was C\textsuperscript{14} dated to the second half of the 19th century AD.
trade. In time this trade was reduced to interregional/regional and local importance. A similar account can be given of the local production. Local production is recorded from the 7th to the 4th centuries BC. The production of pottery and iron artefacts during the 7th century BC is characterised as technologically advanced. Iron was hardened, highly crafted vessels of fine impasto were made while ceramic stands were fired in a kiln with separate combustion- and firing chamber. Though the production of pottery and iron continued in later centuries, the products became indistinctive. The local workshops did not contribute any longer to the significance of the site. This could have been due partly to the decrease in the value of iron and other artefacts. Other factors are a general loss of the economic importance of the site, the transformation in the social position of artisans due to developing craft specialisation and a change in territorial boundaries. Nonetheless, during the late 8th and 7th centuries BC, trade and production at Satricum led to the accumulation of reserves or surplus. In this context, the early use of pre-monetary weight units and scales is not surprising. This view is supported by considering the economic development of the economy at the site in more detail. Whereas contacts on a regional and inter-regional level can be found during almost all periods of the settlement, those on an international scale are found especially in the late 8th and 7th centuries BC. The 'international' imports were mainly present in the tombs and the oldest votive deposit, votive deposit I. This deposit yielded imports mainly from Greece but also from Egypt, Rhodos and the Levantine-Cypriote area. Besides ceramic imports, the high economic standard of the site in the 7th century BC is also reflected in votive deposit I by a considerable number of objects of different metals, such as iron, copper alloy artefacts and some gold, silver and gilt silver objects. The formation of votive deposit I may be considered as an accumulation of reserves of wealth taken from daily circulation. The establishment of votive hoards such as the votive deposit at Satricum, is one of the methods of storing economic surplus. At Satricum one can detect during the 7th century BC a definite shift from 'personal' hoards, exemplified in the rich burials, to 'institutionalised' hoards, exemplified in the wealth of the votive deposits. These 'institutionalised' hoards, however, consisted at least partly of separate votive pits representing personal gifts to the goddess. Moreover, most votive gifts were taken out of daily circulation. The change from 'personal' hoards to votive hoards shows that the religious authorities were able to create reserves of wealth in favour of their institutions. These reserves must have stimulated new market conditions in which the religious institutions played a major role. The wealth of the votive deposits combined with the limitations of the natural resources indicates that the economy of the settlement revolved mainly around the activities at the sanctuaries rather than on its local resources. International contacts gradually disappear during the 6th century BC. In the 5th century BC the economy of the site assumes a mainly local character. Though the economic importance of Satricum declined, local production of pottery and iron continued well into the 4th century BC indicating that in this period production was merely distributed locally. The local production of votive terracottas, however, leads us to conclude that the sanctuaries still remained at the heart of the economy.

In addition to the weights and the pair of scales, an early monetary character of the votive deposits at Satricum is indicated by the large amount of so called aes rude, about 40 to 50 kg, and copper alloy scraps that were found in and around the temples. Among the copper alloy scraps there are several folded artefacts such as strips and vessels, some of which had been folded three to four times. Most of the aes rude and copper alloy scraps were found during excavations at the turn of the century and their context is not well recorded. However the assemblage of aes rude, including pieces of plano-convex, copper-iron ingots, and scraps from Satricum resembles the assemblage of copper alloy artefacts that were excavated in the votive deposits from the sanctuary of Demetra Thesmophoros at

45 Peroni 1979, 16.
The deposits at both *Satricum* and *Bitalemi* included *aes rude*, pieces of plano-convex ingots, distorted vessels and an *aes signatum*. The *aes rude* and copper alloy scraps at Bitalemi were interpreted as pre-monetary copper alloy deposits which consisted of thirty-one separate offerings. The offerings at Bitalemi amount to a total of about 100 kg of copper alloy and are dated to between 640 and 540 BC. These individual offerings occurred also in votive deposit I at *Satricum*. With the procedure *per aes et libram* in mind, the substantial amount of *aes rude* at *Satricum* supports the pre-monetary character of some of the offerings.

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*Fig. 69.
*Satricum*, knife and iron axes which were excavated in square B 18.

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50 *Satricum* 1985, 119. This exhibition catalogue presents the *aes signatum* from *Satricum*.

Fig. 70. Satricum, pottery that was excavated in square B 18.
The source or provenance of the weights discovered at Satricum, is hard to establish. Traditionally, both weights are associated with the Campanian/Oscan territory through their nomenclature. The Roman-Oscan pound as well as the Roman-Attic/Campanian pound, imply an origin in the region south of Latium Vetus. A subdivision into ten units can also be related to an Oscan origin. The subdivision of weights on the balance is ten (Fig. 66) and this is similar to the subdivision of length which can be associated with the Oscan territory. In later centuries the Romans used a division of twelve units. The southern connotation is not surprising if one considers the position of Latium Vetus within the Mediterranean trading system of the 7th century BC. This system was probably stimulated by the developments in the area around Cumae. The increase in 'international' trade during the Orientalising Period, accounts for the employment of quantification by weight and other measures for exchange with foreign trading communities. In order to support this argument it is essential to examine other sites with similar evidence for early market mechanisms.

The evidence from other sites is limited, partly because of the lack of detailed accounts since there are some publications in which weights are implied but not specified. However the evidence that is presented in this section is sufficient to support the concept of exchange by quantification and its early introduction in central Italy. These weights were used in a Mediterranean commercial exchange mechanism of which central Italy became part during the Orientalising Period.

The closest parallel to the metrological conditions at Satricum, both in date and context, is found on Ischia. In the metal-working quarter at Pithekoussai, a disc of lead bound in a bronze ring was found (diam.: 1.7 cm; thickness: 0.6 cm) in the rubbish dump against one of the workshops. It weighs 8.79 g, which is close to the standard weight of the Euboic-Attic stater (8.72 g). The context is definitely pre-monetary and cannot be dated later than the first quarter of the 7th century BC. The excavators imply that the Mazzola pre-monetary weight was used either for weighing precious metals or for weighing the finished products of metalworking. On the basis of circumstantial evidence they argue for jewellers' workshops at Pithekoussai where silver and gold could be worked. The weight from Pithekoussai would suit in size the pair of scales found in votive deposit I at Satricum (Fig. 66).

The evidence for the processing of precious metals such as silver and gold at Pithekoussai is indirect. There is, however, direct evidence for the processing of iron and copper alloys. The Mazzola site yielded as Satricum, iron slags and raw, unworked iron. The structures that belong to the metalworking activities, are better preserved at Pithekoussai than at Satricum. There is also convincing evidence for the casting of copper alloy fibulae at Pithekoussai. The refuse from the workshop area produced a miscast of a copper alloy fibula and several other copper alloy artefacts. Some lumps of lead from the same refuse are not described in detail but one of them is illustrated by Klein. This piece of lead does look similar in shape and dimensions to the Roman-Oscan pound from Satricum. However the weights of the lumps of lead from Pithekoussai were not published. In the summer of 1994, Buchner kindly showed me another weight that was discovered at Pithekoussai. This scratched, rectangular piece of lead has the same weight (268 g) as weight A from Satricum (Fig. 65 a). However it was found in the

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52 I refer to Peruzzi for linguistic arguments: Peruzzi 1985, 43, 62.
53 See section 4.4.
54 Klein 1972; Buchner 1979, 135-8; Radgway 1992 a, 95.
55 See section 3.6.1.
56 Klein 1972, 36-7; See section 3.6.1.
57 Klein 1972, fig.5.
58 It would be interesting to have a more complete account on the lead pieces and the metalworking quarter at Pithekoussai.
acropolis dump at Monte di Vico which dates from the Middle Bronze Age to the first century BC. Therefore it unfortunately is from an inconclusive context.

To complete the comparison between Pithekoussai and Satricum it is necessary to recollect the fundamental difference between both sites. By the late 8th century BC, Pithekoussai was inhabited by both Greeks and Levantines while the population at Satricum was indigenous. The first archaeological evidence for measures in Italy both in weights as in volume derives from Pithekoussai, followed not much later by the evidence from Satricum. This indicates that trade between the indigenous population of central Italy and the Greeks/Levantines was to some extent regulated soon after their arrival in mainland Italy. It is open for debate whether this regulation was imposed by local authorities or was the result of common interests between foreign traders and the local elite. The southern connotation of the weights from Satricum points to mutual interests since the weights discovered do not appear to be based on locally developed measures. Nevertheless, the context in which the Roman-Oscan pound was found at Satricum, does not contain evident imported goods from the Levant or Greece and, therefore, indicates an indigenous framework (Figs. 68 to 70). The social stratification in central Italy is exemplified in the 'princely' tombs and was advanced enough to make regulation of exchange feasible. The weights and scale from Satricum imply that commercial contacts in Latium Vetus between a basically non-market oriented society, (the local population), and a more market adjusted economy, (the Levantine and Greek traders), were monitored for specific commodities, probably metals, from at least the second half of the 7th century BC.

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Ridgway 1992 a, 84-5.

See also section 4.3.
Another site with indications for the use of standard weights and containers is the pre-classical wreck in Campese Bay near Isola del Giglio. The excavation of this vessel was published in an interim report. The wreck is identified as a merchant ship and is dated around 600-590 BC. Because of the merchandise on board it is not surprising that some weights are reported. In addition to unworked amber and raw and worked metals, it contained transport amphorae from Etruria, East-Greece, Samos and from Phoenician-Punic centres though most of the amphorae were Etruscan. The ship also carried fine wares from Corinth, Sparta, Etruria and from East Greece as well as anchors made from a granite that is available on the Island of Giglio. The freshly dressed anchors were probably loaded onto the ship for trading purposes. On the basis of the commodities on board it is probable that the ship went from relay point to relay point, at each place both exchanging and loading merchandise. The three lead weights recovered from the wreck are not discussed in detail and unfortunately their weight is not mentioned. Bound believes that they were associated with scales. One of the weights from the ship (Fig. 71) has a similar shape to the weight from votive deposit I at Satricum (Fig. 65 b). Dr. Rendini from the Soprintendenza Archeologica Toscana has kindly informed me that this lead weight including the copper alloy arrowhead, weighs 352 g. Considering that one has to subtract the weight of the small hollow arrowhead but on the other hand must add the weight of the ring for suspension, this weight from the wreck at Campese Bay comes relatively close to the weight of the Roman-Attic pound from Satricum (Fig. 65 b). It can, therefore, be assumed that a metrological system existed in central Italy around 600 BC which included at least the unit of 341 g since this unit has been found at two separate sites. The presence on the ship of weights and various commodities including standardised vessels such as amphorae, substantiates the view that for certain commodities an early market exchange mechanism existed in central Italy around 600 BC. On account of the evidence presented above and based on the influx of gold, silver and ivory artifacts in central Italy during the Orientalising Period, I suggest that this mechanism developed soon after the arrival of Levantine and Greek traders on mainland Italy. By 600 BC the use of weight units was probably acknowledged at ports of trade and other trading places. The weights from the shipwreck and the weights mentioned at the beginning of this section demonstrate that both in Latium Vetus and in Etruria a system of quantification by measuring in pounds of copper alloy existed.

In addition to quantification by weights during transactions, some early Etruscan coins have been reported. However these early coins are controversial because they are limited in number and their date is often uncertain. The early coins that are known do not constitute a single homogenous monetary system. This correlates with the suggested scattered metrological systems. Important Etruscan towns such as Caere, Vulci and Veii never minted coins while, according to Crawford, Etruscan silver coinage from the 5th century BC may be assigned to Vulci. Panvini Rosati dates the early Etruscan coins to the late 5th and early 4th centuries BC and assigns an early mint to Populonia. Though the Etruscans were familiar with coinage, they did not employ coins for regular, local transactions. In addition, some Greek coins circulated in Etruria but this did not contribute either to monetary market conditions in central Italy before the 3rd century BC. At the end of 4th century BC, Rome started to strike issues of silver

61 Bound 1991.
64 See sections 4.5 and 4.6.
65 Crawford 1985, 2.
67 A regular monetary market mechanism is documented by substantial amounts of copper alloy coins of small denominations. These coins of little value attest that small purchases could be made on local markets. Such conditions did not arise in central Italy during the period 800 to 400 BC.
coinage but it is only after about 270 BC that there is a relatively regular sequence of Roman struck coins which were probably issued for payments to soldiers.68

Transfer of commodities can be accompanied by various exchange mechanisms such as gift exchange, barter and more commercial procedures such as exchange by quantification. A pre-monetary exchange mechanism based on scales, *aes rude* and weights, developed in central Italy from 700 BC. The evidence reported in this section implies that this system was adopted on a modest scale. On a regional and local level, transactions were probably still based on barter or set within a social context. These conditions must have affected the market function of the centres and towns. A direct relationship between craftsmen and consumers counters the emergence of middlemen such as stallholders and shopkeepers. The procedure *per aes et libram* on a regular base in a customary setting would have demonstrated the development of markets. However established markets are rarely reported in pre-Roman Italy and their evolution appears to be delayed until the 3rd century BC when coins began to be struck on a regular basis.69

4.3 Volume

The measures of capacity presented in this section are closely related to the weights which were discussed in the previous section. Both quantities are associated with regulated exchange that depended on fixed standards. Furthermore, one of the units of capacity, the *kotyle*, contains 273 ml which would weigh 273 g, the weight of the *Roman-Oscan* pound, when it is filled with water. As in the previous discussion on weights, a metrological assessment of ancient measures of capacity remains hypothetical. This is to some extent the result of the method applied. Measuring the contents of containers can be accomplished by several methods such as filling the jar with water or polystyrene granules. Another approach applied in this section is one of simple mathematical calculation.70 Based on an accurate drawing of the container whose volume is to be determined, a vertical line is drawn down the centre from base to rim which divides the vessel into two equal parts (Fig. 72). One half of the vessel in then subdivided in a multitude of horizontal sections. The volume of each of these sections can be calculated using the formula $V = \left[\frac{R_1 + R_2}{2}\right]^2 \pi h$.71 The sum of the volume of each section establishes the capacity of the whole container.

![Fig. 72. Illustration of a simple mathematical equation for the calculation of the volume of vessels.](image)

With regard to ancient measures of capacity, it is difficult to determine the level to which one has to calculate the content of a vessel. Some determine the capacity to the rim while others calculate it to the internal angle depending on vessel type and its application. Otherwise, it should be remembered that measures of capacity for liquids may differ from those for dry matter. Containers for liquids could be filled to one level (for example to the

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68 Crawford 1974, 44-5; 1985, 30-8.

69 See also section 4.6.

70 Rigois 1981.

71 $a$ and $b$ are the length of the lower and upper radius of each section, $\pi = 3.14$ and $h$ is the height of the section.
internal angle), while containers for dry matter might be filled to the rim. These variables lead to confusion when discussing ancient measures. In this context it is appropriate to recall that many medieval towns recognised the custom of measuring grain as a heaped measure of capacity. This medieval example confronts us with regulation of metrological custom as well as with a system of approximation. Both the ancient and medieval metrological practice indicate that our contemporary accuracy of standards which is regulated on a national and even worldwide level, cannot be applied without due regard to ancient customs. Because I am mainly interested in the adoption of known measures of capacity transmitted from the Near East or Greece to central Italy, it is possible to adopt an unconventional approach. The volume of the containers presented in this section are determined to the level at which they equal historically known units. Thus the calculation of the content of a vessel is concluded at levels which correspond with the volume of a Hin, Congius, Kotyle, Choinix etc. The adopted method cannot be applied to concealed, local measures or units which are not historically recorded. The research which is presented here does not attempt to decipher the intricacies of international and local metrological systems which were implemented in central Italy before the Romans. It is restricted to the archetypal liquid and dry capacity standards. I will argue that archaeological evidence indicates that measures of capacity were employed in central Italy at least from the 7th century BC. For this purpose, I start with a discussion of a study by Durando on the transport amphorae excavated at Pithekoussai. Durando judges that the existence of standardised metrological systems for commercial purposes during the late 8th and 7th centuries BC is hard to demonstrate. The calculated contents of the amphorae from Pithekoussai are quite diverse which makes it difficult to reveal the idea of commercial standardisation. Therefore it is more convincing to discuss metrological systems of the 8th and 7th centuries BC as standardisation by approximation. In spite of this assessment, he was able to identify some clusters of amphorae that were produced at Pithekoussai and which have approximately the same content. Durando implies that a Pithekoussan standard might have existed which was based on an Euboean unit. This corresponds with the early pre-monetary unit that was found at Pithekoussai. According to the excavators this weight corresponds with the weight of an Euboic-Attic stater. Moreover, he calculated that six Attic SOS amphorae from Pithekoussai contained between 51 and 52 l which is close to a duplication of 26.2 l, the Attic Metretes of the Classical period. Furthermore, it appears that the Kotyle, about 273 ml, was employed as a unit of volume from the 8th century BC. An amphora from grave 575 at Pithekoussai contained 200 units of a Kotyle. This amphora is of Greek type, is dated to the third quarter of the 8th century BC and is inscribed with three Semitic signs, two of which indicate that the amphora was originally a container of 200 units of liquid. Its capacity was calculated as 54,826 litres or 200 standard units of the Ionic-Attic Kotyle. Durando considers this amphora to be a one-off without parallel. He hesitates to transfer the units that were known in Classical Greece to the Orientalising Period. However the repeated implication of their use from the 8th century BC allows for the hypothesis that during the Orientalising Period, units and standards from the Near East were transmitted to both Greece and central Italy. I will argue that the adoption of these units by the Greek and Italian population took place during the Orientalising Period when the international trade as well as the development of the workshop mode of production required concepts of equivalence. As such the Orientalising

73 See section 4.5.
74 Durando 1989.
75 See section 4.2.
76 This amphora enclosed the inhumation of a baby, a rite often described as enchytrismos.
77 Ridgway 1992 a, 111-5.
78 Durando 1989, 81-4.
79 Durando 1989, 82.
Period constituted the formative stage of concepts which matured in later historic times. This is most distinct for the units of volume which all appear to have been adopted from archetypal liquid and dry capacity standards, already mentioned in the Old Testament (see table 3).

### Measures of Capacity for dry matter

<table>
<thead>
<tr>
<th>Old Testament</th>
<th>Greek</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Log</td>
<td>0.547 l</td>
</tr>
<tr>
<td>1 Qab = 4 Log</td>
<td>2.188 l</td>
</tr>
</tbody>
</table>

### Measures of Capacity for liquids

<table>
<thead>
<tr>
<th>Old Testament</th>
<th>Greek</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Hin</td>
<td>6.564 l</td>
</tr>
<tr>
<td>1 Ephah = 6 Hin</td>
<td>39.384 l</td>
</tr>
</tbody>
</table>

Table 3. Some archetypal liquid and dry capacity standards.80

The **Kotyle** (273 - 273.6 cc) and its double, the **Xeste** (546 - 547.2 cc), are used in the Greek system as unit of volume for both dry and liquid matter.81 The **Chous** is the wet measure and equivalent to three **Choinikes** in the dry system, since both contain twelve **Kotylai** (1 Chous = 3 Choinikes = 12 Kotylai = 3280 cc).82 The Romans used the **Sextarius** as a unit for dry and liquid matter which equals the **Log** and the **Xeste** (547 cc) in content. The Romans used the **Congius** for liquids which equals the Greek **Chous**.83

The archetypal system for capacity makes a discussion of its introduction in the various regions of the Mediterranean essential. As far as I know, the employment in Attica of the **Chous** as a unit of volume, can be shown from the 6th century BC.84 However for central Italy I will present some vessels which predate the 6th century BC **Chous** from Attica. I have concentrated on the content of jars which were marked by the potters before firing. This procedure of marking ceramic measures of capacity in a leather hard state is also reported for the Agora at Athens which can be considered the ultimate market place of the Classical world.85 The jars selected (Fig. 73) were all marked in antiquity and most likely intended to contain specific quantities.

Two vessels, one from **Satricum** and the other from Rome, contain 1 Hin (6.56 l) and 1 Congius (3.28 l) respectively at the internal angle. Both vessels were marked in antiquity before firing with an X and they date typologically to the late 7th century BC. Their archaeological context will be discussed below. Two other vessels, one from **Satricum** and the other from Veii, contain 1 Choinix (1.09 l) at the rim. These vessels are dated to the 6th century BC. Both jars were marked before firing, the jar from **Satricum** with four lines and the jar from Veii with some X tokens.

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81 Büsing 1982, 28.
82 Lang and Crosby 1964, 57.
83 Hultsch 1882, 704.
84 Stazio 1959, 560-1.
85 Lang and Crosby 1964, 57.
Jar no.1 (Fig. 73) was excavated at Satricum from the same context as the Roman-Oscan pound. The archaeological context of this jar is represented in Figure 67. Jar no.1 is immediately to the left of the square socketted iron axe and is represented as the jar with complete profile. Next to jar no.1 was another olla, which was also marked before firing with a token that is similar to the mark on jar no.1 (Fig. 70). Unfortunately a complete profile of this olla was not preserved. The dimensions of this jar as well as the mark suggest that the volume it could originally contain might be half the volume of jar no.1.

Jar no.2 (Fig. 73) was excavated on the Forum Romanum in the pozzo arcaico dell'area sacra di Vesta. From this pozzo several jars with complete profile were found which are at present on display in the Antiquario Forense.

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86 See section 4.2.

87 Bartoli 1961.
on the *Forum*. These *olle* are dated to the 7th and early 6th centuries BC.\(^88\) Jar no.2 is the only vessel in this collection that is marked. Its volume up to the internal angle is 3.28 l which equals the volume of the standard *Congius/Chous* and is half the volume of Jar no.1.

Jar no.3 (Fig. 73) was excavated in the last century at *Satricum* in votive deposit I. It derives from the same archaeological context as the balance and weight no.2 (Figs. 65 b and 66).\(^89\) The body of this jar was marked before firing with three vertical lines and one horizontal crossing stroke. The jar is dated typologically to the 6th century BC.\(^90\) A classical standard of volume for dry matter, the *Choinix*, contains 1090 cc, which equals the volume of four standard *Kotylai*. The four lines on this vessel may represent four *Kotylai* since its volume equals the volume of four *Kotylai*.

The *Choinix* is also the capacity of jar no.4 from Veii (Fig. 73). This jar is an isolated find but typologically it is dated to the second half of the 6th, early 5th centuries BC.\(^91\) It was marked before firing with an X, once on the exterior base and twice on the body.\(^92\)

Jars 3 and 4 from *Satricum* and Veii are equal in volume to the *Choinix* which corresponds to the content of 4 *Kotylai* employed for measuring dry goods such as grain.

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\(^88\) Colonna 1963-1964, 19.

\(^89\) See section 4.2.

\(^90\) Bouma 1996, 305-419.

\(^91\) *Grande Roma* 1990, 104.

\(^92\) Cavallotti Batchvarova 1965, 186.
vessels with signs cannot be deciphered as measures. Thousands of ancient containers were marked before or after firing with a simple sign such as a cross. Generally these signs are not interpreted explicitly. The marking of household vessels before firing was carried out in pottery workshops and most likely conveys a practical function. Simple signs on these vessels can be read as:

a. a numeral,
b. a method to separate a batch vessels in a pottery workshop,
c. a serial character,
d. an indication for dimensions or volume.93

Leaving aside the options a. to c., simple signs can specify plain vessels as measures of capacity. One of the best illustrations of this principle is a klepsydra from the Athenian agora marked with XX (Fig. 74). The vessel is dated to the 5th century BC and is a kind of water-clock filled with 2 Chous water which could drain from the vessel via a spout close to the base. A klepsydra was commonly used in the Athenian law courts from the end of the 5th century BC for restricting speaking time. One could speak in front of the court as long as the spout was draining water which is, starting with a klepsydra that contains two Chous, approximately 6 minutes.94

In my opinion, the vessels illustrated in Figure 73 represent specific quantities for various reasons. First of all, their content is equal to archetypal liquid and dry capacity standards. Besides, jar no.1 (Fig. 73) was found in the same archaeological context as the Roman-Oscan pound which is illustrated in Figure 65. Therefore this context contained originally at least two different early metrological standards. Moreover, it can be associated with the exchange of metal artefacts and organic or liquid matter. The exchange of these materials was quantified by concepts of equivalence as the weight and the measure of capacity. A third argument is provided by jar no.3 (Fig. 73). It was found at the turn of the century in votive deposit I at Satricum in the same complex as weight B and the jewellers balance (Figs. 65 b and 66). The weight, the pair of scales and the measure of capacity support the view that the religious authorities vouched for the value of metrological units. Furthermore jar no.3 was graded with four lines and its capacity corresponds with four Kotylai. The jars from Rome and Veii provide two parallels for the situation encountered at Satricum. The idea put forward of an early implementation of the historical metrological system for capacities in central Italy is, therefore, recorded at sites other than Satricum. It is suggested that the existence of units of capacity at other sites in central Italy besides Satricum points to a factual metrological system. This is supported by the evidence from amphorae trade. The indigenous population of central Italy was aware of standardisation from an early period since they were familiar with Phoenician amphorae. Several of these amphorae were found in Latium Vetus since 1970 AD. These amphorae signify Levantine trade with central Italy and were excavated in native contexts that are dated to the late 8th and 7th centuries BC. Several of these amphorae have been found in well furnished tombs at Laurentina, Ficana and Castel di Decima. A relatively high number of similar Phoenician amphorae were found at Sardinia and the comptoir of Pithekoussai while others were discovered at Mozia, Carthage and Toscanos.95 Botto considers that commerce with central Italy by foreign traders was directed from Pithekoussai as well as from the Phoenician colonies in south-west Sardinia. Whatever the origin of the various commodities, the increase in commerce with central Italy would have facilitated the implementation of the archetypal liquid and dry capacity standards.

93 Sassatelli 1994, 214.
94 Young 1939, 275.
95 Botto 1990, 208-9.
4.4 Length

Units of length are the last quantity to be discussed in this chapter. A review of the evidence for the implementation of linear measurements from an early period is more complicated than the previous discussion of units of weight and capacity. This is a result of the absence of rulers and a mass of seemingly unrelated information.\(^96\) The evidence derives from buildings and terracotta roof systems which foster standardisation since they are assembled from many prefabricated parts. The roofs are constructed from various components whose dimensions are usually directly related to each other. However the corpus of measurements of terracotta elements from various Archaic buildings in central Italy, are difficult to relate to particular units of length such as Roman, Oscan or other feet. Recently Wikander subjected the roof systems of central Italy to a study of terracotta modules.\(^97\) He indicates that there are no tile units even though some clusters of linear measurements could be recorded. Furthermore, Wikander mentions that ‘there may be a certain tendency in Late Archaic times towards the production of pan-tiles with dimensions close to 63 x 47 cm., but the extent of this development was limited and remained so.’\(^98\) The measurements of tiles are of little consequence for the examination of early linear measurements since it is assumed that the wooden frame of the houses was adjusted to the proportions of the terracotta components available. Wikanders’ research confirms that the mass of linear measurements from Archaic terracotta components is not yet suitable for reconstructing a coherent system for units of length. Nevertheless, Wikander does not reject the idea that the Italic or Oscan foot of 27 cm was employed while constructing the Archaic building at Poggio Civitate (Fig. 36). He is sceptical of the early use of terracotta modules and considers the evidence from Poggio Civitate as an isolated example. The application of the Italic or Oscan foot of 27 cm at this site is most explicit in the dimensions of the interior walls of the complex. These are given in Italic/Oscan feet as 160 by 150 and 149.5. The last figure is considered as an acceptable inaccuracy. Most of the architectural terracottas of the building correspond to the courtyard plan since the ceramic frieze plaques are all 54 cm and thus two Italic/Oscan feet in length. The width of the majority of the pan-tiles and lateral simas is also about 54 cm.\(^99\) Furthermore, the Italic/Oscan foot was employed while constructing the stoa workshop at Poggio Civitate which dates to the the third quarter of the 7th century BC.\(^100\) The pattern established indicates that a common standard of 27 cm was employed at Poggio Civitate from about 650 BC. This is supported by the other metrological evidence presented in section 4.2 and 4.3.

Other indications for the application of module systems during planning and constructing houses in central Italy, have been presented by Maaskant-Kleibrink.\(^101\) She made some schematic reconstructions of the layout of buildings excavated at Satricum. These reconstructions were compared with buildings from Acquarossa and Veii and Maaskant-Kleibrink submitted the view that a regular building system existed from the early Archaic period. Her proposed system has a basic unit of 4.80 m, which is 16 Roman feet.\(^102\)

The only documentary evidence for linear measures is from a much later date but confirms the use of both the

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\(^96\) Rottländer mentions a figurative image of the Pes Romanus from the 5th century BC, that is kept at Oxford and which is published by Wesenberg. The measurement given for this depiction of the Pes Romanus is 296 mm: Rottländer 1993, 125, table 2. I was unable to find additional references nor other details on this comment.

\(^97\) Wikander 1993 b.

\(^98\) Wikander 1993 b, 68.

\(^99\) Phillips 1993, 9, 19.

\(^100\) Nielsen 1987, 91.

\(^101\) Maaskant-Kleibrink 1991.

Oscan and Roman foot by the end of the Republic. Varro and Frontinus record that the Roman unit for land measurement was one of 120 by 120 feet. In Umbria, in Oscan territory and in Campania with its Oscan population, the *vorsus* was a unit of 100 by 100 Oscan feet.\(^{103}\)

The evidence on units of length suggests that from the 7th century BC standards were known but reluctantly applied. They may originally have been employed for limited purposes. On the other hand, the mould-made terracotta roof systems demonstrate an increase in linear standardisation based on their mode of production. Thus linear standardisation increased from the 7th century BC but is difficult to relate to specific units apart from the evidence discovered at Poggio Civitate.\(^{104}\)

4.5 *Marzabotto*

So far I have presented evidence for the early use of metrological systems that were based on units which were either archetypal or whose existence was confirmed in a later period by literary sources. The reconstruction of a local system of measures is only possible when sufficient evidence is available. The sole Etruscan town which revealed an adequate corpus of measures, is Marzabotto.\(^{105}\) A reconstruction of the means of exchange at this site is essential since it has abundant workshops. The mere existence of various of these workshops in the urban centre demonstrates that commodities were exchanged. Its early market mechanism by quantification has not been discussed before in detail except in the case of one of the metalworkshops which seems to have been actively involved in the manufacture of currency bars.\(^{106}\)

The weights known from Marzabotto, indicate a local system based on various stones and pebbles which are incised with numerals and marks (Fig. 75). The stones were collected at random in the last century and cannot be dated more precisely than to the second half of the 6th and 5th centuries BC. The lowest standard appears to be around 120 g while the two largest stones weigh about 38 kg, one of which is inscribed with the Etruscan family name *Lautunia*.\(^{107}\) The 24 published stone weights from Marzabotto seem to be a random collection of unrelated weights. However if one accepts an inaccuracy of about 5% then there is some regularity in their distribution (Fig. 76).\(^{108}\) For example, there are six stones which vary from 3.5 to 3.8 kg, which is equal to the smallest unit, 120 g, ± 5% multiplied by thirty. The stone weights reflect a metrological system by approximation which could be accounted for if one considers these weights not as consecrated, official units but as market weights. A market system of measures by approximation is also recorded for the *Agora* at Athens where a variation of 5 to 10% is given.\(^{109}\)

A determination of the local measures of capacity also requires a suitable collection of marked items, in this case containers with complete profile. The marked and inscribed vessels from Marzabotto were recently published

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\(^{103}\) Crawford 1985, 14. Crawford gives details on the passages in the ancient texts.

\(^{104}\) The section on length is confined because it is not directly related to pre-monetary exchange.

\(^{105}\) The data in this section derive from: Brizio 1889 and Sassatelli 1994.

\(^{106}\) See section 3.6.9.

\(^{107}\) Brizio 1889, 320, 343-4.

\(^{108}\) Eleven of the twenty-four weights that were reported by Brizio, are incorporated in the diagram of Figure 76. Most of the remaining thirteen marked stones can be interpreted with a unit of 120 g when an inaccuracy of ± 5% is accepted but their presentation is not convincing because they have not been preserved in pairs. The unit of 120 g is the greatest common divisor that I can discern. Some of the stones can not be interpreted.

\(^{109}\) Lang and Crosby 1964, 18, 47-8.
in detail by Sassatelli.\textsuperscript{110} It is characteristic that most of the marked ceramic vessels derive from workshop contexts. If these vessels convey measures of capacity, they may illustrate the exchange mechanism between workshop and customer in an Etruscan city. From the catalogue of marked ceramic vessels compiled by Sassatelli, I was able to abstract six bowls, three of which contain approximately two units of 120 ml while the other three bowls hold around three units of 120 ml (Fig. 77).\textsuperscript{111} This corresponds to the marks on some of the bowls. One bowl is inscribed with two lines and two other bowls with three lines. Figure 76 combines the evidence from Marzabotto in a diagram. On one side are the measures of capacity and on the other side the weights. From the diagram it is deduced that the inaccuracy of the units of volume is more than $\pm 5\%$. Actually, this imprecision corresponds with marked vessels from the \textit{Agora} at Athens where only some of the containers officially assessed can be considered reliable.\textsuperscript{112}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{fig75.png}
\caption{Marzabotto, incised and marked stones and pebbles that are interpreted as weights.}
\end{figure}

\textsuperscript{110} Sassatelli 1994.

\textsuperscript{111} I refer to section 4.3 for the mathematical method that was employed for the calculation of the capacity of the bowls.

\textsuperscript{112} Lang and Crosby 1964, 39-61. The inaccuracy is that large that one might wonder whether these marked vessels can be considered measures of volume. I decided to incorporate the bowls from Marzabotto in this section because:
- the conformity of weights and capacity by a unit of 120 g or ml, similar to the conformity between \textit{Kotyle} and \textit{Roman-Oscan} pound by a unit of 273 g or ml,
- the marks, some of which correspond with the quantity of units, two or three times the unit 120 ml.
Moreover, Lang and Crosby report related problems with the marked vessels from the \textit{Agora} at Athens.
Fig. 76. Marzabotto, diagram of measures of volume and weight.

Fig. 77. Marzabotto, marked bowls that could represent measures of capacity.
The examination of the marked objects from Marzabotto show that one of the mechanisms for local exchange was determined by quantification, probably at or near the workshops. Other mechanisms such as barter may have occurred as well. So far, the units that were calculated for this site are not known at other centres. Therefore they remain an isolated metrological system. It could be a local system because during the 5th century BC, most of the Etruscan early states became in economic terms increasingly independent. This corresponds with the considerable diversity of measures in central Italy once they developed from the international standards that I recorded for the Orientalising Period.113

4.6 Conclusion

The concepts of standardisation and metrology appeal to our notions of value, equivalence, measures, regulation, authority and ever expanding markets. However in many pre-capitalist societies, the ‘political elite tends to be the custodian of restricted exchange’.114 By 600 BC it appears that the religious authorities vouched for the value and content of fixed measures in central Italy. This elite controlled the metrological systems and simultaneously may have regulated the foreign access to the markets of central Italy.115

As such, metrological systems belong to the technical infrastructure of exchange and their development is usually associated with a marked expansion in the scale of consumption. Economic development such as described for the period 800 to 400 BC, is generally correlated with an increase in standardisation. Thus, the introduction of metrological systems during the 7th century BC is in accordance with the conspicuous consumption of the establishment in central Italy. During the Orientalising Period, the prominent members of society made by taste, a selection from imported goods and ideas while providing models and control for social discrimination and local production. Due to the increase in local demand, craft specialisation occurred which by itself necessitated exchange and the formulation of concepts of equivalence, weights and measures.116

Several metrological systems were recorded for central Italy in this chapter. However the evidence is scarce while the monetary system for market purposes developed at a later date. It seems that commodities were still transferred in their social context within a limited market structure. The measures which I was able to isolate, were essential for exchange by quantification. Hart describes the determination of value by quantification as exchange through the market system. It is a significant step in the abstraction of social labour and occurs often in a customary setting.117 The evidence so far collected suggests the early use of standards for exchange with outside traders and transactions of metal goods. As such, these standards functioned as a pre-monetary system since they grade metals by weight. Furthermore, the early use of measures of capacity imply organic commodities. From the evidence presented, I deduce that concepts of a commercial exchange mechanism for certain products existed in central Italy, though it remains open to debate how and to what extent these ideas were applied. It could be that they were originally intended for transactions with foreign trading communities such as the Levantines and Greeks. This suggestion is supported by the lack of evidence from the main Etruscan centres and the marked development of entrepôts such as Gravisca, Pyrgi and others. For example, Arafat and Morgan suggested that these highly ritualised entrepôts controlled foreign access to the markets of central Italy.118 These ports-of-trade functioned as an

113 Crawford 1985, 14. See sections 4.2 and 4.3.

114 Appadurai 1986, 33.

115 See section 1.7.

116 Renfrew 1972, 493.

117 Hart 1982, 40-1. See also section 1.7.

institutional means of restricting the zone of commodity exchange. Internal distribution of commodities could have been structured along other lines. The spheres of exchange of prestige and subsistence items are likely to have been independent of each other. This separation can, however, never have been absolute. Appadurai states that ‘many societies create specialised arenas for tournaments of value in which specialised commodity tokens are traded, and such trade, through the economies of status, power, or wealth, affects more mundane commodity flows’.

The evidence from 5th century BC Marzabotto suggests that the various workshops were directly involved in the exchange of their commodities and that quantified measures were involved.

An enigma remains the customary setting in which market transactions proceeded in central Italy during this period. The emporia along the coast of Etruria functioned as markets for external trade while early markets for internal exchange in the primary centres are yet to be defined. It seems that these markets may have developed around some of the sanctuaries. At Latium Vetus these have been termed ‘emporic sanctuaries’ and this corresponds with the highly ritualised setting of the factual emporia along the coast. Clear examples of such sanctuaries are those at St. Omobono in Rome, St. Cecilia in Anagni and the sanctuary on the acropolis at Satricum. The term ‘emporic sanctuary’ is misleading for this study because it does not correspond with the description of emporia presented in section 1.7 because the presence of foreign trading communities near these sanctuaries though implied, is not recorded. Moreover, these sanctuaries clearly functioned within a local framework. Therefore I will not employ the phrase ‘emporic sanctuaries’ but rather early or incipient fora because these locations combine religious, public and market functions like the fora of later periods. The difference between the incipient and later fora is their grandeur. The early fora are marked by monumental sanctuaries which received imports from various regions. However the structures associated with market functions are not clear whereas the later fora are characterised by temples, shops and porticoed squares. These features are less evident at the incipient fora though the last major reconstruction of the layout of the acropolis at Satricum around 500 BC might present an illustration of the stages involved.

The implementation of measures is related to a pre-monetary exchange mechanism based on metallic weight standards and measures of capacity. Several of these metrological units were found at the Latin site of Satricum. The Roman-Oscan pound was found together with a jar with a capacity of one Hin, in a settlement context dated to the second half of the 7th century BC. The Campanian pound was found in votive deposit I which is dated from the 8th to 6th centuries BC. Moreover, a pair of precision scales and a jar with a capacity of one Choinix, were discovered in the same deposit. These implements were discussed in detail relating them to their archaeological context and the economy of the site. In connection with the measures from Satricum, two aspects of the economy, local production and trade, are essential. Both aspects are examined for the site and revealed a close parallel with circumstances at Pithekoussai where an Euboean weight standard was excavated in the metal-working quarter dated to the early 7th century BC. Systems of weights are initially tools of industry and ultimately trade. The association of early

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119 Appadurai 1986, 50.
121 cf. Coarelli 1988 a.
124 During this last reconstruction the temple area was elaborated with stoai which replaced the courtyard houses: Maaskant-Kleibrink 1992, 139-44. See on early markets also the Epilogue, Chapter V.
125 Petruso 1978, 163. Illustrations of the close relation between workshops with weights and balances are from all periods. They are known from workshop contexts in Mesopotamia that are dated to about 2000 BC, on Crete where a tomb of late Minoan date contained besides other
weights and measures with the workshops at Pithekoussai, Satricum and Poggio Civitate shows that craftsmen were directly involved in the transmission of these units of equivalence. They were instrumental for the dispersion of the concept of quantitative exchange as they were for the transmission of writing. Their role in cognitive information indicates that craftsmen were not of subordinate status during this period. It indicates that they were independent and played an active role in the spread of concepts and general knowledge. Furthermore, the metrological evidence from Pithekoussai and the shipwreck at Isola del Giglio were presented in order to substantiate the concept of exchange by quantification in Italy itself. Thus, the evidence for measures from Satricum could be related to the Mediterranean exchange mechanism during the Orientalising Period.

Wikander and Durando labelled some of the units of capacity and length, one-off isolated examples. In my opinion the evidence presented constitutes too many isolated examples to be dismissed as accidental. The corresponding units at Pithekoussai, Satricum, the pre-classical wreck at Campese Bay, Rome and Veii add up to the hypothesis that measures were known and implemented in central Italy during the Orientalising and Archaic periods. As previously mentioned, it remains open to debate how and to what extent these measures were employed.

The metrological systems which have been described, indicate an integrated character. The system for capacities is based on the volume of the Kotyle, about 273 cc, while the Roman-Oscan pound has the weight of a Kotyle filled with water, that is 273 g. According to Haeberlin, the Oscar pound derived from Babylonian and later Phoenician weight-systems. The Oscar pound of 273 g descended from the original subdivision of the Talent of 32745 g in sixty Mina which equals 120 Oscar pounds. I am unable to disentangle the several inextricably linked Babylonian and Levantine weight standards and other metrological systems, to which all Mediterranean and even some modern measures seem to be related. To present an example of the complexities involved I elaborate on the integrated nature of Kotyle and Roman-Oscan pound. Büsing mentions that, in antiquity, one Kotyle water would have had a weight of 60 drachm which means that a Drachma weighs 4.55 g. The Attic measure of weight of 4.55 g. was the unit of numerous market weights discovered on the Athenian Agora. Moreover, the Drachma unit of 4.55 g. was employed for the gold staters of Pantikapaion which are dated to the second half of the 4th century BC. This weight-unit can also be related to Roman coins from the late 3rd century BC. The Roman-Oscan pound of 273 g is subdivided as one pound of silver into 60 denarii of 4.55 g. The early Roman silver denarius did indeed weigh 4.55 g. This basic conformity and the early use of the Roman-Oscan pound in central Italy suggests the existence of an integral, archetypal metrological system for the Mediterranean during the Orientalising Period. This system is most likely to be related to the Levantine trading diaspora which explicitly regulated exchange with indigenous tools for working precious metals, crystal lenses with a magnification of 10X, a bronze scale and 3 weights while scales and weights might also be depicted in workshop contexts on for example, Egyptian or Roman reliefs: Moorey 1994, 84; Renfrew 1972, 340-5; Neuburger 1926, 33-68.

127 cf. Wikander, Ö., 1993 b, 70; Durando 1989, 82.
128 Haeberlin 1909, 1, 31-2.
129 cf. McDonald 1992. For example, I traced two similar weights from Mesopotamia which might in theory be related to the Roman-Oscan pound. These weights were recovered at Susa and were listed by: Karwiese 1990. Karwiese presented one third of a total of 560 weights which were found at this site. Among these weights there are two of about 270 g. One was made of chalkstone in the shape of corn, 271 g, while the other is made from sandstone in the shape of a duck, 272 g. However, these weights are dated to the third and second millennium BC and cannot be transferred without intermediate stages, to central Italy during the Orientalising Period. Moreover, the standard of Susa is calculated to be around 504 and 510 g and this standard can not be directly correlated to the early weights from central Italy. See: Karwiese 1990, 68-71, 108.
130 This Drachma corresponds with an Attic measure of weight and should not be understood as the weight of the Attic drachma coin of 4.36 g.
Asylum was granted at sanctuaries which during this period, functioned partly as meeting points between the different economic zones. With the advance of regional trade and urban development this system might have been broken up into several, local varieties. This projected development would correspond with one of the characteristics of standardisation since standards require revision depending on particular circumstances.

I have mainly concentrated on an economical interpretation of the origins of coinage as fixed metallic monetary units. As an illustration of this principle, one can quote Aristotle, who wrote a passage on trade and currencies in the *Politeia*. Aristotle mentions that: 'The supply of men's needs came to depend on more foreign sources as men began to import for themselves what they lacked and to export what they had in superabundance; and in this way the use of a money currency was inevitably instituted. The reason for this institution of a currency was that all the naturally necessary commodities were not easily portable and men therefore agreed, for the purpose of their exchanges, to give and receive some commodity which itself belonged to the category of useful things and possessed the advantage of being easily handled for the purpose of getting the necessities of life. Such commodities were iron, silver and other similar metals. At first their value was simply determined by their size and weight; but finally a stamp was imposed on the metal which, serving as a definite indication of the quantity, would save men the trouble of determining the value on each occasion.'

Aristotle described a sequence of mechanisms for exchange. Originally men reciprocated 'naturally necessary commodities'. After this stage goods were exchanged for metals by size and weight. This phase corresponds with stage 5 in the sequence of commoditisation described in section 1.7. In antiquity, iron spits or *obeloi* are recorded as a proto-monetary system of value at sanctuaries such as the Argive Heraion and the Apollo sanctuary at Delphi. Nevertheless, most of these spits in sanctuaries and tombs are related to the roasting of meat during banquets. Strøm argues on the basis of archaeological and epigraphical evidence, that the transition to the proto-monetary system of *drachmai* consisting of six *obeloi*, is closely related to exchange activities with the Near East as well as with the assimilation of the Near Eastern banquet at Greek sanctuaries around 700 BC. Standardised units of six *obeloi* were eventually replaced by the institution of coinage. Strøms' reconstruction reflects conditions in central Italy because both the banquet and pre-monetary exchange mechanisms were introduced during the same period. Moreover, it supports the hypothesis that sanctuaries were essential as locations for the transmission of goods and ideas. However the communities in central Italy adopted coinage slowly. They maintained the system in which some commodities were exchanged for metals by weight. The preservation of this mode of exchange during the 5th and 4th centuries BC is one of the archaic features of the economy of central Italy. The Etruscan communities accepted occasionally coinage and even struck some issues during the 5th and 4th centuries BC but these early coins did not include smaller denominations and, therefore, were hardly suitable for routine market purposes. Some of the archaic characteristics of the economy can be associated with the decrease in 'international' trade with central Italy. Measured by the imported pottery, this trade was restricted in *Latium Vetus* from 600 BC while it ceased in Etruria during the 5th century BC. The economy of the early states in central Italy became essentially independent. During the 5th century BC, the towns became primarily economic and political centres for their territories while imported goods were relatively scarce. The economy, including the workshops,
became structured along with the urban and regional polities and thus reduced the need, for the institution of coinage. The self-sufficient economy of these polities accounts for the development of local metrological systems such as found in Marzabotto.

In general terms, the 6th century BC was a period of transition between on one hand the long-distance and inter-regional trade of the 7th century BC with their archetypal metrological systems, and on the other hand, the scattered systems of the 5th century BC that are probably related to the early states of central Italy. This conforms with the change in production and markets. During the 6th century BC, the advance of the workshop mode of production is recorded simultaneously with a shift in the nature of goods. The workshops were no longer involved in the production of luxury goods. Instead they produced primarily common household commodities. I mentioned above that the polities in central Italy of the 5th century BC did not develop a monetary system except for a few specific coins. Neither did they become fully literary as Classical Athens, the capital of the Ancient World. In central Italy markets seem, therefore, rudimentary and I have described some of them as incipient fora. The evidence from Marzabotto indicates another option since exchange at this site was probably still closely associated with individual workshops along some of the towns' major roads.

I presented an economic interpretation of measures but this view can be augmented with an ethical meaning. The development of these measures belongs in the 'framework of the development of social relations and the definition of values'. The evolution of an urban community cannot occur without the existence and implementation of norms known to all inhabitants. The employment of units as argued here, corresponds with the context of urbanisation in central Italy during the period 800 to 400 BC.

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139 Austin and Vidal-Naquet 1977, 56.