Price Behaviour in the Roman Empire*

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*Prepared for the conference on 'Long-Term Quantification in Mediterranean Ancient History', Brussels, October 2009. I thank Roger Bagnall, Walter Scheidel and members of the Columbia Workshop on Economics for Ancient History organized by William V. Harris, Columbia University, June 2009, for helpful suggestions.

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Despite a great scarcity of price data for the Roman Empire, ancient historians appear to have conventional opinions about its behaviour. Prices were stable, which includes growing at only one or two percent a year, from the Late Republic though the second century of the Empire. In fact, the onset of inflation after that time is one of the markers of the transition from the Early to the Late Roman Empire.

There also is a conventional view of the inflation, that it was the result of currency debasement, expressed often through graphs like Figure 1. Howgego (1995, 123), however, argues that we should be 'cautious about theories which imply a simple relationship between the coin supply and prices'. There must be some relationship between the coin supply and prices; our task is to illuminate it. Lendon (1990) for example argued that we only know about inflation in Egypt and denies any relation at all between inflation and either the fineness of coins or their quantity, attributing inflation to an erosion of public confidence. Howgego's well-advised caution should not lead us to throw out the baby with the bathwater, and I propose an intermediate theory here.

Indices

Hopkins (1980) is justifiably famous for the taxes and trade theory. It also is noteworthy for the introduction of various indices of Roman economic activity as well as an index of the money supply, that is, coins in circulation. I propose to avoid the hazards of estimating the ancient money supply and instead to gather the scarce price evidence that we have into an index of inflation. Given the scarcity of price data, I do not attempt

to estimate the rate of inflation in the index, but only to distinguish between two states of affairs. The first state is price stability, meaning prices that change less than two percent a year. Stability in this sense would appear to any person living through it as price stability. The second state is inflation, meaning prices that change more rapidly. To the best of our knowledge, prices changed much more rapidly in the third century, and there is no problem of deciding which state the economy was in. This procedure keeps us from having to estimate the rate of inflation and from deciding if the rate of inflation was constant or varying over time.

Before we examine the sparse evidence for Roman prices, we need to distinguish between market and administered prices. Market prices are the results of purchases and sales in markets. They are free to vary over time. In fact, the distinguishing characteristic of market prices is that it is not possible to predict the future variation of prices in advance. We may suspect that inflation will continue over the next decade, but it is impossible to know today if a particular price will be higher or lower tomorrow. In the jargon of economics, market prices move in a 'random walk', in which the variation from this period to the next is a random variable. (If inflation is expected, prices may move in a 'random walk with drift'.) Administered prices, by contrast, change only infrequently. Tomorrow's price will be exactly the same as today's, except for the rare occasions when the administrative prices are changed.

There are not enough Roman prices to make a firm distinction between these two varieties of prices, but about 3,000 prices have survived for Hellenistic Babylon, spread over six commodities for about 400 years and ending about fifty years before the end of the Roman Republic. These prices can be tested to see if they moved in a random walk,

that is, if they were market prices. The test showed that they moved in a random walk and were market prices (Temin 2002). Babylon was not Rome, but the fortunate survival of many Babylonian prices reveals to us that market prices were widespread in the ancient world. I infer that the scarce Roman observations that resemble market prices were in fact market prices.

There also are administered Roman prices, such as census classes and army pay scale. These prices did not move in random walks; they stayed constant for long periods of time. When they did change, I regard the changes as responses to previous inflation. In other words, I presume that the administered prices only changed when market prices had changed enough to render the administrative prices dysfunctional. This implies that inflation *preceded* changes in administrative prices; the changes in administered prices were the result of inflation, not its cause.

Coinage was widespread in Roman areas by the end of the Babylonian prices series. The earliest prices we seem to have are the casual values Polybius was told about on his travels. Rickman (1980) regarded these few observations as reliable in his brief survey of wheat prices around the Mediterranean. Kessler and Temin (2008) used these and a few other price observations in an analysis of relative prices around the Roman sea. The implicit assumption in that study was that prices remained sufficiently stable in the late Republic and early Empire that their pattern was due to the effects of location rather than inflation.

There are two ways to see that these few prices indicate price stability. Rickman compared them to a notional price of wheat in Rome. Market prices in the capital city were complicated by the *annona* and not easily available, and Rickman's prices need to

be seen as a modern educated guesses. He said that the price of wheat was between three and four sesterces per modius around 150 BCE and between five and six sesterces two centuries later in the early Empire. This is an increase of about 50 percent in two centuries. An inflation rate of one percent a year doubles prices in 70 years, and this assumption implies a long—approximately three century long—period of stable Roman prices. In addition, Kessler and Temin were able to show that these prices from all over the Mediterranean fit into a coherent pattern of low prices far from Rome and higher prices in and around the metropolis. In other words, the pattern of stable prices was stable throughout the Mediterranean area for these centuries.

I therefore show no inflation for this period in Table 1. Historians often phrase this assumption as inflation of one percent a year. This seems very little, but it implies more price change over these three centuries than is observed in the few prices we have. Rathbone (1997, 2007) said that prices were stable. Hollander (2007, 153) followed Burnett's (1987) conclusion that prices doubled in three centuries. Scheidel (2009) assumed inflation at the slow rate of one percent. Such a long period of price stability is not unique. Clark (2007, 156) showed that English prices remained largely stable for five centuries from 1200 to 1700 CE, with inflation only over one percent during the price revolution of the 16th century. Even then, the rate of inflation generally stayed below two percent per year. Price stability in highly monetized agrarian societies may be unusual, but it is not particular to ancient Rome.

This long period of price stability came to an end at the end of the second century CE. This much is commonly accepted in the literature, although the evidence—while more abundant than for earlier years—is less direct than we would like. Many historians

have reasoned that the debasement of the coinage must have led to inflation, citing evidence like the well-known graph in Figure 1. This of course is only indirect evidence, and price data would be a far better indicator of inflation than the silver content of the currency.

Some market prices have survived from Egypt, which was connected to the rest of the Roman Empire in a complex way. Administered prices are known for the rest of the Empire, but they pose questions about the underlying rate of inflation as discussed earlier. Harl (1996, Chapter 11) described many market and administered prices both while they were stable and during the inflation, but he did not assemble them into any kind of price index.

Rathbone (2007, 713) summarized the start of inflation in Egypt: 'The price bands for other [non-wine] goods and wages display a remarkable stability from the AD 70s to the 160s, and then again from the 190s to AD 174. … The sharp doubling of prices and wages in the later second century is best explained as a sign of temporary economic dislocation caused by the Antonine Plague'. Rathbone's graph of these prices is shown here as Figure 2. Rathbone interpreted the scarce data as the result of sharp bursts of inflation, not of a continuous process. He also notes the importance of the Antonine Plague, although the mechanism by which plague causes inflation is not clear.

Bagnall (1985, 64) started his survey of Egyptian prices in the fourth century. He found continuing, rapid inflation for the first two-thirds of the fourth century. The price of wheat rose from under 2,000 drachmas per artaba at the beginning of the century to almost close to 1,400 talents (each worth 6,000 drachmas) by 360. That is an increase of 6,000 in less than two-thirds of a century, confirmed by a few more prices for the same

time period in Bagnall (1997, 226). The large number of drachmas needed to purchase a small quantity of wheat raises important questions about the nature of inflation. We do not believe that people brought over eight million drachmas with them to buy an artaba of wheat.

It is possible that transactions were being done in gold by 360. A far smaller weight of gold than of silver or debased silver coins would be needed to make this purchase. But this possibility only raises further questions. The solidus maintained its weight and purity for seven centuries (Jones, 1974, 203). That makes the gold coins good money, while the debased silver ones clearly were bad money. Gresham's Law tells us that bad money drives out good, and the silver coins should have driven out the solidus. Presumably there came a time when the solidus replaced the successors of the denarius, but we cannot pin down the timing from the scarce records of transactions. Banaji (2001, 45) stated that, 'The most important change in the monetary system in the late empire was of course the introduction of a stable gold coinage and its progressive diffusion as a mass currency'.

This does not tell us the rate at which gold took over from the debased silver coinage or how small purchases were made, and there are very few examples of gold prices in the fourth century. Roman soldiers apparently were paid in gold, as revealed by Julian's changes in mid-century, but their pay consisted of very few solidi, exposing the issue of how they were spent (Kent, 1956, 193). Whittaker (1980) and Bowman (1980) discuss the problem of stable gold prices and rising silver ones without reaching any conclusions. Were solidi functioning as real payments, that is, payments adjusted for inflation, in an inflationary world? Or were they the main currency?

Purchases may have been made by some form of credit, and silver prices were used to keep accounts rather than to indicate numbers of coins. Unless there were offsetting credit entries, coins must have been used at some point, raising questions similar to those arising from the first possibility. I take Bagnall's data at face value in the absence of answers to these questions and indicate the presence of inflation from the late second century through the third century.

These Egyptian market prices can be supplemented by some non-Egyptian administered prices for confirmation. The pay for the Roman Army is the most well-attested and long-lived of the administrative prices that have survived. Although Speidel (1992) and Alston (1994) disagree about the level of the base pay, they agree on the timing of changes, which is the important point here. Base pay was established by Augustus and was increased by Domitian (in 84 CE), Severus (197), Caracalla (212) and Maximinus Thrax (235). I assume that these prices were adjusted when the pay became dysfunctional, that is, when prices of goods and services that soldiers would buy increased so much that the pay for legionnaires no longer attracted enough of them. Inflation by this assumption preceded each of the rises in administered pay. That leads to the entries for army pay in Table 1. The pattern echoes that of the Egyptian prices. There was price stability before the late second century with the exception of Domitian's pay hike. After that, the other increases correspond roughly with the Egyptian evidence of inflation in the third century, although they show inflation continuing during the apparent Egyptian price stability in the first half of the century.

Wheat is a good index of inflation because its quality does not vary much over time and it forms a large part of ordinary diets. Army pay is not consumed, and it is a

good proxy for general inflation only if the relative price of soldiers, that is, the purchasing power of legionnaire wages, did not change. There were many wars in the third century, and the size of the Roman army probably increased. It is possible therefore that the emperors increased army pay in order to attract more workers to be soldiers, not to keep up with inflation. If so, then the Egyptian data may give a better index of inflation than army pay in the second century. This caveat illustrates one of the difficulties with quantification in the ancient world. We know the history and its implication that army pay may have risen relative to, say, the price of wheat, but we do not have a measure with which to calibrate how important this implication was. Rathbone (1996. 323) cautiously suggests the dilemma is not large, stating: 'I am prepared to believe in a cumulative increase [in army pay] of about 100%, which more or less compensated for the severe bout of price-inflation in the late second century'. We face the uncomfortable choice of either accepting army pay and ignoring this complication or throwing it out as a poor proxy for inflation. I am reluctant to discard potentially useful information, and I include army pay as a proxy for inflation in Table 1.

What accounts for the anomalous army pay hike by Domitian? I suggest that it was the result of inflationary troubles under and just after Nero. The start of these troubles was the fire that consumed the city of Rome in 64 CE. Nero needed resources to rebuild the capital city, and he did not have a quick way to increase the coinage. Instead, he debased the currency, and it is reasonable 'to assume that the reform was intended to enable the government, either by extensive recoinage or by more profitable use of existing bullion stocks, to achieve more with the same resources (Griffin, 1984, 198)'.

Nero reduced the silver content of the denarius from 3.65 grams to three, a level that was more or less maintained by his successors (Howgego, 1995, 116). Roman citizens may not have realized that the denarius contained less silver immediately, but they would have been aware quickly that the government was spending more. Whether because people realized the currency had been devalued or because of the extra expenditures, inflation probably increased. After 20 years, Domitian apparently was having trouble recruiting legionnaires, and he raised their pay. Nero's inflationary pressure must have dissipated over time to allow the new pay scale to last for a century; it was not the start of continuing inflation.

How rapid was the inflation once it became endemic toward the end of the second century? The sources indicate large apparent jumps in prices, but the period we are discussing also is long. An idea of the average rate of inflation in the third century can be obtained from Diocletian's Edict of 301 CE. It listed the price of wheat as 100 denarii, far higher than the prices analyzed by Rickman (1980). Jones (1974, 200-01) described this contrast as follows: 'The figure of 100 denarii is therefore comparable with the low average price of the first and second centuries, half a denarius. The price had then gone up about 200 times in a century and a half'.

The calculations in Table 2 translate Jones' comparison into annual rates of inflation. The first column lists various rates of inflation. The second column translates these rates into multipliers that can be used to convert prices in one year into those of the next year at the different rates of inflation. The third column gives the time period suggested by Jones. The final column calculates how much each rate of inflation in the first column raises prices after 150 years; it raises the multiplier in the third column to the

power of the number of years in the fourth column. For example, at an inflation rate of one percent a year, prices only increase by a factor of four in a century and a half. But at an inflation rate of four percent a year, prices increase by a factor of almost 360 over a century and a half. The average rate of inflation from about 150 to 300 was just over 3.5 percent a year according to Jones. If the initial price was higher than Jones asserted or the final price lower as Duncan-Jones (1982, 66n4) suggested, then the average rate of inflation was lower. If we follow Rathbone and assert that prices began to rise later in the second century, then there was less time for them to rise to the heights of the Diocletian Edict, and the average rate of inflation was higher for a shorter time period. The precise number is not important; its order of magnitude is. This was high enough to be noticed at the time, as the European Price Revolution of the sixteenth century was noticed, but it is very far from a hyperinflation. Cagan (1956) defined a hyperinflation as more than 50 percent inflation per *month* in his classic work on modern hyperinflations—clearly a different phenomenon.

The same calculation can be used backwards to understand the rate of inflation implied by Bagnall's data. For prices to rise by a factor of about 4,000 in 55 years, the annual inflation rate must have been about 15 or 16 percent a year. There appears to have been an acceleration of inflation in the fourth century, although still nothing approaching a hyperinflation. People definitely would have noticed this kind of inflation, although it would not have prompted a flight from money like a hyperinflation. Given the limited data and questions about the relevance of silver prices, it is hard to tell if the apparent acceleration represents an intensification of long-run inflationary forces.

Instead of correlating prices with debasement, I propose an index of political instability to compare with the index of inflation. The new index counts the number of Imperial emperors in each half century. The list is conventional, taken off the Internet, supplemented with biographical information when necessary. There are four variants of this index, all showing essentially the same picture. Two indices divide centuries; the other two start in 25 BCE to correspond more closely with the start of the Empire and to make sure that using centuries does not affect the pattern. For each starting date, one index counts all emperors proclaimed by the army; the other only counts emperors confirmed by the Senate.

The four indices appear in Table 3 and reveal the same pattern. The number of emperors in each half-century stayed in single digits until some time late in the second century, after which it stayed in double digits until 500 CE. This pattern is very similar to the pattern revealed in the index of inflation in Table 1. As with the index of inflation, there are complications here. Turnover of emperors does not indicate political instability if they all die in their sleep. One way to see if the rising number of emperors indicates dynastic conflicts is to examine the differences between the two emperor counts. If there were more emperors recognized by their legions but not the senate, this indicates conflict and instability. The difference between the two series rises from zero in the first two centuries to two in the third century and even higher late in the fourth century, providing additional evidence of the growing instability suggested by the number of emperors in any time period.

In addition, there were co-emperors starting in the late third century and separate emperors in the east and west empire starting a century later. The increase in the number

of emperors therefore may indicate administrative needs rather than political instability. If so, then the fourth century was more stable than the indices suggest. This correction suggests that the indices in Table 3 may overstate political instability in the fourth century. The large number of emperors and the growing difference between the two emperor counts indicate renewed political instability in the fifth century.

The difference between the indices in Table 3 indicate that we cannot define with precision the change from the stable political regime to the less stable regime starting in the late second century. Different definitions and time periods generate more differences in the period of transition than in more stable years. If we desire to have more precision of the timing, we will need more information to know if, for example, the auction of the Empire after the murder of Pertinax in 193 was a new norm for the Empire..

Stability

These indices raise two questions that must be addressed. The first question is how the Roman Empire—and the late Roman Republic before it—maintained more or less stable prices. Having lived through the inflationary twentieth century, we want to know how the Romans avoided that condition for so long without knowing any of our modern economic rules. The second question is why this long reign of stable prices came to an end in the late second century. These are very different questions that may be expected to have very different answers. Since the two questions refer to adjacent periods of the same political entity, good answers to the two questions should be compatible.

Lo Cascio (1981, 85) suggested thirty years ago that the Roman government was interested in monetary stability: 'It was particularly by … the adjustment of the weight and fineness of an entire issue that the Roman government tried, mostly with success, to counterbalance the negative effects on the coins of a changing ratio between the metals'. The desired stability extended beyond the supply of small change to include, according to Lo Cascio, army pay and 'even financial relationships among the aristocracy'.

The more general point is embarrassingly contemporary. 'In time of crisis, lack of liquidity brings about a sharp rise in the rate of interest and a fall in land prices, and it becomes difficult to repay debt (Lo Cascio 1981, 85)'. One needs only interpret the rate of interest to mean the return on risky assets and land to mean include houses to see ancient crises as a distant precursor of 2008. The Tiberian response to the crisis of 33 CE, to flood the economy with liquidity, is the same as 2009 U.S. Federal Reserve System policy. Given the similarity of ancient and modern crises and policies, it is illuminating to apply modern tools to the analysis of ancient problems. I discuss the problem of bimetallic stability first and then progress to more general monetary stability.

Gresham's Law tells us that bad money drives out good money. Bad money in this phrase is coinage that is worth more as coinage than the metal contained in the coins is worth as bullion. Good money is the reverse, currency that is worth as much or more as bullion than as coins. Good money gets melted down for the metal it contains, while no one melts down bad money. The only way to keep a full bimetallic currency going is to have the relative value of coins of different metals exactly mirror the market price of the metals in the coins. If market prices change or if the ratio is set wrong, then bad money drives out good—and the economy is on a single metal standard. The United

States, for example, was nominally on a bimetallic standard for much of the 19th century. Gold however was worth more as gold than as dollars initially, and the country was on a silver standard. When gold was discovered in California in 1849, the price of gold fell and gold became bad money. The United States shifted to a gold standard, confirmed when the coinage law of 1873 omitted the silver dollar from the coins to be minted (Nussbaum 1967).

We see changes in Roman coinage, but we do not have the information on causation that we have for modern coinage changes. We therefore observe changes in coinage and use Gresham's Law to infer what must have happened on the market. In about 140 BCE, the denarius was retariffed from 10 to 16 asses. The silver denarius was raised in official value relative to the bronze as. Our modern presumption is that the relative price of silver was rising. As the relative price of silver rose, the denarius turned into good money. Denarii must have been getting scarce as they were melted down to recover the silver they contained. The retariffing was an effort to keep the currency on a silver standard and not let it go onto a copper or bronze one. The Roman government performed a number of similar revaluations designed in this case to keep the supply of small change from taking over the monetary standard and in other cases to reflect changing market prices of silver and gold (L o Cascio, 1981).

Gresham's Law depends on there being markets for the metals used for currency. We know little about the market for non-monetary silver and infer its existence from currency changes. It is hard to believe that there was much non-monetary silver in use, given how hard it was to mine silver in the ancient world (Rihll 2001). There were agricultural and manufactured goods whose traces we see more clearly in the records that

have survived. The question is whether the Roman government intervened to keep the value of money constant, that is to maintain the relative price of silver and, say, wheat. If the price of silver rose—that is, if there was actual or threatened deflation—did the government mint more denarii?

I do not think that the Roman government thought in these terms, but I suggest that a simple monetary rule would have produced the same effect. Assume that the government minted more denarii or debased existing denarii if it needed more resources in a hurry when it ran short. This rule does not require that the emperor thought about the price level at all; he simply looked at his own demand for money. As the Pax Romana expanded and more people used currency based on the denarius, the emperor found that he was losing his currency to the provinces. He minted more money to keep up with his own demand. Nero needed money in a hurry, and he devalued the denarius instead of minting more coins to the old standard. We presume that this did not lead to a general inflation because the demand for money was rising fast enough at the time to absorb the increase in the number of denarii in circulation.

This monetary rule works well when the economy and the demand for money are expanding. What happens if the economy is declining? If the emperor needed more money quickly, like Nero, he would debase the denarius. But if the economy was not expanding, there would be more money for the same or smaller amount of goods. The result would be inflation. If emperors needed money frequently to defend their rule or if putative emperors needed money frequently to attack existing rulers, then the rule indicates successive debasements and resulting inflation.

This simple rule of thumb leads to a rule that can explain both price stability and price inflation. When the economy was expanding and the government was stable, the government's need for money was consistent with stable prices. But when the economy was not expanding and government was less stable, the demand for money at the centre generated too much money to keep prices stable. The question then is why the economy and price behaviour shifted from a stable to an inflationary regime.

Identification

I turn therefore to the second question about prices: why did stable prices give way to inflation at the end of the second century? To answer this question, I need to take a small detour into modern economic theory. The similarity of the two indices shown in Tables 1 and 3 suggests there is a relationship between them. Economists have created methods to infer more complex interactions than just correlation. They refer to this task as the identification process, meaning the need to identify the direction of causation between the variables. There are three possibilities. It is possible that political instability led to inflation, or that inflation generated political instability, or that both inflation and political instability were caused by some third cause. With a lot of data, there are sophisticated statistical tests to identify which of these possibilities is the most plausible. These tests are hard to use with the limited data available for the Roman Empire and even more difficult to use with the simple patterns shown by the indices in Tables 1 and 3.

We need instead to examine each of the possibilities in turn to see which one is the most plausible. We cannot extract from the data an estimate of plausibility for each story, but we can employ our historical understanding to identify which of the various

possibilities appears most plausible. For example, it is easy to understand how political instability can cause inflation. Instability means lots of conflict and therefore demands by soldiers for pay. If the contenders have access to silver, they can issue more coins; if not, they can debase existing coins. Either way, they generate inflation. This can be seen clearly in the Hellenistic Babylonian prices described earlier. Those prices jumped dramatically after Alexander's death in 323 BCE and took several decades to return to previous levels. Given the wealth of prices that have survived for that time, we can be confident that the price rises were the result of general inflation, not changes in the demand for individual commodities (Temin, 2002).

The index of political instability in Table 3 reveals that dynastic succession was a continuing problem in the late Roman Empire. The inflationary consequences are clear. In most contests for political power, the need for more cash was immediate. In those cases, emperors and putative emperors devalued coins instead of minting new ones. Either debasing or minting more coins is inflationary, as noted already, but debasement was the mechanism used in the Late Empire. This accounts for the correlation between the silver content of coins and inflation that Howgego discussed.

Unfortunately, it also is easy to construct stories of reverse causation, showing how inflation could have produced political instability. For example, if taxes were fixed in money terms, inflation would decrease government revenue. Emperors without resources would be prime suspects for replacement. Jones (1974, 193) argued that many Roman taxes were fixed in nominal terms and decreased with inflation. Bagnall (1993, 312n) argued that one third of Egyptian taxes were collected in money in the third century. Brunt (1990, 356) however warned that, 'It is impossible to insist too strongly

on the paucity of documentation for the imperial fiscal system'. At the present state of knowledge, we can neither affirm nor refute this possible direction of causation.

This brings us the third possibility, that both inflation and political instability were the result of a third cause. This case can coexist with the two possibilities already described, because inflation can be both caused by and cause political instability if they both were stimulated by a third cause. If there was this kind of mutual causation, however, the system was unstable. Once inflation or political instability was started by the third cause, the interaction between them would have set in motion a cumulative process that would have prolonged the results of the initial impulse.

This kind of mutual causation makes the task of historians both easier and harder. Easier because we only need to find an initial cause to start the process off. The mutual causation of inflation and political instability then would have taken over to continue both processes. Harder because any event of the late second century that was not the result of either inflation or political instability is a candidate for this third cause. There are no formal tests that can help us identify the impulse that starts an unstable process; we are thrown back on our historical understanding of the time.

One big event of the late second century stands out as a possible cause of this transition: the Antonine Plague. Sallares (2007, 37) described it as follows: 'The appearance of pandemics was a side-effect of the general increase in inter-regional trade and movement of people in classical times. The first pandemic was the so-called "Antonine Plague," which raged for about twenty years in the second half of second century AD. The causative agent responsible for the "Antonine Plague" … is widely

agreed to have been smallpox. … [L]ater parallels make it plausible that the "Antonine Plague" might have killed about a third of the population, at least in some areas'.

This description makes it clear that the plague was what economists call *exogenous*. We believe that the variables we are trying to explain, inflation and political instability, were determined by a process I am hoping to illuminate. In the words of economists, they are *endogenous* variables. Plague however was not caused by either inflation or political instability. In fact, quite the reverse; according to Sallares the Antonine Plague was the result of the long period of stable political institutions and prices that preceded it. The Antonine Plague therefore is a good candidate for the third possible cause alluded to earlier.

To have this important effect, the Antonine Plague must have been large. Rathbone (2007, 700) confirmed Sallares' view of the plague, at least for Egypt: 'No one disputes that the Antonine Plague, which was carried into Egypt in AD 166/7 caused over the next decade a dramatic aggregate population loss, probably of around 20-30 percent to judge from some attested case'. This may be all the information we can gather about the magnitude of the Antonine Plague; the Justinian Plague did not leave even as much evidence as we have for the second century in the historical record (Little 2007). This evidence is sufficient for the Antonine Plague to have had a major impact.

Duncan-Jones (1996) and Scheidel (2002) analyzed the effect of the Antonine Plague on relative prices, such as a rise in wages relative to food or land due to the decline of the number of workers in the inflation. They appeared to find changes in relative prices that were consistent with the size of population declines estimated for the plague, although Bagnall (2002) was sceptical that the available evidence supported firm

conclusions. Taking into account the paucity of evidence, I argue here that there is enough evidence and logic for us to take seriously the role of the Antonine Plague as an important exogenous variable.

The next step in the argument is how the plague could have affected inflation, that is, prices in the whole economy, as opposed to prices in markets peculiarly subject to disruption in a plague. Rathbone, in the passage quoted earlier about Egyptian prices, asserted that 'temporary economic dislocation caused by the Antonine Plague' could have caused rising prices and wages. I described earlier how dynastic struggles induced inflation, but the Antonine Plague did not lead to a struggle over leadership of the Roman Empire, or at least did not lead to such an effect quickly or directly. Without a more specific mechanism, it is hard to evaluate whether temporary economic dislocation could have caused inflation. We must search for a more direct link.

Let me take the reasoning used by Duncan-Jones and Scheidel a bit further. Plague reduced the number of workers relative to the amount of land and therefore affected relative prices. It also reduced the number of workers and consumers relative to the supply of money in existence at the time. Plague killed people, but it did not reduce arable land, animals or coins. Fewer people then were using the same amount of money, that is, more money per capita, to purchase goods, and prices rose. The impact on demand was increased by the plague's effect on supply. With fewer workers, grain and other agricultural production undoubtedly was lower, and the resulting products were scarcer relative to the amount of money than before. Consumers had more money than before, because there were fewer consumers, and they used this money to bid the prices of goods up.

Lo Cascio (2007, 646) added a further dimension to this argument, describing the effect of plague on the government: 'The Antonine Plague drastically reduced the productive basis from which the imperial state drew its financial resources'. Lower tax revenues put the government in a bind. If it responded by coining more money or debasing existing coins, then there would have been even more money chasing the reduced quantity of goods. All these arguments work in the same direction. They provide mechanisms by which the Antonine Plague could have caused inflation. Rathbone alluded to similar problems when he agued that the plague led to economic disruption. If the disruption led to political instability, this was the other element in the cumulative process. As noted earlier, there is no argument for reverse causation, for inflation or political instability causing the plague. The plague was an *exogenous* event that could have set in motion a cumulative advance of prices and political instability.

This argument is complicated by the simultaneous debasement of the Alexandrian tetradrachm in 176/7, during the Antonine Plague, and shown in Figure 1. We do not know the cause of this debasement, but it does not appear to have had a large effect because subsequent issues were small and were not obtained by reminting earlier coins. And if the debasement was the result of the Antonine Plague, it would not indicate a separate cause of inflation (Rathbone, 1996, 328, 334). Nevertheless, the debasement clouds the link between the plague and prices.

The cumulative process is very different from the process started by the 64 CE fire in Rome. The added demand for money led to an expansion of money and—we think—some inflation. But it did not set in motion a cumulative process of political instability. We can speculate whether this *exogenous* fire led to the dynastic struggles of

69 CE, the Year of Four Emperors, but that is a side issue. The important issue is that the political instability lasted only one year, to be followed by a century of relatively smooth transitions of power. Not all *exogenous* events generate continuing processes.

Conclusion

This paper offers new indices of inflation and political instability for both the early and late Roman Empire. It uses these indices to suggest an explanation for the change from the Early to the Late Roman Empire. There are of course myriad explanations in the literature. I make no claims for originality or exclusiveness in presenting the Antonine Plague as an important event. The plague was important not only because it was large, but also because it stimulated the change from a regime of stable prices to one of continuing inflation. The increase of political instability was part of the cumulative process that effected this change.

I also make no claim for the completeness of this story. The indices cannot expose the details of the inflation or the political process. This story is an abstract version of the process by which the early Roman Empire turned into the late Roman Empire. It undoubtedly is consistent with many other stories about this momentous change.

The originality in this paper is the attempt to consider the mechanisms by which observed events interacted. While the paucity of information leaves ample room for speculation, we should restrict ourselves to speculations that are internally consistent. I have used economic theory to maintain consistency in the analysis of this epochal change. This enables us to make connections between events that are more specific than

casual statements about these connections. It is easy to present hypotheses; it is much harder to find ways to discriminate among them. Careful consideration of economic interactions is one tool to use in this daunting task.

Table 1

Inflationary periods in the Roman Empire

(1 indicates inflation)

Years	Rathbone	Bagnall	Army Pay	Synthesis
000 - 025	0		0	0
026 - 050	0		0	0
051 - 075	0		0	0
076 - 100	0		1	1
101 -125	0		0	0
126 - 150	0		0	0
151 - 175	1		1	1
176 - 200	1		0	1
201 - 225	0		1	1
226 - 250	0		1	1
251 - 275	1			1
276 - 300		1		1
301 - 325		1		1
326 - 350		1		1
351 - 375				
376 - 400				

Sources: Bagnall (1985), Rathbone (1997).

Table 2

Effects of annual inflation rates over a century and a half

Inflation Rate (%)	Annual Multiplier	Years	Total Multiplier
1	1.010	150	4
1.5	1.015	150	9
2	1.020	150	19
2.5	1.025	150	41
3	1.030	150	84
3.5	1.035	150	174
4	1.040	150	359
4.5	1.045	150	737
5	1.050	150	1508

Source: Author's calculations.

Table 3

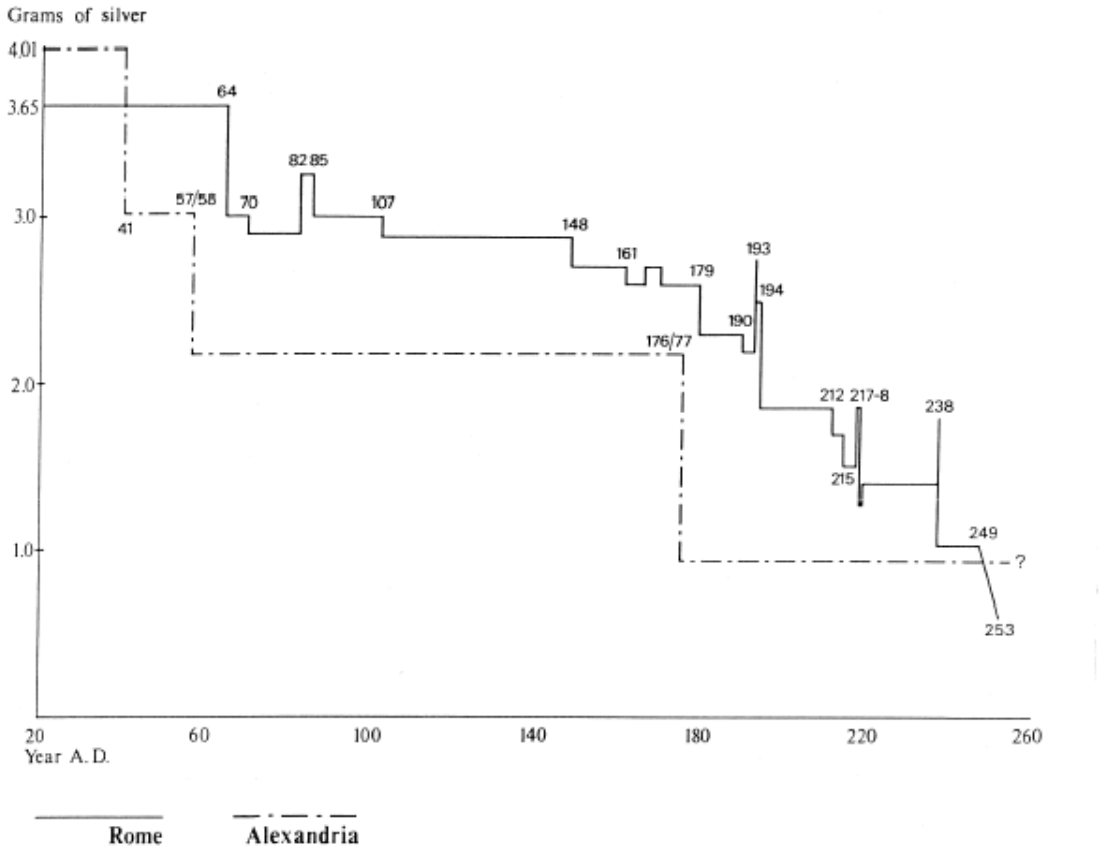
Numbers of Roman Emperors, by date and proclamation

Years	Legion Emperors	Senate Emperors	Years	Legion Emperors	Senate Emperors
-25 - 25	2	2	01 - 50	4	4
26 - 75	7	7	51 - 100	9	9
76 - 125	5	5	101 - 150	2	2
126 - 175	4	4	151 - 200	10	8
176 - 225	12	10	201 - 250	15	13
226 - 275	31	29	251 - 300	31	28
276 - 325	22	20	301 - 350	17	16
326 - 375	14	13	351 - 400	15	15
376 - 425	17	13	401 - 450	12	4
426 - 475	14	9	451 - 500	13	13

Source: Internet emperor lists and biographies. See

http://www.roman-emperors.org/impindex.htm

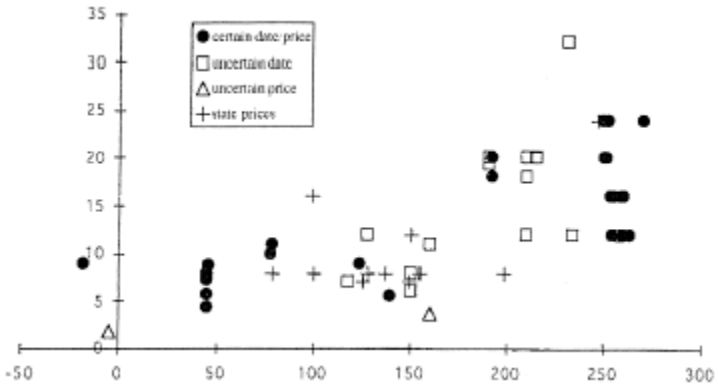
Figure 1



Source: Christiansen (1988, 87).

Figure 2

Egyptian Wheat Prices up to 270



Source: Rathbone (1997, 192).

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