
STUDIES IN HYPERINFLATION & STABILIZATION

BY GAIL E. MAKINEN

WITH WILLIAM A. BOMBERGER
G. THOMAS WOODWARD
ROBERT B. ANDERSON
JARVIS M. BABCOCK

FOREWORD BY
THOMAS J. SARGENT

Center for Financial Stability



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About the Author and Coauthors

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Makenen's areas of research interest include hyperinflation, economic stabilization, monetary theory and policy, economic history, and exchange rate regimes. During his career, he has published seven books as well as chapters in edited works, entries in encyclopedias, and more than thirty articles in refereed journals, including *American Economic Review*; *Journal of Political Economy*; *Journal of Finance*; *Journal of Business*; *Journal of Economic History*; *Southern Economic Journal*; *Atlantic Economic Journal*; *Economic Inquiry*; *Journal of Money, Credit, and Banking*; *International Journal of Energy, Environment, and Economics*; *Economic Development and Cultural Change*; *Public Budgeting and Finance*; and *Eastern Economic Journal*.

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William A. Bomberger is an Associate Professor of Economics in the Warrington College of Business at the University of Florida. Before taking his position at the University of Florida, he held a faculty position at Wayne State University. He has also served as a Visiting Scholar at the Congressional Research Service of the Library of Congress and a Research Associate for the State of Rhode Island. Bomberger has a Ph.D. from Brown University. His research has focused on inflation, in particular episodes of hyperinflation and developing empirical measures of uncertainty regarding future inflation. His published research has appeared in *American Economic Review*; *Journal of Political Economy*; *Journal of Money, Credit, and Banking*; *Economic Inquiry*; *Journal of Finance*; *Southern Economic Journal*; *Economic Development and Cultural Change*; and *Atlantic Economic Journal*.

G. Thomas Woodward

G. Thomas Woodward is now retired from public service after providing economic analysis to the U.S. Congress in various capacities over 30 years. He continues to write and research topics in economic history, taxation, and monetary economics.

Woodward served as an Economist with the General Accounting Office; Analyst and Section Head in the Economics Division of the Congressional Research Service at the Library of Congress; and Chief Economist for the minority staff of the Budget Committee of the House of Representatives. From 1998 until his retirement in 2009, he was Assistant Director for Tax Analysis with the Congressional Budget Office, overseeing its tax studies and revenue projections.

He received his B.A. from the College of Wooster and his M.A. and Ph.D. in economics from Brown University. His work has appeared in the *Journal of Political Economy*; *International Economic Review*; *Journal of Money, Credit, and Banking*; *Southern Economic Journal*; *Public Budgeting and Finance*; *National Tax Journal*; *Journal of Business*; *Review of Economics and Statistics*; and various conference volumes.

Robert B. Anderson

Robert B. Anderson met Gail Makinen when both were professors of economics at Wayne State University in the mid-1970s. Subsequently, they worked together at the U.S. General Accounting Office in Washington, D.C. Anderson left the General Accounting Office to work on the staff of the Board of Governors of the Federal Reserve System for two years in the early 1980s. From 1983 through 2012 he worked at the Office of Management and Budget, serving on the committee that prepares the Administration's macroeconomic forecast and briefing the organization's officials on economic issues. Anderson's main interests in economics were in economic growth and long-run fiscal policy. For many years, he drafted the sections of the annual federal budget that analyzed budget prospects outside the normal ten-year budget window.

Anderson did his graduate work at Johns Hopkins University. He published papers in *Public Finance*; *American Economic Review*; and the *Journal of Money, Credit, and Banking*. He died on October 25, 2013.

Jarvis M. Babcock

Jarvis M. Babcock taught economics at Wayne State University, the University of Michigan, and Oberlin College. He served on the staff of the Council of Economic Advisers during the administration of President Lyndon Johnson. He was also a township trustee in his native Rochester, Ohio, where he worked the family farm. He did his graduate work at Iowa State University. He died on May 28, 2012.

Preface

Hyperinflation imposes heavy economic costs and undermines political and social stability. Its often terrible consequences have made it a topic of enduring fascination for economists and public alike. The articles in this volume primarily examine episodes of hyperinflation and the efforts by governments to bring them to an end.

The first reliably recorded case of hyperinflation occurred in France in 1795, during the upheaval of the French Revolution.¹ No subsequent cases were recorded until after World War I. In the political and economic turmoil that accompanied the creation of new nations from what had been parts of the Austro-Hungarian, German, and Russian empires, several episodes of hyperinflation occurred in central and eastern Europe. The public anger that Germany's hyperinflation aroused fueled the early political career of Adolf Hitler, who made an unsuccessful armed attempt to seize power in Bavaria (the "Beer Hall Putsch") in early November 1923, when inflation was near its peak.

The post-World War I hyperinflations prompted inquiry by economists that continues to be read today. Among the early works now regarded as classics are John Maynard Keynes's *Tract on Monetary Reform* (1923), *The Austrian Crown* by J. van Walré de Bordes (1924), Frank Graham's *Exchange, Prices, and Production in Hyperinflation: Germany, 1920-1923* (1930), and *The Economics of Inflation* by Constantino Bresciani-Turroni (1937). Other than Keynes's book, Bresciani-Turroni's work is probably the best-known of the bunch today because of its detailed, compelling eyewitness reporting. The enduring interest in this topic can be seen by the popularity of Thomas Sargent's *The Ends of Four Big Inflations* (1982), which has garnered nearly 1,000 citations by other economists. The League of Nations and the International Labour Organization, both founded soon after World War I, collected data on the hyperinflations that many subsequent

¹ Hyperinflation is conventionally defined as beginning in the month the rise in prices exceeds 50 percent. This definition owes its origin to Phillip Cagan (1956).

economists have used.

In the 1930s, economists' interest in hyperinflation waned because the pressing problem of the Great Depression was deflation, not inflation. John Maynard Keynes's *General Theory of Employment, Interest, and Money*, published in 1936, drew economists' attention away from the importance of money and monetary policy. In the 1940s, though, further episodes of hyperinflation occurred in Europe and in East Asia. In 1956, Phillip Cagan published a condensed version of his Ph.D. dissertation, "The Monetary Dynamics of Hyperinflation," as a chapter in the book *Studies in the Quantity Theory of Money*, which was edited by his dissertation supervisor Milton Friedman. Cagan studied seven episodes of hyperinflation, five in the aftermath of World War I (Germany, Austria, Hungary, Poland, and Russia) and two during and after World War II (Hungary and Greece).

Other economists immediately recognized the importance of Cagan's work, and have cited it in nearly every subsequent paper on hyperinflation. Cagan's objective was to demonstrate that even during the turbulence of hyperinflation, it was possible to identify factors that would reliably predict how much money people would hold, or, as economists say, he showed that a stable demand for money existed. For each episode he studied, he estimated a simple demand for money equation in which real (inflation-adjusted) money balances were a function of the expected rate of inflation, with expectations being formed adaptively (that is, on the basis of an extrapolation of recent and past experience with rising prices). Cagan's work had broader implications, for he also inquired into reasons for the increase in the supply of money during these episodes. Cagan's work led to a revival of interest in the study of hyperinflations, the source of money supply growth, and the means that would likely succeed in bringing these chaotic episodes to an end. As a consequence, his dissertation and the studies it inspired helped to restore to macroeconomics a more balanced treatment of the role and importance of money.

About This Volume

The studies in this volume are motivated by the work of Phillip Cagan. They add two more episodes to the seven he studied; they add

additional regressors to explain money holdings in hyperinflations; they introduce new data, and, in other cases, reinterpret the data he used.² This should not be taken as a criticism of his work. As we said in one of our papers, “It is no reflection on Cagan’s careful and exhaustive efforts that subsequent work has occasionally uncovered other time series or questioned some of his assumptions. Indeed, considering the empirical thrust of Cagan’s original article, it is puzzling to us that scholars inspired by his work have spent so little time trying to expand and refine his data set. Much more attention has been devoted to econometric techniques than has been applied to improving the data used to test those techniques. In our view, many of the puzzles in these hyperinflation episodes can only be resolved by a further examination of the data.” The reader will also note that in most of the papers in this collection the authors gratefully acknowledge the generosity of Phillip Cagan in providing encouraging support and useful comments.

Some of the studies in this volume are primarily concerned with stabilization or the efforts made by governments to reign in the inflation and return to price stability. These too owe a debt to Cagan’s work for, as noted above, his dissertation was also an inquiry into the nature of the money supply process.

The articles in this volume are a collaborate efforts. The only person whose name appears on all of the papers is Gail Makinen. He has been joined in various configurations by four coauthors. The research agenda they represent largely began by accident or chance occurrence. The first and most important chance occurrence was that Makinen, early in his career, worked for 18 months with a young Army officer, Captain Thomas J. Sargent. History records that Captain Sargent went on to win the Nobel Prize in economics in 2011. What may not be as well known is how this association changed the focus of Makinen’s research interests from international trade and finance to macroeconomics and monetary economics.

The first paper in this volume reflects this new interest. It is a comparison of the stabilization effort made by the United Nations and

² Recently, Hanke and Krus (2012) have provided an exhaustive list of the countries experiencing hyperinflation according to Cagan’s definition. The length of this list suggests that hyperinflation may have been one of the most frequent severe economic problems of the past century.

the United States in Korea and Vietnam, respectively, during the war in each country. The U.S. effort was far more successful in containing the inflation in Vietnam than was the UN effort in Korea. The more successful outcome in Vietnam was due in part to a more effective use of foreign aid to offset the war-induced decline in production and to meet the extra demand resulting from the introduction of a substantial number of foreign troops. In Makinen's opinion, which his later coauthors share, most of the papers in this volume need no revisions except to correct for minor errors, but this first paper might stand some more fundamental changes.³ The discussion of the velocity of money assumes adaptive expectations. "Rational expectations" theory had not yet entered the literature when the paper was written.⁴ The discussion of velocity would likely change somewhat if the treatment of expectations were to be revised. Additionally, Makinen discovered how the disparity between the official and the black market exchange rates in Vietnam was used by American contractors operating in Vietnam and some Vietnamese nationals to expedite the illegal flight of capital from that country. A common pitfall, demonstrated in the studies to follow, was the frequent attempts by authorities to deal with inflation by fixing prices. Such attempts nearly always have undesired and harmful consequences. Expediting illegal capital outflows is one that should be added to the list.

The second paper, on China's hyperinflation of the late 1940s, was also the result of an accidental occurrence. Makinen had come across a study of money demand during the Chinese hyperinflation. The estimating equation modified the original Cagan specification in one important respect. The original specification assumed that the actual and desired money holdings of individuals were identical. That is,

³ Jarvis Babcock, a coauthor of the China paper, died before this project began.

⁴ Expectations about inflation are an important determinant of the turnover rate of money and of money spending. If they are "adaptively" formed, it means that individuals extrapolate the current and past history of inflation in deciding what the future rate of inflation will be. If they are "rationally" formed, it means that all relevant information is used in coming to this decision such as the current and expected future position of the government's budget. Since the acquisition of information can be costly, it is possible in some instances for adaptive expectations to be rational.

whenever individuals had cause to change their money holdings it was done instantaneously. The new specification allowed for partial adjustment or an adjustment that occurred over time. Makinen had some concerns about this specification and approached Jarvis Babcock to discuss them. He and Babcock noticed one anomaly in the Chinese study using this new variation. This was the possibility that the inflation could become self-generating.⁵ Cagan had raised the possibility. His estimating technique furnished the means to test this notion—he dubbed the crucial parameter “the reaction index.” For several high-inflation countries in his sample he obtained a sufficiently large value for the reaction index to suggest that self-sustaining inflation could occur. Even though the rate of inflation in China was on a par with rates in the European countries in Cagan’s sample, the reaction index was noticeably smaller. This led Babcock and Makinen to undertake a more comprehensive study of the data for the Chinese hyperinflation. They discovered that the Chinese government had introduced a gold-based currency to restore public confidence in the rapidly depreciating paper money. The data used in the original paper that had sparked Makinen’s interest commingled the data from both regimes. Separating these led to a better understanding of what had happened in China and to a reaction index quite in line with Cagan’s findings. The new result is the subject of the second article in this volume.

Many of the subsequent papers were set in motion after Makinen found a copy of *Money: Whence It Came, Where It Went* by John Kenneth Galbraith (1975) in a remainder bin of a bookstore in the Durham, North Carolina airport while he waited for a flight. On that flight, he read the chapter on the German hyperinflation. Questions provoked by that reading were to dominate his research interests for the next 35 years. The chapter pointed out that during hyperinflations the composition of the money stock changes—currency displaces checks as the primary means for making payments.⁶ Since currency held as

⁵ This means that once the inflationary process is set in motion, for whatever reason, it will continue indefinitely, even if the money supply growth slows down or stops. This involves an interaction between rising expectations of inflation and a rising sensitivity of money holdings to those expectations.

⁶ The reason for this is that it takes time to clear checks—that is, to transfer the ownership of deposits. During this time, the increase in prices will erode

bank reserves supports many times its value as deposits, when currency is withdrawn from the banks, deposit money must fall by some multiple. A rising ratio of currency to deposits is symptomatic of hyperinflation and offsets to some degree the effect on the money supply from printing additional currency.⁷ Cagan had noted this phenomenon and had observed that it occurred in six of the seven countries in his sample. The outlier was the hyperinflation in Hungary at the end of World War II ("Hungary II"). An explanation for the cause of this anomaly led to the extension of an ongoing collaboration between Bomberger and Makinen. They discovered that the indexed bank deposits, used by Hungarians as a protection from inflation, were commingled with non-indexed deposits, something not discovered by Cagan even though he knew that Hungary had experimented with indexed money. In a sense, this was *China déjà vu*. In addition, the Hungarians had experimented with indexed currency during the final two months of their hyperinflation, but these data were not commingled with the non-indexed currency.

The Hungarian research was aided immeasurably by the generosity of Dr. L. László Ecker-Racz, an American military officer and economist who was present at the U.S. Legation in Budapest during the 1945-1946 hyperinflation and who reported extensively on economic conditions in Hungary to the State Department. Dr. Ecker-Racz had kept copies of many of these reports and shared them with Bomberger and Makinen at a time when such information was difficult if not impossible to obtain since both the Hungarian and State Department archives were closed. The use of indexed currency and bank deposits was a unique aspect of Hungary's hyperinflation. Bomberger and Makinen showed how this policy aggravated the hyperinflation. Several years after this paper was published, Makinen presented a paper at a

the checks' real value. This is not true for currency. Hence, it becomes the preferred means of payment.

⁷ Those familiar with the methodology developed by Friedman and Schwartz in their *Monetary History of the United States* (1963), in which the determinants of the money stock are the monetary base and the money multiplier, will recognize that a rising currency-to-deposit ratio reduces the value of the money multiplier, which slows the growth of the money supply. In a hyperinflation, the growth of the money supply is dominated by the growth of the monetary base.

conference in Spain at which the finance minister of Argentina told him that his government had put aside the implementation of a similar policy after reading the Bomberger-Makinen paper.

Later, a chance discovery by Makinen of an alternative time series on money and prices during the Greek hyperinflation in the *International Labour Review* set in motion his work on that episode—a work made easier by Dr. Gardner Patterson's masterly doctoral dissertation and subsequent interviews with Dr. Patterson, an American military officer and economist. Dr. Patterson was in Greece during 1944-1946 when the hyperinflation was at its peak and, at the youthful age of 30, played an important role in bring it to an end as well as assuring the successful stabilization of the drachma. Makinen found that these alternative time series produced different results from those reported by Cagan (see below).

During the period encompassed by these studies, new ideas and methods of estimation were becoming part of the received doctrine of macroeconomics. Among the most important of these new ideas and methods was rational expectations. Bomberger and Makinen returned to the second Hungarian episode to examine how an assumption of rational expectations would affect their earlier results. Makinen later returned to the Greek episode to see how people responded to changes in government policies that were designed to promote stabilization. The results they obtained were mixed. For Hungary, the new results seemed to suggest rationality, but, in Greece, the public appeared to respond positively to changes in policies that were largely cosmetic, which would be inconsistent with rationality.

The new data on Hungary and Greece also made it possible to deal with a problem that Cagan found in his data. Toward the end of four of the seven hyperinflation episodes, he observed real money holdings that were much larger than implied by his estimated equations given the expected inflation rates—the so-called outlier problem. He excluded these observations from his estimates on the grounds that they likely reflected the anticipations of the public that stabilization was at hand. In the case of post-World War II Hungary, the exclusion of these data was significant since it meant reducing the observations by nearly one-half in a sample that was already very small. With the new data for Hungary and Greece, Anderson, Bomberger, and Makinen

showed that this problem disappeared: there were no outliers. This not only added to the robustness of the small samples Cagan had, but the results tended to discount the idea that rational expectations may have played a part in pre-stabilization behavior. Babcock and Makinen also found several outliers at the end of the Chinese hyperinflation and attributed these to the fact that the price index used (it covered only Shanghai) may only have reflected localized inflationary conditions and not those for China as a whole, and that the currency data may have reflected both the amount in circulation and the amount printed but held in the vaults of the central bank awaiting to be put into circulation.

Integral to the study of hyperinflations is the nature of the monetary regime in place when they occur and the subsequent changes that take place in those regimes that yield a successful stabilization. Traditionally, these studies have been largely descriptive, as are several in this collection. Developments in time series analysis during the 1970s, due in large part to the pioneering work of Clive Granger and Christopher Sims, make it possible to see if one time series (such as money) can be useful in forecasting the subsequent behavior of another (such as prices), thereby confirming and enriching the conclusions drawn from the descriptive work. Makinen and Woodward used the method of Granger and Sims to see if, following a successful stabilization, the monetary regime suggested by the data as having generated the inflation had in fact come to an end. Using Cagan's data and subsequent post-stabilization data for these same countries, they discovered this to be largely true. That is, the Granger-Sims estimating technique implied that the post-stabilization data were generated by a different monetary regime. The Makinen and Woodward collaboration was based on their joint view that the extensive literature on the crisis surrounding the French franc in 1926 suffered from a number of shortcomings as did the newly emerging view that interest-bearing debt would, in the absence of legal restrictions, circulate as currency. Their study of the franc crises yielded an unexpected but glaring counterexample to the latter view. This collaboration also expanded the number of hyperinflation episodes by adding the one that occurred in Taiwan during and after the Nationalist government's encampment there in 1949. This additional episode was possible because Taiwan, although a part of China, was maintained as a separate currency area

from the mainland.

Finally, Bomberger and Makinen investigated whether inflation uncertainty had any effect on the demand for money in hyperinflations. This built on developments in estimating money demand with U.S. data as well as several studies involving hyperinflations. The studies using U.S. data showed that even with low inflation rates, uncertainty about inflation helped to explain the demand for money. Bomberger and Makinen wondered whether inflation uncertainty could play a similar role in a world with high inflation rates. They found this additional regressor to have a significant positive effect on money demand when added to the standard Cagan estimating equation for the six countries in the Cagan sample (Hungary II was excluded because the small size of the sample imposed what statisticians call a degree-of-freedom constraint). These results linked U.S. behavior with similar behavior in high inflation countries.

Several papers in this volume discuss the shocks that caused governments to pay for their expenditures by printing money rather than by explicit taxes, this being the essence of inflationary finance. The episodes investigated in our papers occurred during and in the immediate aftermath of war, in which the national tax bases of the respective countries were severely compromised and the fiscal needs of governments become subject to extraordinary demands. In Greece, inflation began in 1943 during the German occupation. It is one of the two places in the Nazi empire in which this occurred.⁸ The inflation in Hungary took hold after the Nazi army was driven out by the Soviets during 1945. The Chinese switched to inflationary finance in 1937 after the Japanese occupied the major part of eastern China, depriving the national government of a major source of its revenue: the tariff. Taiwan's fiscal difficulties began in World War II when it was a part of the Japanese empire. The island was heavily bombed, which substantially weakened its economy and tax base. It was in this state when it was restored to Chinese sovereignty in 1945. China's ability to improve conditions was hampered by its then ongoing civil war. Wars in Korea and Vietnam also led to inflationary financing of government.

⁸ The other was in the rump state created in Poland during the 1939-1945 Nazi occupation, known as the General Government.

Lessons

What lessons do we learn from these papers? We offer the following:

(1) *Governments must avoid substituting money creation for taxation.* We, like others, have identified the cause of hyperinflation as the substitution of money for the tax financing of government expenditures. In an important sense this is only the proximate cause of these episodes. We have not attempted to explain why it occurs—which is, of course, the ultimate cause of the episodes. We leave this investigation to others.

(2) *Inflationary finance can only be temporary.* John Maynard Keynes famously observed in his *Tract on Monetary Reform* (1923) that governments can live by inflation when they can live by no other means of finance. But we, like others, discovered that inflation only prolongs this life temporarily. Once the public discovers what is occurring it seeks to avoid the inflation tax by shedding money balances. The resulting rise in velocity shrinks the tax base, necessitating a larger increase in the inflationary tax rate to yield the same command over real resources.⁹ Ultimately, the tax base becomes so small that even very high tax rates can no longer raise sufficient revenue.¹⁰ At this point, reform is inevitable. Not mentioned by Keynes is the point that governments seldom see inflation as an alternative method of taxation to which the normal analytics of public finance apply.¹¹ If they did, they would be unlikely to create inflation-protected financial assets to serve as alternatives to money, reducing the tax base for the inflation tax.

(3) *One-time measures fail.* Government policy makers often seem oblivious to the fact that inflation usually reflects what economists call

⁹ The *Tract on Monetary Reform* contains a very simple and concise discussion of money creation and inflation as a method of taxation. It should be required reading for central bankers and finance ministers. It is often overlooked that prior to his famous *General Theory*, the monetary writings of Keynes were often in the context of the quantity theory of money.

¹⁰ In the *Tract*, Keynes provides a calculation on how much revenue Germany was able to raise by issuing money in the final chaotic days of its hyperinflation—it is surprisingly high given the small tax base.

¹¹ The inflation tax may be unique among taxes in the sense that it can be avoided, but not evaded. It also escapes the need for legislation. Perhaps these attributes make it so attractive to governments.

a persistent flow disequilibrium. That is, tax revenue can be thought of as a recurring flow of income to the government, and expenditures as a recurring outflow. A continuing excess of expenditures over tax revenue constitutes a persistent flow disequilibrium. Since government policy makers seldom see it in these terms, they often seek to deal with the disequilibrium by one-time measures such as selling existing stocks of goods or precious metals. If the supply of these stocks is large and if they are priced appropriately, they can provide important budget support of a temporary nature. Nevertheless, the flow disequilibrium must ultimately be dealt with if monetary stabilization is to be achieved, and this involves substituting explicit taxes and other budgetary measures for printing money (the inflation tax).

(4) *Monetary control is essential for stabilization.* For stabilization to be successful some kind of control must be placed on money creation. This can involve several steps. Of first importance is that the government's budget come into reasonable balance. Second, the monetary authority must be freed from the obligation to finance the deficit. In some instances this may involve turning the monetary authority over to an international body or to foreign nationals, or linking the currency to precious metals or other stable-valued currencies. Whatever the arrangements, the government must adhere to them and must convince the public that they will work.

(5) *The costs of stabilization are smaller than the costs of hyperinflation.* It is not clear that the costs in terms of lost output and unemployment from successful stabilization of hyperinflation are comparable to what might be expected from stabilizing a much lower rate of inflation. In the hyperinflation episodes, staggered contracts governing the prices of goods, services, and labor eventually vanish. Without these contracts a good deal of the price rigidity that impedes rapid adjustment to decreases in demand vanishes, thereby expediting the return of income to a full-employment path and significantly reducing the costs of stabilization.

(6) *Indexation is flawed.* Several of the stabilization plans in the episodes we studied involved changes to the monetary arrangements of a country, e.g., indexing bank accounts for inflation and introducing currencies in some way linked to commodities such as gold or silver. Often, these new monies circulated side by side with the existing

monies. Separating these components is often essential to an empirical investigation of the relationship between money and prices, since the new monies are likely to have changed the underlying nature of the data.

(7) *People have trouble distinguishing good from bad stabilization plans.* While individuals draw information from a variety of sources in forming expectations, it is not clear that, at least over short periods of time, they are able to distinguish genuine reforms that promise success from superficial reforms that will ultimately prove ineffective.

(8) *Public policy often worsens inflation.* As we note in the studies to follow, governments have had a dismal record in implementing successful policies to stabilize inflation, and often changes in policy actually have worsened ongoing inflations. It should also be noted that governments have sometimes, serendipitously, implemented policies that have unintentionally worked to curb inflation.

(9) *Real money balances provide an early signal of successful stabilization programs.* We have judged the success of stabilizations by the return of the public's willingness to hold real money balances. After this occurs, governments often have issued large sums of currency. Critics of the money theory of inflation have pointed to this as proof that money issue does not cause inflation. We disagree. Our line of reasoning is that once the public comes to believe that the stabilization will be successful, it will wish to hold larger money balances and the demand for money will rise. This is what would be expected based on a Cagan money demand equation. If the supply of money is not increased following stabilization, the interest rate and, possibly, the foreign exchange rate will have to rise to choke off the increase in money demand. To prevent this, the government has a one-time opportunity to increase the supply of money, and this is the reason why the large increases in money following successful stabilizations can be noninflationary.

(10) *Hyperinflation need not directly involve the foreign exchange market.* The German hyperinflation occurred during a period when Germany had to pay reparations for World War I and the two came to be causally connected through the effect of reparations on the exchange rate. A line of reasoning held that the payment of reparations caused the German exchange rate to depreciate, increasing the costs to produced

output in Germany and the German mark cost of reparations in the budget (and the budget deficit). The central bank, it was argued, passively increased the money supply to finance the larger deficit and to prevent the cost-induced rise in prices from causing unemployment. Both Greece and Hungary II involved similar budgetary stresses. Both countries had to pay an indemnity and bear the costs of an occupation army. While these additional outlays undoubtedly led to higher budget deficits for both countries, they did not involve feedback through the foreign exchange markets since the indemnities were paid in kind.

(11) *The inflation rate is likely to accelerate over time.* Hyperinflation does not emerge full-blown. Rather, the inflation rate tends to accelerate over time. At least two reasons explain this. The first we covered in (2) above. The second has to do with the lag between the time taxes are collected and their subsequent remission to the government. During this period their real value falls, forcing the government to substitute additional money issues to pay its bills and accelerating the ongoing inflation rate.

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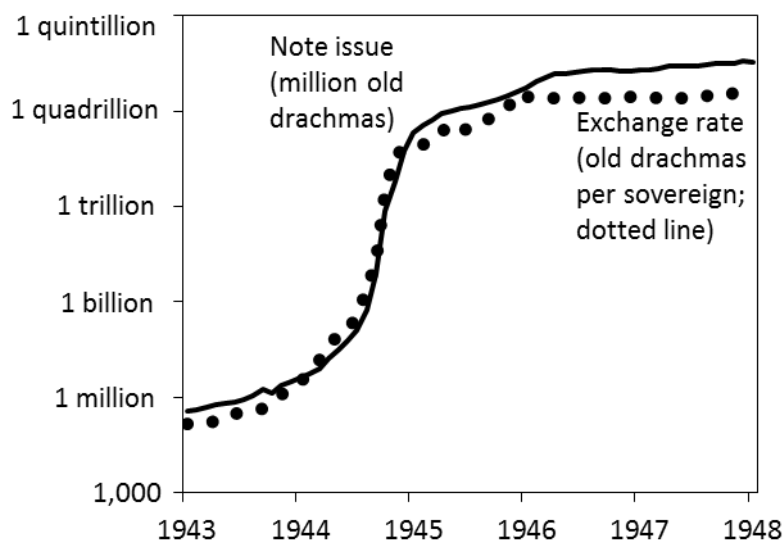
The Greek Stabilization of 1944-46*

It is a matter of great contention among economists whether economic stabilization programs can be instituted without imposing high real costs. Those believing in the core or underlying rate of inflation hypothesis argue that relying only on conventional monetary and fiscal policies will impose high costs. The rational expectations proponents, on the other hand, argue that a convincing anti-inflation program will likely minimize these costs as economic agents respond to a genuine regime change or change in the rules under which monetary and fiscal policies are conducted.¹ A way of discriminating between these contending views is to examine the stabilization phase of the world's episodes of hyperinflation. Thus far, the work of Thomas Sargent (1982) on the post-World War I experiences in Austria, Hungary, Poland, and Germany, and William Bomberger and myself (1983) on post-World War II Hungary have adduced evidence in support of the rationalists' view. Price level stability was achieved rapidly without a prolonged period of high unemployment. The Greek stabilization of 1944-46 is not so straightforward and, as such, provides an interesting contrast to the other episodes. Its unique feature is that price level stability took over a year to achieve following the initial reform of November 11, 1944. It was not achieved until, in a third reform in early 1946, the Greek government put in place those features identified by the other studies as essential to the successful stabilization efforts they

* This study has benefited from constructive comments by Phillip Cagan, Gardner Patterson, Thomas Woodward, Robert Anderson, William Bomberger, and two anonymous referees. My understanding of the stabilization effort was substantially enhanced by reading Patterson's dissertation.

¹ The "core" or "underlying inflation" view of stabilization is best identified with Arthur Okun (1978), James Tobin (1980), and Otto Eckstein (1981).

Figure 1. Price of the Gold Sovereign and Note Issue in Greece, January 1943-March 1948 (end of month data)



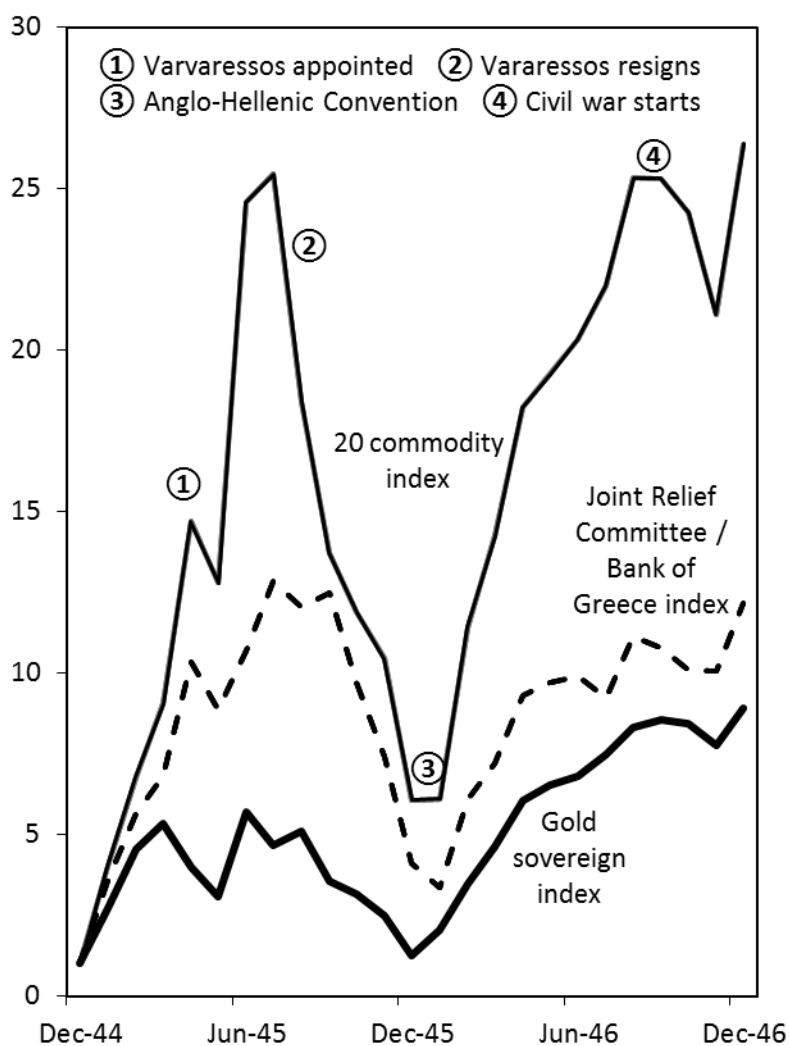
where unemployment apparently declined. The Greek episode thus provides a good setting for evaluating the alternative views on stabilization as well as elements of successful and unsuccessful stabilizations.

To give some perspective to the period to be studied, in Figure 1 data on the money stock (measured as notes of the Bank of Greece) and the market price of the gold sovereign are recorded for the period 1943-1948, a period both before the hyperinflation and after the successful stabilization. (The source for Figures 1 and 2 is Delivanis and Cleveland 1949.) The market price of the sovereign was selected to reflect prices in general for two reasons. First, no price index exists on a monthly basis which covers the 1943-48 period. Second, it is the least encumbered by prices which were either frozen (rents) or set by government decree (as were many food prices).

I. Stabilization

While the particulars of the various stabilization efforts differ, the prior

Figure 2. Real Money Balances in Greece, Deflated by Various Measures, December 1944 (= 1) to December 1946 (end of month)



studies identified two specific measures as essential to their success. First, an independent central bank was reconstituted with the power to refuse the government's demand for unsecured credit. Second, fiscal policy was substantially overhauled so that through a combination of tax increases and expenditure reductions, the government budget in the near term and over the longer run was brought into reasonable balance (if not surplus).

To the extent that these changes are convincing, rational economic agents will perceive a regime change and revise downward their expectations of future inflation, and a phenomenon associated with successful stabilizations will be observed: a substantial increase in high-powered money occurs without a parallel movement in prices (i.e., real money balances rise). Supposedly, these same forecasts of inflation should lead to a moderation in wage demands so that unemployment need not rise during the stabilization.²

The stabilization phase of the Greek hyperinflation will be discussed in terms of the initial event which occurred on November 11, 1944, the second attempt, the Varvaressos Reform, in June 1945, and, finally, the third effort, the Anglo-Hellenic Convention concluded on January 24, 1946. This will be followed by an analysis of the behavior of unemployment and real balances.

A. November 11, 1944

This initial effort at reform had but two essential features. The first limited the government to an overdraft of 2 billion drachmas at the Bank of Greece. The second involved a massive conversion of old drachmas for new at a rate of 50 billion to one.³ The new drachma was

² In his study, Sargent notes that the foreign exchange rates also stabilized as well. Data on these rates were not available to Bomberger and me.

³ By way of contrast, only in Germany and Hungary II did the initial reform coincide with the introduction of a new unit of account. In Poland the introduction was delayed several months and in the cases of Austria and Hungary I by several years. In all of the other episodes the reform legislation forbade the governments from borrowing from the central bank on an unsecured basis. However, in the cases of Germany, Poland, and Hungary II, the governments were allowed an initial limited overdraft in order to finance expenditures until the new taxes yielded revenue. Finally, in both Germany

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then made convertible into British Military Authority (BMA) pounds at the rate of 600 to one (but only in lots larger than 12,000 drachmas).⁴ Old and new drachmas and BMA pounds were made legal tender, although the latter was not legal tender in Britain. No changes were made in the tax system nor were expenditure cuts announced. However, Greece expected to be the recipient of massive amounts of foreign aid that was to be sold and the revenue used for budget purposes.⁵

The results of this first stabilization effort were less than promising. Within the first two months the government had exceeded its legal overdraft at the Bank of Greece and thereafter operated in disregard of the law. During the first seven months after stabilization, prices, as shown by the cost of living index in Table 1, rose 140 percent (measured as May over November). Since this index contains commodities and services (principally rent) fixed or controlled by government edict, it likely understates price movements in general. As a substitute, if the price of the gold sovereign, the principal alternative to commodities as an inflation hedge, is used, the rise is over 800 percent.⁶ Taxes yielded less than one-sixth of total revenue and, while the sale of aid goods yielded almost 45 percent of total revenue, their distribution

and Hungary II, an absolute ceiling was initially placed on the amount of notes the central bank could issue.

⁴ This convertibility placed no effective limit on the fiscal activities of the Greek government. By secret treaty, the British had agreed to advance a maximum of 3 million BMA pounds. This ceiling was never reached (see Patterson 1948, pp. 58-60). In essence, this convertibility was analogous to the relationship of the U.S. Treasury to the Federal Reserve in determining the composition of the U.S. money supply.

⁵ At the time of the reform, the British were furnishing substantial aid to the Greeks. On April 11, 1945, the aid program was taken over by UNRRA. From April to December 1945, UNRRA spent \$350 million which, if one disregards price level changes, was equal to about one-half of the 1938 national income of Greece. No other stabilization effort benefited from this type of aid. In Austria and Hungary I, stabilization was supported by foreign loans and, in the case of Germany, the Dawes Commission suspended her reparations payments and rescheduled the remainder so to reduce their burden.

⁶ The foreign exchange rates did not stabilize, the black market rates continued to rise, and the gap between them and the official rates widened over this period.

**Table 1. Selected Greek Economic Data,
December 1944-December 1945 (percent per month)**

	Rate of inflation	Rate of note issue	Rate of rise in the price of sovereigns	Expenditures covered by receipts
December 1944	63.2-a	990.0-a	47.6	n.a.
January 1945	-8.1	270.0	35.5	2.3-b
February	5.3	78.0	7.1	6.5
March	6.7	42.0	20.0	30.5
April	1.6	65.0	122.2	36.4
May	40.0	22.0	58.3	51.7
June	-38.5	17.4	-36.8	47.2
July	5.4	9.2	33.3	75.0
August	69.5	22.4	12.5	57.5
September	55.0	15.9	66.7	52.3
October	51.6	31.3	46.6	50.9
November	42.1	25.1	59.1	55.5
December	126.3	31.3	160.0	37.7

a-Percentage for December calculated from November 11, 1944.

b-The 2.3 percent represents the total for the months of December 1944 and January 1945.

Source: Delivanis and Cleveland (1949, p. 188).

costs were high. So high, in fact, that for all of 1945, the aid program yielded no net revenue (gross revenue was 16.4 billion drachmas while distribution costs were 16.8 billion).

The failure of the economy to revive and the acceleration of the inflation rate in April and May convinced the Greek government that a new reform was needed. On June 3, Kyriakos Varvaressos, a prominent economist, was named as a sort of economic czar.

B. The Varvaressos Reform of June 4, 1945

As Varvaressos saw it, the failure of the Greek economy to recover was due to a lack of effective state control over the economy and inadequate assistance from abroad. To remedy affairs, the government:

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(1) devalued the drachma (the official rate was still under the black market rate); (2) accelerated the arrival and distribution of foreign aid; (3) raised wages, especially at the lower level; (4) imposed wage and price controls; and (5) reduced by one-half the prices at which aid goods were sold. As provisions 3, 4, and 5 adversely affected the Greek budget, a large tax was imposed on the occupants of rented dwellings (rents having been frozen in Greece since 1940).

Varvaressos did not succeed largely because he antagonized a politically powerful group with his rent tax and the government could not guarantee supplies of those items subject to price controls. He resigned on September 1.

During his three months in office, prices fell in June, rose slightly in July, and sharply in August (see Table 1). The gold sovereign price shows a similar movement. State finances recorded some improvement. Once the potency of the rent tax was reduced, the fiscal situation deteriorated during the remainder of 1945 and inflation accelerated.

In December, the British initiated a major effort to stabilize the Greek economy. The result was the Anglo-Hellenic Convention of 1946.

C. The Anglo-Hellenic Convention, January 24, 1946

The provisions of this convention, embodying the reforms common to the other successful episodes, contributed substantially to a final and successful stabilization.

First, British experts helped to revamp the fiscal system by (a) preparing a realistic budget, (b) improving the tax assessment and collection administration, (c) adjusting many specific taxes for past inflation, and (d) increasing substantially the prices at which aid goods were sold. Had it not been for the outbreak of civil war in September 1946, the budget would have been balanced.

Second, while an independent central bank was not reconstituted, a five-member Currency Committee was created whose unanimous consent was required before the Bank of Greece could issue any notes. The Committee came to exercise a pervasive control over the Greek

economy and public finances.⁷

Third, to enforce fiscal and monetary austerity, the Bank of Greece pledged to maintain a fixed exchange rate vis-à-vis the dollar and pound sterling through open market operations in gold sovereigns.

This restored the gold convertibility of the drachma for Greek citizens.⁸

Fourth, to provide the financial wherewithal to carry out this program, the British cancelled their loan of £46.5 million made to Greece in 1940-41. This unencumbered over one-half of the reserves of the Bank of Greece. In addition, they made a loan of £10.0 million to serve as a cover for the note issue.⁹ The United States furnished credits of \$80 million.¹⁰

The effect of policy based on the Convention was immediate. The Bank of Greece commenced open market sales of gold sovereigns and maintained the drachma-pound-dollar exchange rate. The price level as shown in Table 2 not only stabilized but a mild deflation set in. While state receipts covered only 45 and 36.5 percent of expenditures in January and February, they rose to over 50 percent in March. The fiscal picture improved markedly thereafter. This is demonstrated by the fact that whereas the government borrowed 204 billion drachmas from the

⁷ The Committee contained an American (Patterson) and a British member. While it abridged the sovereignty of Greece, both Austria and Hungary I had had to admit a League of Nations supervisor to ensure that the provisions of their stabilization programs were being carried out.

⁸ At this time, the drachma was devalued and set at rates closely approximating those on the black market. Greece was then one of the only countries in the world with an internal gold standard. In no other stabilization program was gold convertibility restored.

⁹ This reserve was more superficial than substantive since these notes had no gold reserve requirements or other specific backing. This is not true of the other stabilizations.

¹⁰ Since the British were very instrumental in stabilizing the economies of Austria and Hungary at the end of World War I and, at the time the Committee was functioning, Hungary was busy stabilizing its own monetary system, I was interested to learn the ways these experiences were being used in Greece. I was told that the British may have used them in their plans made in London, but they were never mentioned in the deliberations of the Currency Committee (Patterson 1983).

Table 2. Selected Greek Economic Data, 1946 (percent /month)

	Rate of inflation	Rate of note issue	Rate of rise in the price of sovereigns
January	32.7-a	33.6	-17.6
February	-13.6	61.6	-4.5
March	2.1	27.5	-4.1
April	2.1	30.4	n.a.
May	1.3	7.1	-0.9
June	0.2	5.8	1.7
July	-0.2	7.8	1.7
August	-3.1	11.6	n.a
September	3.2	3.2	0.5
October	3.1	-1.2	n.a
November	3.7	-7.4	0.4
December	-5.7	14.8	n.a

a-The inflation rate for January is computed using the old price index. Data for subsequent months using this index are unavailable.

Source: Delivanis and Cleveland (1949, p. 188).

Bank of Greece for the first two months after the Convention, it only required 196 billion for the final nine months of 1946.

II. Evidence Bearing on a Regime Change

A. Unemployment and Output

Any interpretation of the unemployment and output effects of stabilization in each of the episodes is clouded by individual real dislocations or shocks that each economy suffered. After World War I, Austria and Hungary emerged as independent countries greatly reduced in size with the need to realign their economies accordingly. Poland was newly created and Germany lost substantial territory in the east and west. Both Hungary and Greece were major battlefields during World War II. Greece, in addition, had to readjust her foreign trade as her major prewar trading partners were Axis countries and those in the newly emerging Soviet sphere of influence.

The data assembled by Sargent show that while unemployment rose substantially in Austria, it was not as serious a problem in Hungary; that while it rose substantially in Poland it was no worse than in some months before stabilization; and that in Germany unemployment decreased.¹¹ Bomberger and I found that unemployment rose in Hungary II, but not by a magnitude or duration that would be suggested by those adhering to the concept of a core rate of inflation.

Unfortunately, no data on unemployment were ever collected on a systematic basis at this time in Greece. Two observations do exist, however, for the period following the Anglo-Hellenic Convention. A survey undertaken in the summer of 1946 fixed the Greek population at 7.257 million and the labor force (14 years and older) at 2.663 million, of whom 197,000 or 7.4 percent were unemployed.¹² On December 31, 1947, the Greek Ministry of Labor reported unemployment at 122,000.¹³ Whether the two methods of estimating the unemployed are comparable is unknown. Reinforcing the conclusion that unemployment fell are data on the real national income of Greece: it rose 5.5, 62.1, and 33.9 percent, respectively, in 1945, 1946, and 1947.¹⁴

Because of the real dislocations surrounding the economies during each of the stabilization episodes, the employment and output results may only be circumstantial evidence bearing on rational behavior. For that reason, a study of the movements of real balances is of interest.

¹¹ The reference for Sargent's conclusion on Germany is F. D. Graham (1930, p. 287). However, Graham reports (p. 317) that among trade union members, those wholly unemployed rose from 6.3 percent in August 1923 to 28.2 percent in December (when the series ends) while those partially unemployed rose from 26.0 percent in August to 42.0 percent in December 1923. Thus, while unemployment initially rose dramatically, it was short-lived and did not persist into 1924.

¹² This survey was undertaken by the Allied Mission to Observe the Greek Elections (1946) and is analyzed in Jessen and others (1947).

¹³ See Bank of Greece (1948, p. 72).

¹⁴ National income data for 1945-1947 are reported in High Board of Reconstruction (1950); for 1944, see Delivanis and Cleveland (1949, p. 22).

B. Real Balance Holdings

If one starts from the premise that economic agents in Greece realized that the hyperinflation of 1943-44 was caused by a chronically unbalanced budget covered by recourse to advances from the Bank of Greece, one must then ask whether the set of events on November 11, 1944, convinced them that the fiscal money supply regime had changed such that they could expect future stability in the price level.

For economic agents to believe that the November 11 reform was a regime change they had to believe that 1) convertibility of the drachma into BMA pounds, 2) the government's 2 billion drachma overdraft at the Bank of Greece, and 3) the promise of substantial foreign aid would be sufficient to limit new money issues to noninflationary proportions. Does the movement in real money balances show us they were convinced?

In Figure 2, real money balances are plotted for the 25 months following this first effort at reform. While three different prices indices are used to deflate the note series, all tell a similar story. The analysis will, however, use the series deflated by the market price of the gold sovereign for, as noted earlier, it is the least encumbered by prices that were either frozen or subject to state control.

In examining these data, one notices immediately that they do not exhibit the more or less uniform increase over time that characterizes similar data in the other studies. Rather, for 1945, the level of real balances shows large fluctuations—a rapid rise followed by an equally spectacular decline. Is this pattern, so much at variance with the other studies, consistent with rational expectations?

To answer this question, two somewhat different models of rational behavior should be distinguished. One implies that the economy is inhabited by a sort of omniscient agent who, when presented with a new set of information, is able to assess its significance quickly and act accordingly. The agent is able to do so even in those instances in which there could be a good deal of uncertainty about important pieces of information; an uncertainty that can only be reduced by observing the government's actual performance. This model is a kind of ultrarational expectations view of the world. The other behavior model implies that agents are less omniscient. In many instances they can be expected to

consume more time in gathering and processing the significance of new information. The additional time may be due to the uncertainty of the information. This should not be taken to mean that expectations are formed adaptively. Agents are still assumed to be forming expectations based on information concerning the monetary and fiscal policies to be pursued by the government.

If the omniscient behavior model is applicable, one might have expected the Greeks to have rejected the November 11 reform as being without substance, as it did not contain the crucial elements identified by past studies as being important in stabilizing economies—particularly, the overhaul of the fiscal system and the creation of an independent monetary authority. Nevertheless, the five-fold increase in real note balances from December through March 1945 far exceeds similar behavior in the other stabilization efforts.¹⁵ Obviously, the Greeks reacted positively to this reform. How might this behavior be explained? The explanation makes use of the less than omniscient behavior model in a world in which policy announcements are clouded with uncertainty.

Using this model, the explanation holds that agents had some notion that the November 11 reform indicated that the government was serious in trying to deal with the economic crisis. However, one major uncertainty in their evaluation of the reform's substance was the likely value of foreign aid to the Greek budget, this being the crucial element in the Greek effort to achieve a balanced budget. While the dollar value of this aid was known to be substantial, its value to the Greek budget was highly uncertain. To reduce this uncertainty required information on how much aid was to be delivered, when it was to be delivered, the prices at which it was to be sold, and the costs to distribute it. Only the passage of time in which the government's performance could be observed would yield information to reduce the uncertainty on these crucial elements and enable the Greeks to see whether the reform had substance. The evidence presented suggests that it did not take long for information to become available that the

¹⁵ Comparable increases were two-fold for Austria (September-December 1922), 1.7-fold for Hungary (March-June 1924), and 2.4-fold (August-October 1946), 1.5-fold for Germany (December-March 1924) and 1.8-fold for Poland (January-April 1924).

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net revenue from this aid would be small. Since this outcome was obvious, the Greeks must then have entertained little hope for a balanced budget and noninflationary issues of money, that is, the reform was seen to be without substance. As a consequence, real balances declined in April and May of 1945.

This decline was interrupted by the appointment of Varvaressos as economic czar with his startlingly new rent tax, whose potential to raise revenue was great. Since the elements of his reform program were contradictory, time was again required to assess their substance. Once he resigned and the potency of the rent tax was reduced, economic agents became convinced that this reform was also without substance. The entire preceding nine months were then viewed as having consisted of two temporary changes in policy in the context of a regime remarkably like the one that had generated the hyperinflation. As a result, real money balances declined precipitously, and, in December 1945, they were barely above their level one year earlier. Whether they would have continued to decline cannot be known for Greece and Great Britain signed the Convention in January 1946.

Once the Anglo-Hellenic Convention was signed and the institutional changes put in place, the actual money supply process did in fact change. While it remained true that the budget deficit would still require borrowing from the Bank of Greece, the resultant note issue would be held to noninflationary proportions through open market operations in gold sovereigns. Under these circumstances, did individuals perceive that this reform had substance (i.e., that a regime change had taken place)? The evidence suggests that they did and did so quickly.

We observe behavior much like that noted in the other studies. The four-fold rise in real note balances during 1946 closely approximates in magnitude similar behavior one year after the German and second Hungarian efforts were undertaken. In addition, this rise in real balances is more or less continuous, which is also similar to all of the other European stabilization experiences.¹⁶

¹⁶ One year after stabilization, real note balances had increased in Austria 2.6-fold; in Hungary 2.6-fold (first hyperinflation) and 4.4-fold (second hyperinflation); in Germany 3.8-fold; and in Poland 1.8-fold.

III. Conclusion

Economic behavior in Greece ultimately paralleled that observed in the other stabilization episodes. It took three reforms and success was not achieved until the Greeks put in place those changes the other studies identified as crucial to a regime change. The Greek experience, however, somewhat weakens the case for ultrarational expectations. The behavior of real balances during the first two reforms suggests that the public could not fully evaluate the possibility that these reforms constituted genuine regime changes without additional time to evaluate the government's actual performance—even when the nature of the reform might have suggested that a genuine regime change had not taken place.

One can conclude that, while the adaptive expectations-unit cost-core inflation view of the world is deficient as an explanation of Greek behavior during stabilization, the highly idealized version of rational expectations may not be entirely consistent with the evidence either. Rather, it may take time for individuals to evaluate and process new information.

The Taiwanese Hyperinflation and Stabilization of 1945-1952

(with G. Thomas Woodward)*

On the list of recognized hyperinflations one will not find Taiwan.¹ Its hyperinflation of 1945-49 has either gone unrecognized or is assumed to be part of the hyperinflation then occurring on the mainland of China during its civil war. Yet, the Chinese Nationalist government attempted to isolate Taiwan from the mainland inflation by creating it as an independent currency area. And during the later stages of the civil war it was able to end the hyperinflation on Taiwan, something it was unable to do on the mainland despite two attempts.

The experience on Taiwan is worth recounting. Hitherto our knowledge of stabilizing hyperinflation economies has been confined to European episodes. On Taiwan we can examine how an economy in a different institutional setting reacted to the traditional tools of monetary and fiscal policy.² In addition, a unique aspect of this stabilization was the creation of bank deposits offering high real interest rates. These deposits appear to have played a role in the stabilization, and help explain the unusual behavior of real money balances during the stabilization period. Finally, unlike most of the European episodes, the stabilization program on Taiwan was undertaken with little prospect of balancing the budget or bringing money creation under control, with two and a half years passing before

* The authors wish to thank Robert Worden and Donald DeGlopper for assistance in translating and two referees for their numerous helpful comments.

¹ The Taiwanese episode accords with the definition originated by Cagan (1956).

² The relevance of the mainland stabilization is limited since it occurred after the Communist takeover in 1949-50.

price stability was achieved. It, therefore, provides insight into the public's perception of and reaction to stabilization policies. The events cast doubt on some of Sargent's (1982) conclusions about the nature and perception of regime changes and the rationality of expectations.

I. Hyperinflation

In November 1945, Taiwan reverted to Chinese sovereignty. A hyperinflation was then in progress on the mainland, the legacy of war with Japan financed mainly by currency issues, a method of finance continued during the ensuing civil war. On Taiwan, however, the notes of the Bank of Taiwan (which was basically a commercial bank) remained the principal medium of exchange for five more months. The inflation there was under way as a consequence of the release of pent-up demand suppressed during the war by price controls and rationing.

To isolate the major areas of the country previously ruled by Japan (Manchuria and Taiwan) from the ongoing inflation, the Nationalist government created each as a separate currency area tied to the rest of China by adjustable exchange rates. The provincial government of Taiwan was authorized to adjust the rate according to purchasing power parity as measured by the price level prevailing in Shanghai and in Taipei, Taiwan's capital. Despite frequent adjustments, the Taiwanese currency was usually undervalued.

In May 1946, the Bank of Taiwan was authorized by the Nationalist government to issue a new local currency, the "taipi," in an amount of 5.3 billion yuan (the unit of account on the mainland). There were no reserves for the taipi and the amount that could be issued was subject to approval of the mainland government. Thereafter, the public finance practices of the Taiwanese government paralleled those on the mainland in that a major source of revenue was derived from the inflation tax. While detailed budget data are not available for Taiwan during this period, an inference can be drawn from the balance sheet of the Bank of Taiwan and those of other leading banking institutions. In June 1948, 78.2 percent of all outstanding loans made by lending institutions were made by the Bank of Taiwan, of which 70.3 percent were made to the government of Taiwan or its enterprises. By May 1949, the eve of stabilization, almost 90 percent of all loans had their

origin in the Bank of Taiwan, with nearly 82 percent destined for the public sector. The clear implication is that the budget was seriously out of balance.

As hyperinflations intensify, the flight from money reduces the base against which the inflation tax can be levied. To obtain the same level of real resources then requires a higher tax rate, and inflation races ahead of the accelerating rate of money creation. This was true in Taiwan. The average monthly rise in the Taipei wholesale price index during 1946, 1947, and 1948 was, respectively, 11.3, 18.5, and 22.5 percent. For the first five months of 1949, prior to the June 15 stabilization, the average rise was 53 percent (during May, prices rose 102 percent). The corresponding average monthly rise in the money supply was, respectively, 9.8, 9.8, 23.8, and 23.5 percent (39.5 percent for May).³

The literature on hyperinflation episodes often attributes the rise in prices to a decline in real income. Where the data are available, however, the decline cannot account for the rise in prices. Even though data on real output are not available for 1945 and 1946, similar conclusions can be drawn concerning the role of real output in Taiwan's hyperinflation. While real output declined during World War II as a result of Allied bombing (falling in 1944 to less than half its 1942 level), it underwent substantial revival from 1947 on. Industrial production declined into 1946, but more than doubled between 1946 and the time of stabilization. The growth in economic activity, then, mitigated the rise in prices.

The magnitude of Taiwan's hyperinflation was much lower than on the mainland. The average monthly increases in prices and money supply were about one-third and one-fourth as great, respectively. Because its inflation continued for almost four years, the ultimate rise in the price index would make its hyperinflation more severe than those experienced in Austria, Hungary I, and Poland and slightly less severe than the Russian episode. In terms of the monthly average rise in prices, it is the mildest of the hyperinflations.

³ These data are taken from Liu (1970, Appendix Tables A-11, P-1, and P-11, pp. 2, 18, and 19).

II. Stabilization

By the end of May 1949 real money balances had fallen to between 1.5 percent and 6.2 percent of their pre-hyperinflation levels (depending on the date used as the beginning of the episode). Because the fortunes of the Nationalists on the mainland were bleak, a complete repudiation of the currency was a genuine likelihood. Thus, a major reason for undertaking a stabilization program was the belief that it was necessary for the survival of the government. On June 15, 1949, the Nationalists unveiled their program. Its major provisions were:

(1) A unit of account known as the New Taiwan dollar (hereafter NT\$) was to replace the taipi yuan.

(2) One NT\$ was to be exchanged for 40,000 taipi yuan.

(3) The government repaid its advances from the Bank of Taiwan with gold, silver, and commodities, and the Bank then assumed many central banking functions.⁴

(4) A ceiling of NT\$200 million was placed on the issuance of new notes with the reserves of the Bank of Taiwan sufficient to ensure a 100 percent gold, silver, and commodity cover.

(5) The NT\$ was made partially convertible in that foreign exchange was available for a variety of external payments at the rate of NT\$5 for US\$1. Export earnings had to be surrendered at the same rate (although 80 percent was paid in the form of an exchange certificate that could be sold or used for importing goods).

(6) A Gold Savings Deposit Program was created allowing individuals to deposit NT\$ in accounts paying gold at maturity.

Absent from the program was any major effort to reduce the budget deficit. With the task of fighting a civil war and rebuilding a war-damaged economy, the Nationalist government was not in the position to cut its outlays. Moreover, the bulk of any new taxes would have to be borne by the island's indigenous population. In this environment the Nationalists were cautious in imposing heavy new taxes on their hosts. There were efforts to streamline the bureaucracy and some minor tinkering with the tax system, but no overhaul of the fiscal system

⁴ While the offices of the Bank of China were moved to Taiwan late in 1949, the central bank was not activated until 1961.

occurred as had accompanied the successful European stabilizations. As a percent of GNP, the Nationalists in 1950-52 raised only 70 percent of the revenue raised by the Japanese.⁵ Indeed, the island's task of balancing the budget was made more difficult by the need to support the entire apparatus of national government.

Inflation did not come to an immediate end. It did slow dramatically. From the middle of June through December 1949, the wholesale price index rose by 82 percent in contrast with a 729 percent increase for the first five months (see Figure 1). The government during this period lived within the NT\$200 million ceiling, ensuring a 100 percent metallic or commodity cover. Nevertheless, the money supply measured as currency rose 243 percent and as M1, 290 percent. The Bank of Taiwan's balance sheet indicates that the majority of new notes continued to be advanced to the public sector. Because foreign exchange was unavailable for all purposes, and the pressures for external transfers great, a black market developed in foreign exchange. By December, the rate was NT\$8 per US\$1, as opposed to an official rate of 5 to 1. (The market price of foreign exchange certificates also exceeded the official rate.)⁶

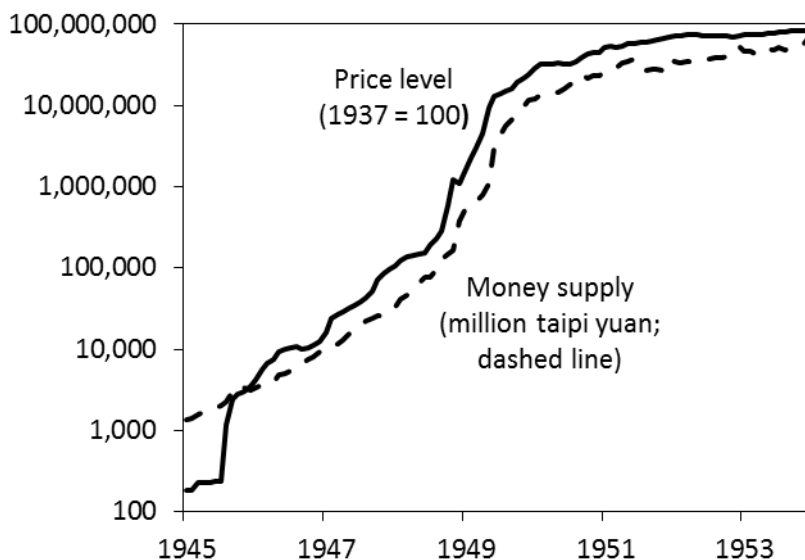
During 1950, currency grew 90 percent while M1 grew 99 percent. By June 1950, the NT\$200 million ceiling on new notes was exceeded. An "extra-limit issue" of NT\$50 million was authorized (to be covered 100 percent by a commodity reserve). At the year's end, the outstanding note issue still had a gold reserve of 80 percent.

During 1950 the Taipei wholesale price index rose by 89 percent, but the rise was quite variable. For January and February, prices rose 20 percent and 11 percent, respectively. The price level was stable from March through June. For August through October, the rise in prices

⁵ For a complete description of the fiscal reform, see Riegg (1978).

⁶ Although the government was liberal in granting foreign exchange (approved purposes included all goods and services "harmless to health" (Liu, p.7), all requests had to be supported by documentation assuring its use for approved purposes. The government's ability to process these applications was overwhelmed. Thus, even legitimate demands for foreign exchange found their way to the black market along with demands related to unapproved goods and capital exports.

Figure 1. Prices and Money Supply in Taiwan, 1945-1953



was 34 percent. Prices then rose only 1.8 percent in November and 2.4 percent in December. The government continued its policy to make foreign exchange available, but brought its selling rate of the NT\$ more into line with the black market rate.

In March 1950, the stabilization effort was augmented by the Preferential Interest Rate Deposit (or PIR) program, a system of time deposits at the Bank of Taiwan and other commercial banks paying positive real rates of interest.⁷ Initially offered with a maturity of one month (three-month, six-month, and one-year accounts were eventually made available as well), the accounts paid interest at the rate of 7 percent per month.

Since the commercial banks were obliged to pay high real rates for these funds, they were forced to charge high real rates on the loans they made. The program provided that all the funds from these deposits that banks were unable to lend out could be redeposited with the Bank of Taiwan at an interest rate at least equal to the rate the banks paid to

⁷ These were high real rates *ex post*. We have no measure of expected inflation and, hence, no measure of the *ex ante* real rate. The acceptance of these deposits by the public suggests that the *ex ante* rate was at least positive.

their depositors.⁸

The deposits rose from NT\$2 million early in 1950 to over NT\$37 million in August (equal to about 13 percent of high-powered money). As the inflation rate slowed, the government apparently believed that the rate payable on the accounts could be reduced. In July, the rate on the one-month account was reduced by one-half to 3.5 percent per month and in October it was reduced further to 3.0 percent. The decrease led to a withdrawal of these deposits, and by December 1950 they had fallen to only NT\$26 million (or about 7 percent of high-powered money).

The outbreak of the Korean War in late June 1950 ensured the ultimate success of Taiwan's stabilization effort. This prompted the United States to commence a large aid program. While the Nationalists had previously received substantial U.S. aid, it was terminated with the mainland's fall in late 1949. Thus, when the stabilization got underway, it was not benefiting from U.S. support.

Although only a small amount of aid would reach Taiwan in 1950, by the end of 1951 it was 10 percent of GNP. Besides military assistance, a large fraction of the aid consisted of consumer commodities and industrial raw materials that the government could sell to generate revenue.

In February 1951, another "extra-limit" currency issue of NT\$95 million was authorized. Thereafter, the limit on currency issue placed no effective restraint on money growth. In April, the exchange stabilization fund became depleted and individuals could no longer convert the NT\$ for external payments. Severe restrictions were then imposed on all foreign payments, imports were limited, and the NT\$ was devalued. At the same time, the interest rate on PIR deposits was raised by over one-third. The deposits then grew over five-fold (by the end of 1951, they were equal to about 30 percent of high-powered money). Moreover, the value of U.S. commodity aid imports grew almost three-fold in 1951 over 1950 (in U.S. dollars commodity aid

⁸ There is some dispute on this point. Irvine and Emery (1966) and Liu report that only the excess of deposits over loans were deposited. Mao (1967) and Kuo (1983) assert that all the preferential deposits had to be redeposited with the Bank of Taiwan. Examination of primary sources supports Irvine and Emery and Liu. Riegg (1978) also supports this view.

increased from \$20.5 million to \$56.6 million).⁹

With the introduction of the PIR deposits, the definition of money becomes arbitrary. During 1951, the money stock measured by currency grew 53 percent (34 percent during the second half of the year), as M1, 61 percent (it actually declined by 1 percent during the second half of the year as the PIR deposits were substituted for demand deposits), and as M1 plus the PIR deposits, 83 percent (7.4 percent during the second half). According to all measures, money growth decelerated during the year, as did prices (the Taipei wholesale price index rose 53 percent for the year, but only 18.5 percent during the second half).

In 1952, price level stability was achieved. For the year as a whole the Taipei wholesale price index rose only 3.4 percent (during the final six months it actually declined 1.3 percent). The money supply measured as currency rose 36 percent; as M1, 42 percent; and as M1 plus PIR deposits, 62 percent (the PIR deposits alone increased by 179 percent and at the end of the year were equal to almost half of high-powered money). Lasting stability was still several years away. Until 1961, prices tended to rise at high single digit and occasionally double-digit annual rates. Yet, the threat of renewed hyperinflation was over.

III. Interpretation

Successful stabilizations undertaken in Europe required both fiscal and monetary measures. Producing balanced budgets (or surpluses) reduced the pressure on the monetary authorities to provide the wherewithal to finance the deficit. In addition, the monetary authorities were given considerable independence to refuse the government's request for credit. Specifically, laws were passed that prohibited the central bank from discounting treasury bills or that imposed gold reserve requirements on all notes.

Unfortunately for Taiwan, neither a major increase in taxes nor an independent central bank was possible. Hence, the reform consisted mostly of trying to restore public confidence in a new currency by

⁹ There is some conflict in the various studies about how much aid reached Taiwan each year. These data are from *Taiwan Statistical Data Book* (1966, p. 139).

making it partly convertible into gold and foreign exchange. It thus resembled the two failed stabilization attempts on the mainland more than it did either the European programs or recent stabilizations in Latin America.¹⁰ Apparently, the Nationalists continued to believe that if zeroes were lopped off the currency unit, and the money associated with precious metals, inflation would end.

Selling gold and foreign exchange to bolster confidence in the new currency was a help, but it could not persist in the face of a chronically unbalanced budget. The government was addressing its fiscal imbalance by selling assets (hard currency) abroad and earning seigniorage on its newly created notes. Providing foreign exchange to the public to import goods was no different from using the exchange to cover its purchases. For the foreign exchange and gold, the government received currency it had previously disbursed through spending. Hence, monetary expansion was reduced in the same way as if the government had spent the gold and foreign exchange directly. This could work only as long as hard currency and assets were available.

Similarly, to the extent that quasi-convertibility or the promise of stability restored confidence in the currency and increased the public's willingness to hold money, the government could money-finance some of its expenditures with minimal inflationary impact. Yet, without budgetary changes, confidence could not last, for as its gold stock diminished, currency was not retired from circulation. In addition, the government's initial allocation of NT\$56 million at the 40,000-to-1 conversion rate amounted to a four-fold increase in the amount of circulating currency over the end of May 1949, and it could be expanded further before reaching the issue limit. Combined with budgetary pressure to produce more notes, further increases in prices were inevitable.¹¹ Seigniorage could be earned for only so long under

¹⁰ The stabilization program on Taiwan may appear to be an example of a "heterodox" approach due to the variety of elements contained in it. In fact, most of these elements either amounted to the same thing (i.e., convertibility) or were not part of the original plan (such as the PIR accounts). Price controls, for example, did not appear to be part of the stabilization plan. They existed in part to affect other goals such as land reform and were otherwise ineffective. Rationing was also used, but mostly to pay public sector employees in kind.

¹¹ An additional, apparently minor, source of money growth was the conversion of mainland currency held by refugees into New Taiwan dollars.

10. The Taiwanese Hyperinflation and Stabilization of 1945-1952

such circumstances.

The Gold Saving Deposit Program was used by the public as a means of acquiring gold by withdrawing deposits as early as possible. It became a significant drain on gold supplies and the program was terminated in June 1950. The loss of hard currency indicates the degree to which the government covered its deficits through asset sales. By 1951, 1.45 million ounces of gold and US\$6.6 million were sold to the public. The hard currency assets of the Bank of Taiwan were exhausted in the spring of 1951 (indeed, the Bank owed more than US\$10 million).

One element of the government's finances that helped reduce the need for money creation was an aggressive effort to borrow from the public to cover the deficit. In 1950, the sale of bonds raised receipts equal to more than a quarter of the deficit. In 1951, this ratio was further increased to almost two-thirds. Unfortunately, these figures overstate the success of this switch in financing since the central bank bought some fraction of these issues and thereby increased the monetary base. By the end of 1952, government bonds constituted roughly 25 percent of the total amount lent by the Bank of Taiwan to the public sector.

A much larger contribution to the stabilization effort was made by the PIR accounts since they also enabled the government to borrow from the public instead of from the central bank. Because the mandated interest rate on the deposits exceeded the level that would have equilibrated the supply of deposits with loan demand, an excess supply of funds that could not be lent to private borrowers was created. The redeposit feature guaranteed that this excess supply of funds would find its way to the Bank of Taiwan. The deposits (and redeposits) then provided the Bank with a means of advancing credit to the public sector without issuing new notes. This reduced the rate of growth in the monetary base. In terms of the consolidated central bank-central government balance sheet, the Chinese government had, through recourse to redeposited PIR deposits, a means to finance more of its deficit by borrowing from the public. Consequently, the real effect of these deposits was to shift a large fraction of deficit financing from note issue to what amounted to bond sales, reducing the rate of money growth.

This description of the role of the PIR accounts contrasts with that of Irvine and Emery (1966) and Liu (1970), who emphasize the role of the deposits in “immobilizing” and “absorbing excess liquidity.” It is unclear whether they mean that the accounts reduced velocity or the money multiplier; indeed, they seem to argue that the accounts diverted funds into savings that would have been spent.

The accounts could not have reduced velocity because they did not offer an incentive to hold additional money balances. Rather, by offering an alternative to money, they should have reduced money demand. Nor could they have absorbed “excess liquidity” in the form of reserves, for they also would have tended to raise the deposit-to-currency ratio, so that the net effect of the deposits, except under implausible configurations of the reserve, currency, and deposit ratios, would have been to swell the supply of money—not shrink it. If anything, they would have increased inflationary pressure by substituting for money and reviving deposit banking. Any effect they may have had on saving, by itself, would have done little or nothing to improve the inflation situation. While an autonomous increase in saving is deflationary, any effect of the PIR accounts on saving would have been due to the high real interest rate they bore—a phenomenon that decreases money demand and increases velocity and prices.

Tsiang (1985) argues that the PIR deposits helped reduce inflation by drawing more savings into the banking system from “underground” or “curb” money markets and that this reintermediation of the economy reduced the need for the Bank of Taiwan to create money to satisfy private loan demand.¹² Central bank discounting of private paper, however, appears to have been a relatively minor source of money creation during the hyperinflation. Therefore, reducing lending to the private sector—even if it had been prompted by interest rates too low to equilibrate supply and demand—would have had little effect on the inflation rate. The crucial characteristic of the deposits appears to be how they provided a substitute source of public finance.

And as a borrowing program the PIR deposits were significant. For 1951, for example, funds redeposited at the Bank of Taiwan increased

¹² McKinnon (1973) also mentions reintermediation, but as a source of improvement in economic efficiency.

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NT\$125 million (this does not include deposits placed initially with the Bank of Taiwan that could not be profitably lent to private borrowers). This was more than three times the 1951 amount of counterpart aid and equal to 40 percent of the budget deficit. Presumably this NT\$125 million otherwise would have been created as high-powered money to finance the public sector.

Sargent and Wallace (1981) note that under certain assumptions, a shift from money to bond financing may not result in a reduction in inflation. Their “unpleasant monetarist arithmetic” shows that if real interest rates exceed the economy’s growth rate, additional borrowing by the government will imply a future deficit that can only be money financed. The expectation of future inflation that this engenders can prevent even a temporary respite from inflation resulting from the interim reduction in money growth.

This analysis assumes no future changes in taxes or primary (i.e., noninterest) expenditures. The rates of real interest and growth, along with the maximum tolerable level of taxation, define a point of no return, after which no plausible fiscal reform can bring the budget into balance short of debt repudiation. If the point of no return is near, and agents’ assessment of the prospects of fiscal reform poor, then no shift from money finance to debt finance can improve inflation, if only because interest rates high enough to compensate lenders for the risk of repudiation (by inflation or other means) would be so high as to make repudiation (and more inflation) more likely.

Yet, with a high real growth rate and the point of no return far in the future, the chances for fiscal reform in the more distant future may be enough to permit a shift from money to bond financing to influence inflation. Moreover, in Taiwan’s case it is not clear that agents realized that the spread of PIR accounts would make future budget balance more difficult. The circuitous nature of the financing made it less likely that the public understood that the accounts were a means for debt financing of the government. Indeed, to our knowledge, no one has pointed out this role for the PIR accounts.

This is suggested by the PIR program itself. One wonders why the government did not directly borrow at high interest rates. There are some possible explanations, but none are as persuasive as the

Table 1. Revenues and Expenditures for All Levels of Government in Taiwan, 1950-1953 (mn New Taiwan dollars)

	1950	1951	1952	1953
Expenditures	1,954	2,430	3,576	3,745
Receipts	1,587	2,121	3,521	3,846
Current revenue	1,527	1,964	3,467	3,791
Income from property	60	156	55	55
Counterpart fund aid	0	40	470	313
Balance	-367	-309	-55	102
Percent of expenditures	19	13	2	n.a.
Revenue from bond sales	96	195	105	29
Not covered by bond sales	-271	-114	50	131

Source: Taiwan, *Statistical Yearbook of the Republic of China* (1975, p. 237).

possibility that the government never understood the monetary implications of the PIR program, and that the program never was part of any coherent stabilization plan. In all likelihood, its monetary consequences were just a fortuitous outcome of an effort to do something else. We note that in two contemporary experiences, analogous efforts were made to employ alternative financial instruments insulated from ongoing inflation. In the case of post-World War II Hungary, deposits (and eventually currency) were indexed for inflation (Bomberger and Makinen 1983). In the formative stages of the Greek hyperinflation, the occupying German authorities used gold sovereigns to purchase commodities (Makinen 1986). In these cases, the innovation worsened the inflation. It may only be luck that the Chinese (impelled perhaps by the same motivations as the Germans and Hungarians) hit upon a mechanism that actually helped slow the inflation rate.

Of course, it is a fiscal overhaul that is required for the permanent success of a stabilization program. It was the fiscal regime change on Taiwan, as in the European episodes, that finally brought price stability. It was the aid program that brought the budget to near balance, and when the aid program reached its full proportions in 1952, prices stabilized.

Data are not available for a comparison of the budget just before

and immediately after the initiation of the stabilization plan. Inferences on the transition must be drawn from central bank advances. These indicate no sudden improvement. The data for the following years indicate budgetary improvement only after aid became available (see Table 1). Deficit reduction from 1950 to 1951 is accounted for entirely by counterpart aid and the sale of property (another temporary source of receipts). In 1952, counterpart aid accounted for all the reduction in the deficit. Moreover, the budget numbers betray only part of aid's deficit reduction role because they show only the counterpart aid. Taiwan also received direct assistance in noncounterpart form. These goods were important in reducing expenditures that otherwise might have been undertaken, especially for defense, which was reduced in real terms between 1950 and 1951 while the armed forces were reequipped. Regardless of the form aid took, it reduced inflation by reducing the amount of government spending financed by the creation of high-powered money.

Besides the aid program and the PIR deposits, the deceleration of the inflation rate during 1951 and the stability of prices in late 1952 was assisted by a substantial increase in real output. This was aided by the enormous amount of human capital brought to Taiwan by the nearly half-million civilian refugees from the mainland (equal to almost 10 percent of the native population) who arrived in late 1949.

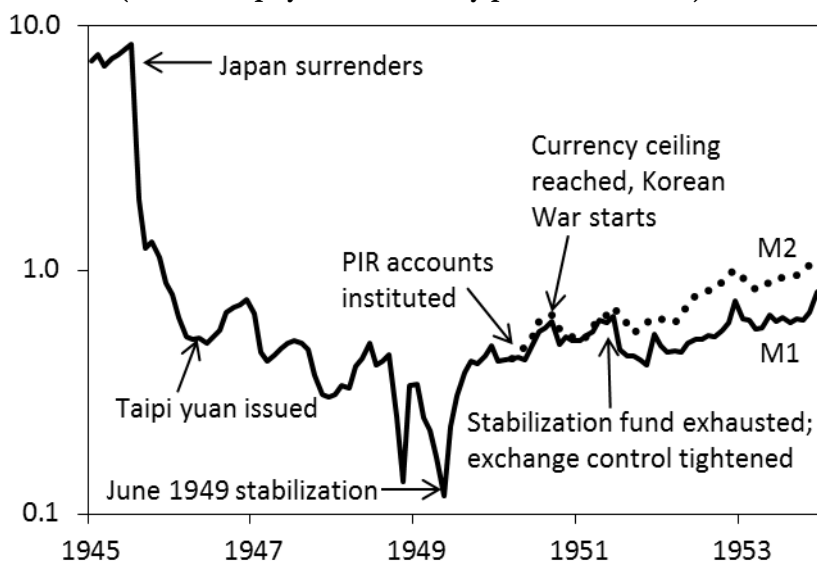
IV. Implications

It is interesting that the aid program, which was decisive in bringing price stability to Taiwan, was announced 13 months after the stabilization. The PIR deposits came after nine months had passed. No one could have known in advance how rapid economic development and the resulting growth in tax revenue might be. In short, the stabilization was embarked upon with neither an actual nor a promise of change in the fiscal or monetary regime.¹³

Nevertheless, the hyperinflation ended. While inflation continued at a high rate, it did slow dramatically. Agents in the economy were

¹³ Alternatively, one might say a regime change occurred, but that it was not of the type identified by Sargent as necessary for ending hyperinflation.

Figure 2. Real Balances in Taiwan, 1945-1953
 (million taipei yuan divided by price level index)



apparently willing to put some confidence in the currency solely on the promise of a convertibility that obviously could not be maintained. The behavior of real balances shows this. For the hyperinflation and immediately thereafter, their behavior mirrors other episodes: at the time of stabilization they were only a fraction of their value at the beginning (see Figure 2). Their rebound immediately following the stabilization is significant; by July, they had recovered from the depths achieved in the final, worst months of the hyperinflation.

Following some further increases in early 1950, however, real balances flatten and even drop somewhat, so that by the beginning of 1952, they are lower than at the end of 1950, having reached only 40 percent of their 1937 level, the last "normal" year available for comparison. This behavior is explained by the prevalence of the PIR deposits. These deposits substituted for money as a temporary abode of purchasing power. When they are included in the money measure (M2), the data reveal the continued climb of real balances (to 54 percent of the 1937 level). The continuation of this general upward trend in the 3½ years after stabilization is consistent with the behavior

one would expect if the public believed that a regime change had taken place.

In other words, even though no regime change occurred at the time of the program's implementation, the public appears to have behaved as if one did. This conclusion is buttressed by the change in the causal relationship between money and inflation which also occurred at the time the program began.

Sargent and Wallace (1973) explain that under appropriate assumptions, the existence of a regime that attempts to extract a fixed proportion of resources from an economy by means of money creation implies a specific causality relation between money growth and inflation. Since the creation of money to pay for resources generates inflation, subsequent note issue by the government has to be increased in response to inflation's effects on the nominal cost of resources to be extracted in later periods. As a consequence, note issue comes to depend on price increases; that is, inflation "causes" money growth. If expectations are rational, agents should set prices based on money growth. And since the rate of note issue depends on past inflation, they should be able to predict the rate of money creation from the past history of prices. Inflation comes to depend on past inflation; money creation drops out of the chain of causation.

This implies a unidirectional causal ordering from prices to money. That is, Granger-Sims style causation tests should show that the lagged values of prices and money explain current values of money better than past values of money alone, while at the same time lagged values of money and prices fail to explain current prices any better than past prices by themselves. A successful stabilization should break this causal nexus from prices to money. A regime change designed to end hyperinflation requires the monetary authorities to reassert control over money creation. With monetary policy no longer subservient to financing the fiscal shortfall, past inflation should cease to be a predictor of note issue.¹⁴

¹⁴ Makinen and Woodward (1988) show that the transition to stabilization and beyond does not necessarily imply a reversal of the Granger causal ordering of inflation and money creation. This results because the stabilization implies a remonetization of the economy as the costs of holding money balances

However, the causal nexus can also be broken by a change in the public's expectations. If agents no longer believe that past prices determine the monetary requirements of the government, then they should no longer be setting new prices based on past inflation. Their resulting willingness to absorb increases in the money supply without corresponding increases in prices should mean that prices no longer Granger-cause money.

Sims tests run on data from the periods before and after June 1949 are summarized in Table 2.¹⁵ The F -values for the equation predicting prices test the contribution of future rates of money growth to the prediction of current observations of inflation, thus indicating whether or not inflation "causes" money growth. For the hyperinflation period we are unable to reject the null hypothesis of no causation from money growth to inflation. However, within a 95 percent confidence interval, the null hypothesis of no causation from prices to money is rejected, implying a regime in which inflation leads to money issue. During the stabilization period the null hypothesis of no causation in either direction cannot be rejected. A Chow test was performed to be sure that the split sample really reflects two different underlying

decrease and velocity falls. Any linkage from money to prices during such a period is weak.

¹⁵ The Sims version of testing for Granger causality involves leading and lagging observations of the independent variables. The estimating equations are:

$$(1) P = a + bT + \sum_{t=4}^{-6} k_t M_t + e$$

$$(2) M = c + dT + \sum_{t=4}^{-6} z_t P_t + e$$

where P is inflation and M money growth, T is a trend and e an error term. F -tests are performed on the lead variables. In our tests of the subperiods, all observations are confined to the subperiods in question. For example, for the stabilization period, the lagged observations do not involve using any values from the hyperinflation period and similarly for the leading observations used during the hyperinflation period.

Table 2. Prices versus Money in Taiwan, 1945-1953

	1945- 1949	1949- 1953	1945- 1953
Money regressed on prices <i>F</i> -statistic	2.47	0.98	1.41
<i>R</i> ²	0.74	0.25	0.32
Prices regressed on money <i>F</i> -statistic	3.02	1.17	11.12
<i>R</i> ²	0.72	0.23	0.53
Degrees of freedom	21/4	30/4	76/4
Critical value of <i>F</i> : .05	2.84	2.69	2.49
Critical value of <i>F</i> : .01	4.37	4.02	3.58

distributions. *F*-statistics of 22.55 and 4.46 (money growth and inflation as dependent variables, respectively) were both significant at the 1 percent level, rejecting the hypothesis that the pre- and post-stabilization regressions are the same. Regressions using notes instead of money yielded the same result.

This could be evidence of a regime change. But since we know that no regime change occurred, it must be taken as evidence that agents perceived a change, and, thus, that the June 1949 reform meant to them that the government would end the practices it had engaged in to cause hyperinflationary money growth.

Data on real balances are frequently supplemented by data on unemployment. Presumably, the expectations that influence individuals to hold larger real balances will lead them to moderate their demands for money wage increase. Since this moderation prevents nominal wage increases from becoming excessive *ex post* real increases when the inflation slows, the economy can make the transition from hyperinflation to price level stability without the necessity of experiencing a prolonged period of high unemployment. Examining the Taiwanese data would tend to lead to a similar conclusion.

The stabilization was accompanied by positive growth in national income, but at a rate substantially less than the 1947-1949 pace. That earlier pace, however, could have been artificially high because of the recovery from the large-scale destruction of World War II, and the use of inflation tax proceeds either to expand state enterprises or distributed as subsidized loans to the private sector. Evidence from

several other hyperinflations suggests that they were also characterized by a booming economy. To the extent that the inflation tax revenue was used for state and private enterprise expansion, resource misallocation could have resulted and been responsible for some of the slower growth after stabilization.¹⁶

While the time series on unemployment only begins in 1951, it reveals that for that year and for 1952, the ratio of unemployed to the active labor force was 7.8 percent. It then rose slightly and remained above 8.0 percent for the next four years. This rate is remarkable when it is recalled that Taiwan was forced to absorb nearly a half million mainlanders early in the stabilization.

Thus, if one examines the Taiwanese experience as Sargent did for four European experiences, one might be led to the same conclusion: that a regime change was perceived, price-setting behavior was immediately affected, and the transition costs of bringing inflation down were significantly moderated.

The problem with this conclusion is that the stabilization program lacked the presence and promise of a regime change. The central bank could not refuse the government's request for credit and the budget deficit made convertibility impossible to maintain. When the regime changed later, it did so as a result of serendipity (the PIR program that raised the amount the government would borrow from the public) and an unforeseen windfall (the aid program prompted by the Korean War).¹⁷

Sargent's proposition that the perception of a regime change can ease the transition costs to price stability requires first that people perceive regime changes. He takes the experience that behavior changed in the European cases as evidence that indeed such changes

¹⁶ Garber (1982) has identified and measured a number of resource misallocation costs due to a distortion of relative prices that occurred during the German hyperinflation. Because some central bank lending was to government enterprises, there is reason to believe that such costs may have occurred in Taiwan during the stabilization.

¹⁷ If one does accept the applicability of "unpleasant monetarist arithmetic," our conclusion is merely reinforced: rational agents would have to have realized that the PIR accounts were making no contribution to the stabilization.

can be discerned. But it must not only be true that when a regime change takes place people perceive it, it must also be true that when no regime change occurs people do not erroneously perceive one nonetheless. This is implicit in his analysis elsewhere (Sargent 1983), where he argues that the failure to have the elements necessary for successful stabilization will add to its transition costs.

In Taiwan the public appears to have believed in a nonexistent regime change—based on the kind of evidence used by Sargent. And Taiwan is not an isolated instance. Makinen (1984) has shown that in Greece the public reacted favorably to two reforms that failed to contain elements necessary to stabilize prices. Thus, the public may have difficulty in distinguishing regime changes from superficial changes in economic policy. This suggests that the public (at least in some circumstances) may be willing to believe in a stabilization solely on the basis of its announcement, with little evidence that it can succeed, and raises the issue of what achieves credibility and what fails to achieve it. If the public finds the mere promise of stabilization partly credible, might they find a genuine regime change less than totally so? If hyperinflations provide us with economic experiments to test public reactions to changes which are large and events that are highly visible, these questions become more troublesome in the case of less rapid inflations and less dramatic stabilization programs.

V. Conclusion

During the period 1945-49 Taiwan experienced a hyperinflation separated from the ongoing hyperinflation on the mainland by adjustable exchange rates between the currencies in use in the two regions. An attempt to stabilize prices was implemented in June 1949, but for a variety of reasons it did not contain the two elements essential for bringing about stable prices: a balanced budget and an independent central bank capable of refusing the government's request for credit.

The government's policy at first consisted of using its reserves of hard assets to cover much of its deficit, reducing money creation as a consequence. As these reserves were being exhausted, it embarked on a program of borrowing from the public through high-yielding bank accounts. Finally, massive U.S. aid helped bring the budget close to

balance. Along with the revival of tax revenue that came with economic growth, this ended rapid inflation by mid-1952—three years after the stabilization program began.

The behavior of real balances, along with apparent lack of significant transition costs, and the results of Granger-Sims style causation tests point to a significant adjustment of public behavior in response to the initial stabilization program. In other countries, these kinds of observations have been taken as evidence that a regime change has been perceived and acted upon. In Taiwan, however, a regime change did not occur immediately, even though it did occur ultimately. This raises questions about the public's ability to distinguish genuine from superficial changes in fiscal and monetary policies.

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