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Currency Crisis and Unemployment
Sterling in 1931

Barry Eichengreen and Olivier Jeanne

1.1 Introduction

With this conference, held nineteen years after the appearance of Krugman's pathbreaking article on speculative attacks, the literature on this subject can be said to have passed through adolescence and reached maturity (in, one hopes, all senses of the word). Like any maturing subject, this one evinces changing preoccupations. The early literature on speculative attacks focused on conflicts between the stance of monetary and fiscal policies on the one hand and the authorities' exchange rate commitment on the other. An attack was assumed to occur when excessively expansionary monetary and fiscal policies gradually depleted the central bank's international reserves. It was triggered when those reserves fell to a critical threshold at which they were abruptly exhausted by currency speculators. This model was attuned to the time in the sense that inflation and, by implication, excessively expansionary monetary and fiscal policies were widespread problems, creating chronically overvalued currencies, and in that capital markets were less than fully liberalized, limiting the

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ability of central banks and governments to borrow to defend the exchange rate.[1]

More recently, attention has shifted to conflicts between the internal and external objectives of governments. Where the "first generation" models referred to above highlighted conflicts between domestic and external policy instruments, "second generation" models focus instead on internal and external objectives. In recent models, optimizing central banks and governments are assumed to maximize a welfare function that has as arguments domestic variables like output, employment, and the stability of the banking system on the one hand and external variables like the commitment to the exchange rate peg on the other. Central banks are free to borrow, and the level of reserves no longer determines their capacity to defend the exchange rate. But there may be a conflict between the steps required to defend the currency and those that work to stabilize output, employment, and the banking system. Hence, worsening domestic conditions may tip the balance toward policies to stabilize output and employment and induce the authorities to abandon the currency peg. To the extent that the markets are aware of these incentives, a gradual deterioration in domestic conditions may lead investors to anticipate the inevitable and precipitate an attack. And that attack can occur without evidence of the inflation, current account deficits, monetary excesses, and overvaluation on which first-generation models depend.[2]

Like their predecessors, these second-generation models, developed in the early 1990s, were stimulated by the events of the time. The speculative attacks of the early nineties took place in an environment of high capital mobility in which the ability of central banks to borrow was no longer an issue. In a number of cases, of which France in 1992–93 is the most frequently cited example, attacks occurred in the absence of obvious evidence of monetary excesses, inflation, competitiveness problems, and current account deficits. They took place in the context of high unemployment, which rendered governments reluctant to raise interest rates and restrict credit in order to defend the currency if doing so meant aggravating labor market conditions. Some countries had weak banking systems whose stability might have been further jeopardized by policies restricting the availability of credit. Others had governments that had issued large amounts

1. Borrowing to defend the exchange rate was not impossible, only difficult. But to the extent that borrowed reserves had to be paid back with interest, borrowing aggravated any existing fiscal imbalance and might not even delay the crisis. See Buiter (1987).

2. The original Krugman formulation assumed purchasing power parity, so no change in the ratio of domestic to foreign price levels was possible; excess demand at home produced current account deficits but no overvaluation. Subsequent models relaxed the purchasing-power-parity assumption and allowed monetization to produce inflation and overvaluation in the period leading up to the attack (e.g., Calvo 1987; Willman 1988). But from the standpoint of the distinctions of concern to us here, these differences in assumption are of little consequence.

of short-dated public debt, on which debt-servicing costs were highly sensitive to the level of interest rates. All these were reasons why officials might have perceived a conflict between the measures needed to defend the currency and those appropriate for pursuing domestic economic objectives, and why a deterioration in domestic conditions might precipitate an attack.[3]

However appealing the explanation these models provide for such episodes as the attacks on the French franc in 1992–93, their generality has been questioned by authors who continue to emphasize excessive inflation and problems of external competitiveness as causes of currency crises (see, e.g., Krugman 1996; Dornbusch, Goldfajn, and Valdés 1995). Second-generation models, they note, have been subjected to few empirical tests (see, however, Jeanne 1997a; Jeanne and Masson 2000). In a sense, the generality and empirical applicability of the insights about real-world behavior that can be gleaned from these models remain contentious issues.

In this paper we explore the insights about the 1931 sterling crisis to be gained from applying a second-generation model and in turn attempt to push this strand of literature forward a few modest steps. Our focus on the 1930s is no happenstance, for the Great Depression is the obvious hunting ground for investigators seeking to understand the connections between unemployment and currency instability. Not only was this a decade of unprecedented unemployment throughout the industrial world, but the period was marked by rampant speculative attacks that culminated in the collapse of the gold-exchange-standard system. Much has been written about the unemployment and the currency crises of the 1930s, but in most of this literature the two phenomena are only obliquely linked. And the sterling crisis is the obvious place to start. Unemployment had been the highest for the longest in the United Kingdom, and the attack on

3. The distinction we have drawn here, between first-generation models, in which attacks occur because domestic demand is excessive (and spills over into imports and reserve losses) and second-generation models, in which attacks occur because domestic demand is deficient (causing unemployment and undermining the authorities' resolve to defend the currency), is different from that drawn by other authors (viz. Krugman 1996; International Monetary Fund 1997; Flood and Marion 1999). These authors emphasized instead the distinction between models that are characterized by unique or by multiple equilibria. From our point of view, this is a secondary issue: both classes of models we have described may feature either unique or multiple equilibria, depending on details of specification. First-generation models produce a unique equilibrium if the authorities' policy process is unique and invariant (in Krugman's case, if they adopt an unchanging fiscal policy and monetize all deficits). They produce multiple equilibria if the policy process is contingent and the authorities are assumed to shift to a more inflationary monetary policy if and only if the currency is attacked (as in Flood and Garber 1984 and Obstfeld 1986). But both possibilities are also present in second-generation models. If a rise in (exogenously determined) unemployment increases devaluation expectations without feedback, the timing of speculative attacks will be uniquely determined. But if unemployment in turn depends on the level of interest rates, which respond to devaluation expectations, then expectations of devaluation can prove self-fulfilling and multiple equilibria can arise.

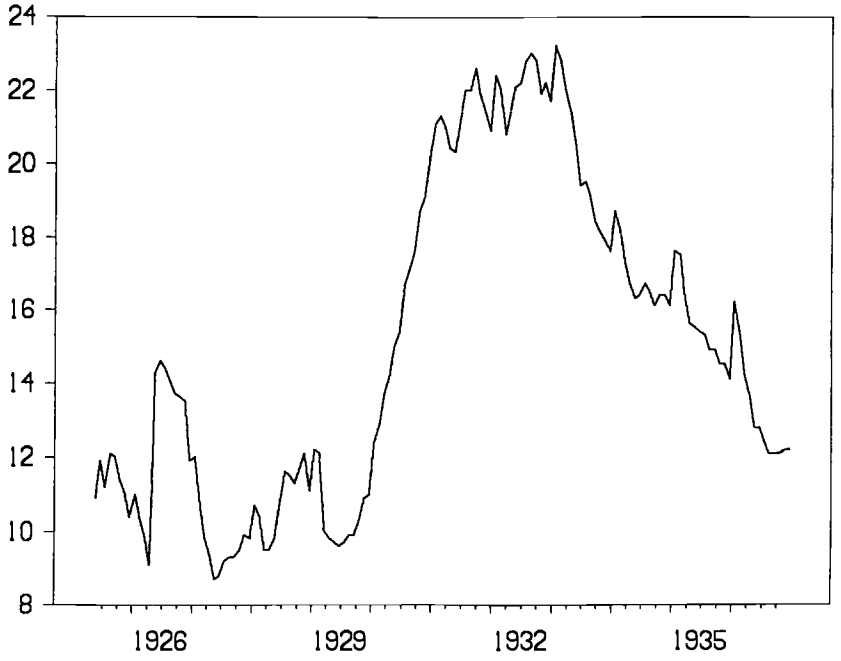

Fig. 1.1 Unemployment rate

sterling in 1931 was the pivotal event in the collapse of the interwar gold standard. We believe—and seek to convince the reader—that a second-generation model of currency crises and unemployment sheds considerable light on this episode.

We do so in a paper organized as follows. Section 1.2 presents an overview of the unemployment and monetary situations. Besides reviewing the evidence, we introduce some prior accounts that are interpretable in terms of the relations driving second-generation models. Section 1.3 presents a theoretical model suitable for formalizing the facts and derives its properties. Section 1.4 reports our attempt to marshal econometric support for that specification. Section 1.5 analyzes the causes of the sterling crisis. Section 1.6, in concluding, seeks to draw out the broader implications.

1.2 Background

The period on which we focus is demarcated by Britain's return to the prewar parity on 25 April 1925 and its departure from gold on 19 September 1931. Figure 1.1, displaying the monthly rate of unemployment as calculated by the Ministry of Labour, reminds us that unemployment was a thorn in the lion's paw throughout the period. Having risen to the double

digits by the time the return to gold took place, the unemployment rate jumped to a new peak in excess of 14 percent in the wake of the coal strike of mid-1926, whose disruptive effects lingered for several quarters. It hovered in the range of 9 to 12 percent before soaring to levels in excess of 20 percent following the onset of the Great Depression.[4]

Debate centered on whether the government's exchange rate commitment had contributed to this joblessness. Starting in 1920 Britain underwent five years of retrenchment in order to reverse the effects of its wartime inflation and to reduce prices to lower levels like those that prevailed in the United States, thereby permitting the prewar exchange rate against the dollar to be restored. Sterling appreciated faster than wages, and prices declined. The markets knew that the act of Parliament suspending the gold standard would expire in 1925 and that extending it would embarrass the government, suggesting that the authorities would persist in their efforts to deflate and to restore sterling to its prewar level against the dollar prior to the end of that year.[5] They bid up the currency in anticipation.[6]

Monetary stringency and high real interest rates superimposed on a backdrop of large-scale demobilization had predictable effects. Unemployment was already high, in other words, when the sterling parity was restored. But why it rose as high as it did and then failed to decline are contested issues. On one side are those who emphasize a series of negative shocks (the coal strike in 1926, interest rate hikes by a Federal Reserve Board concerned with "excessive speculation" on Wall Street starting in 1928, and then the Great Depression) imposed on a labor market that had lost much of its nominal flexibility, combined with a government prevented from engaging in much countercyclical stabilization by the constraints of a fixed exchange rate. On the other side are observers who emphasize labor market rigidities caused by an overly generous unemployment insurance scheme that raised the reservation wage, reduced the in-

4. The official unemployment series reported here was generated by dividing the number of insured workers registered as unemployed by the number covered by the unemployment insurance system. This is problematic to the extent that coverage of the insurance system was incomplete; in particular, agricultural workers, public employees, household workers, and recent labor force entrants (who had not yet made the requisite number of weekly contributions to qualify for insurance) were excluded. Feinstein (1972) adjusted the annual averages using decennial census figures for unemployment as benchmarks, obtaining slightly lower rates. But it was the official figures based on the insurance system that were fodder for the political debate and as such figured in the government's objective function and hence in market assessments of likely future policies.

5. A process modeled by Miller and Sutherland (1994).

6. The extent to which sterling was therefore overvalued when pegged to the dollar in April 1925 is the subject of a classic debate. Keynes's (1925) estimate was that sterling was overvalued by 10 to 15 percent. Subsequent authors have challenged his calculations on a number of grounds; e.g., from a variety of available U.S. price indexes, Keynes just happened to choose the one for the state of Massachusetts indicating the largest overvaluation for sterling. More representative indexes suggested a somewhat smaller overvaluation on the order of 5 to 10 percent.

Fig. 1.2 Real exchange rate

tensity of search, and boosted the equilibrium unemployment rate. The modern literature acknowledges the compatibility of the two views, although there is no consensus on the relative weights that should be attached to them.[7]

Some insight into the operation of these factors can be gleaned from figures 1.2, 1.3, and 1.4. Figure 1.2 shows the real exchange rate, measured as the ratio of U.K. and U.S. consumer prices. It provides no evidence of real appreciation and growing overvaluation in 1929–31—to the contrary.[8] Figures 1.3 and 1.4 suggest that the real wage and real interest rate were more important channels transmitting the negative demand shock to the labor market.[9] Given that the nominal interest rate is bounded at zero, deflation boosted the ex post real interest rate, producing Fisherian debt deflation (fig. 1.4).[10] Given the downward resistance of money wages,

7. The state of the art is Hatton (1988) and Dimsdale, Nickell, and Horsewood (1989).

8. Multilateral effective exchange rate indexes based on trade weights tell essentially the same story; see Redmond (1980).

9. The real wage was computed as the nominal wage divided by the consumer price index (CPI). The real interest rate is a moving average of the three-month nominal interest rate net of CPI inflation over the preceding twelve months.

10. The international evidence on the operation of these mechanisms is extensive; see, e.g., Bernanke and James (1991).

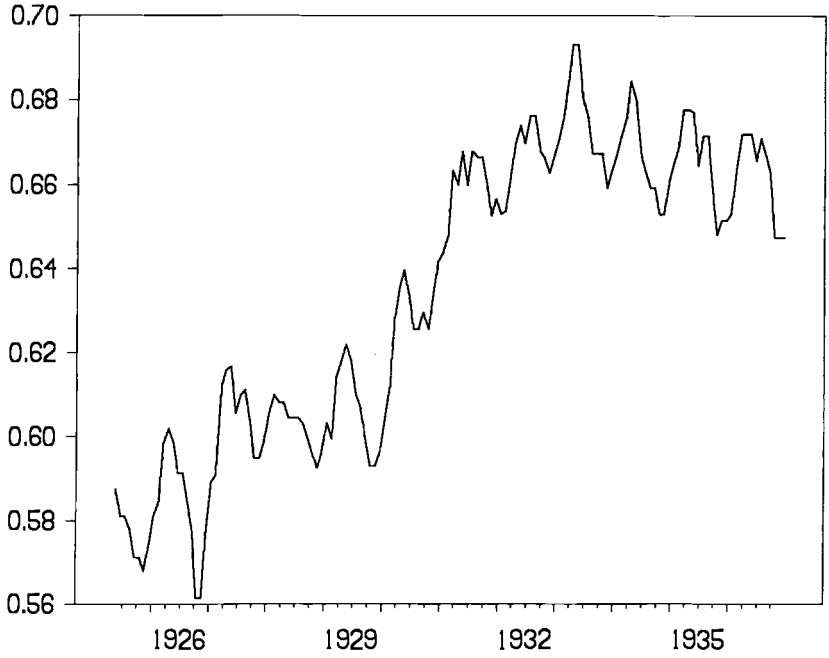

Fig. 1.3 Real wage (*w/p*)

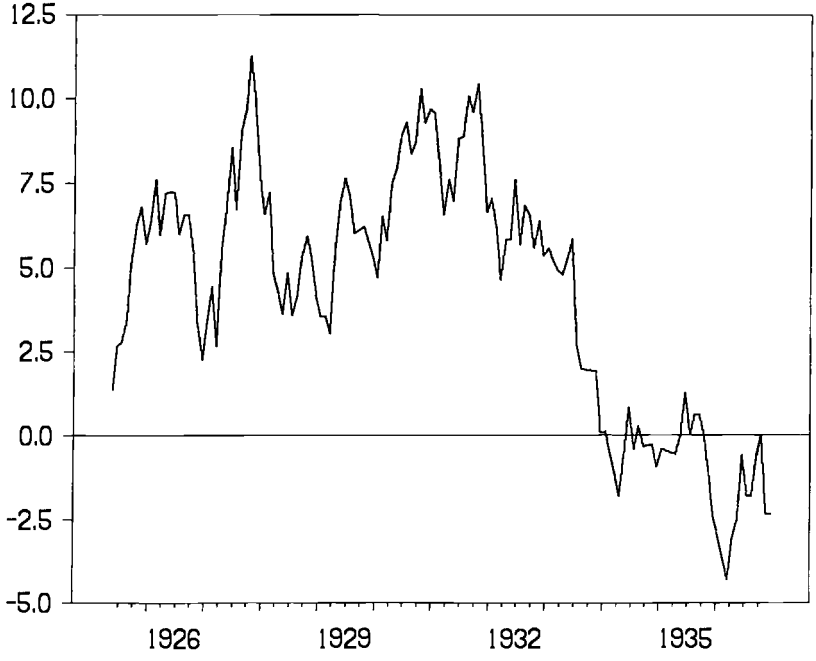

Fig. 1.4 Real interest rate

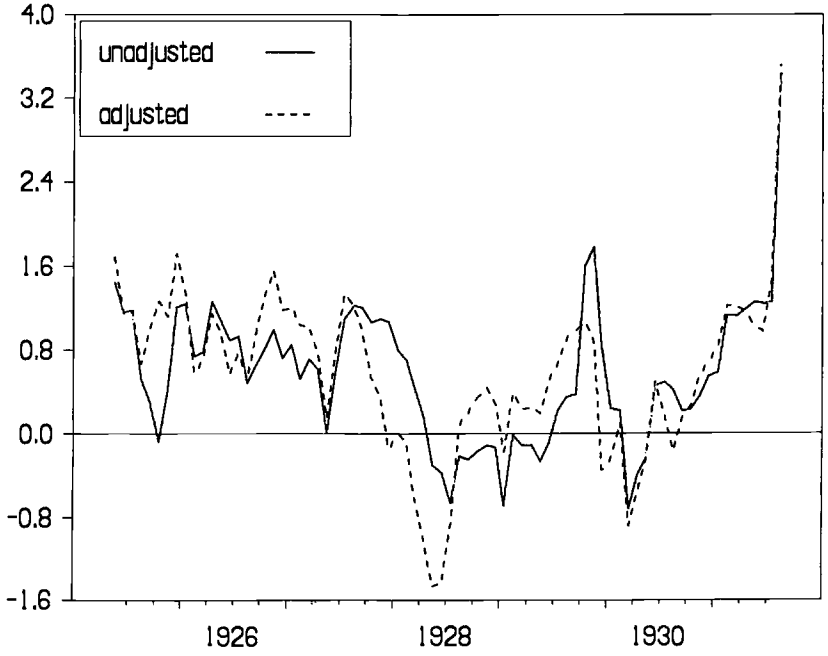

Fig. 1.5 Sterling devaluation expectations (percent)

deflation led to a large rise in the real cost of labor (fig. 1.3). With the authorities slow to adjust unemployment benefits in nominal terms, the fall in prices also led to a large increase in the real value of benefits. Thus the fixed exchange rate, operating through these channels, transmitted the negative external disturbance into a sharp rise in unemployment after 1929.

This unemployment then fed back to the foreign exchange market. Figure 1.5 shows the interest differential as a crude measure of devaluation expectations, along with a more sophisticated measure: the expected realignment probability times the expected change in the exchange rate in the event of a realignment constructed using Svensson's (1993) drift-adjustment method.[11] These estimates suggest that the realignment expectation rose from zero to about 1 percent at the beginning of 1931 (although this perceived probability was no larger than the devaluation expectations that prevailed immediately following Britain's return to gold, during the 1926 coal strike, and during the 1927 episode when the Bank of France

11. The change in the exchange rate was regressed on a constant and on the current rate to obtain an estimate of expected movements within the band. The fitted values were then subtracted from the interest rate, producing the estimates of the expected rate of devaluation.

was converting sterling reserves into gold). In August 1931, devaluation expectations shot upward, coincident with the German financial crisis. This pattern suggests that any effect of unemployment on devaluation expectations was nonlinear: while unemployment rose steadily from the end of 1929, devaluation expectations rose only modestly at best before shooting upward in the two months immediately prior to Britain's forced suspension of the sterling parity.[12]

The linkage between unemployment and realignment expectations hinted at in the historical literature can be understood in terms of the mechanisms highlighted by second-generation speculative attack models. A brief review of events serves to bring this out. Reports of "distrust of sterling" first began to circulate in November 1930, following the Nazis' gains in the Reichstag election and the consequent shock to confidence (Clay 1957, 369). Gold began draining from London to Paris and New York, creating mounting concern in the Committee of Treasury, the Bank of England's policy-making body. The collapse of the Credit-Anstalt in June and the contagious spread of the crisis to Germany were an even more serious shock. Austria's and Germany's imposition of exchange controls reminded observers that gold convertibility was not sacrosanct, and their import-restricting measures weakened Britain's prospective current account balance.[13] In addition, under the provisions of the German standstill, some £70 million of German debts to British banks were frozen (Cairncross and Eichengreen 1983, 62).

As in modern models of contagion, the crisis soon spread to Britain. On Monday 13 July, the day the failure of one of Germany's largest financial institutions, the Darmstadter Bank, was announced, the Bank of England first lost gold for export. Not only did that failure freeze additional British claims on central European banks, but it occurred on the same day the press printed the findings of the Macmillan committee, whose report included an alarming estimate of London's short-term foreign indebtedness. Two days later sterling fell sharply against the dollar and the French franc, and gold losses accelerated. Over the two and a half weeks from 13 July, the Bank of England lost more than £50 million of reserves, the equivalent of a month and a half of exports. Sterling dropped sharply on 15 July,

12. A prior attempt to account for the time profile of devaluation expectations (Eichengreen and Hsieh 1996) did not test for such a nonlinearity. These authors regressed the measures in fig. 1.5 on U.S. and U.K. unemployment, the British real exchange rate (a proxy for British competitiveness), the British balance of trade (as a monthly proxy for the current account), and German gold reserves (a measure of any contagion effects of the German crisis). They found that an increase in British unemployment was positively associated with devaluation expectations over the entire sample period (significantly so, with a t-statistic ranging from 2 to 4).

13. Similarly, the increasingly real threat that the countries of central and eastern Europe might suspend interest payments on their external debts and that Germany might suspend reparation payments led to negative revisions of consensus forecasts of the British current account position.

prompting George Harrison of the Federal Reserve Bank of New York to cable Montagu Norman, the governor of the Bank of England, expressing his alarm. Next followed the release of the Report of the May Committee on National Expenditure, which showed how markedly the fiscal position had deteriorated in the face of the deepening slump.

The immediate task for the government then became to strengthen the fiscal position. Not only would this reduce the pressure of demand, improving the current account, but it would signal the authorities' commitment to financial orthodoxy, strengthening confidence and not incidentally making it easier to borrow abroad. (J. P. Morgan and Co., among others, made clear that their willingness to lend to the British government would be conditioned on its adoption of budgetary measures.) This proved, however, to be easier said than done. The Labour cabinet was unwilling to significantly reduce unemployment benefits, as recommended by the May committee. The resulting deadlock led the prime minister, Ramsay MacDonald, to tender his government's resignation to the king. The coalition national government that was formed on 24 August did little better in the month that followed. The chancellor, Philip Snowden, unveiled a new emergency budget on 10 September, but marches by the unemployed, objections by judges and teachers over prospective pay cuts, and passive disobedience by sailors in the Atlantic fleet, played in the press as a mutiny, raised doubts that it could be implemented. This rebellion on the left raised the prospect of a Labour victory in the impending general election, implying that any rapidly implemented fiscal steps might only be reversed (Cottrell 1995).

Thus, with the immobilization of fiscal policy, responsibility for defending the exchange rate fell to the central bank. What is striking about the Bank of England's response was its reluctance to raise interest rates. An increase in the discount rate was considered on 16 July but rejected. The rate was raised by one point to 3.5 percent on 23 July and by another point a week later. But this was the final change prior to the suspension of gold convertibility. The textbook response would have been to "let gold go" (to allow gold losses to set the deflationary price-specie flow mechanism into motion) and to step up Bank rate to reinforce the deflationary pressure. And from July there were calls for the Bank of England to do just that (Sayers 1976, 392–93). Instead, it utilized spot and forward market intervention to support the exchange rate, keeping it well above the gold export point and relying on foreign credits to finance the requisite operations in the hope that the weakness of the balance of payments would prove transitory.[14] All the while, reserves drained away. They were replen-

14. The one time the Bank of England allowed sterling to fall below the gold export point, on 5 August, precipitated a near panic, after which the Bank resolved not to repeat the experience. An analysis of the Bank's spot and forward intervention is Moggridge (1972).

ished in late August by another round of foreign credits, but by 17 September more than half of these had been consumed. The reserve losses of the 18th were massive and unprecedented. The Bank of England saw the writing on the wall: late on the 18th, a Friday, Sir Ernest Harvey, the Bank's deputy governor, informed the prime minister that the Bank retained limited resources for intervention on Saturday, but in any case it would be unable to support the rate when the markets reopened on Monday. The Bank should therefore be authorized to suspend gold payments, with legislation to be passed on Monday. The decision was taken to abandon gold.

This hesitancy to raise the discount rate and to otherwise allow credit conditions to tighten is remarkable in light of the fact that Bank rate increases had been the standard tool for dealing with reserve losses since the days of Walter Bagehot.[15] As Fraser put it, "That Great Britain should go off the gold standard with the bank rate at 4 1/2 per cent seems unbelievable. That the rate was not pushed up to 8 or 10 per cent in July 1931 created an unfavourable impression abroad, and caused foreigners to believe that, after all, the British authorities would not make a real fight for the gold standard" (1933, 113).

The explanation, historical accounts suggest, is that the authorities feared that interest rate increases would worsen unemployment, already in the neighborhood of 20 percent, and aggravate the stagnant condition of the British economy. "At the onset of the Great Depression," Janeway wrote, "Britain had already suffered nearly a decade of unemployment in excess of one million insured workers. This was the central economic fact that constrained monetary policy throughout the period" (1995–96, 255). Further deterioration in the employment situation threatened to undermine support for the government and for its gold standard policies, suggesting that the discount rate increase might ultimately have to be reversed. Realizing that the tactic was unsustainable and, if anything, increased the likelihood that the defense of the exchange rate would have to be abandoned, investors would have responded negatively to further increases in Bank rate and stepped up their sales of domestic assets.

What distinguished the Bank of England's priorities in 1931 from its priorities in previous periods was partly that unemployment had now scaled unprecedented heights, tipping the balance away from further austerity in the interest of currency stabilization. In addition, important changes in the political environment had occurred. Before World War I, in Sir Otto Neimeyer's famous words, "a change in bank rate was no more regarded as the business of the Treasury than the colour which the Bank painted its front door." During the war, however, the maintenance of the

15. As Bank of England officials themselves described in National Monetary Commission (1910) and again in their evidence before the Macmillan committee in 1931 (Committee on Finance and Industry 1931).

gold standard and pursuit of price stability had been subordinated to other, more pressing goals, ultimately, national survival. This "wartime politicization" of Bank rate carried over to the March 1919 veto by Lloyd George's chancellor of a proposed increase (Janeway 1995–96, 255). When the central bank again attempted to raise interest rates in October 1919 to prevent the economy from overheating, it was strongly attacked by establishment spokesmen like the *Economist* and the *Statist.* Even more significant than the existence of this opposition, as Hume notes, were the arguments on which it was based, namely, whether "a rise in bank rate [will] check speculation more than it checks production" (*Economist,* 8 November 1919, p. 850; quoted in Hume 1970, 133). Sayers noted similarly that each of the Bank rate increases of the early 1920s aroused "criticism on the grounds of aggravation of the trade depression" (1976, 129–39). He went on to observe that this marked "a new tide that was destined to affect policy, or at least the atmosphere in which policy was taken, for the remainder of the decade." Clearly, World War I was a watershed dividing the central bank autonomy of the nineteenth century from the more politicized monetary policy environment of the interwar years.

The rise of the Labour Party, the growth of trade unionism, and the prewar extension of the franchise had all worked to heighten this politicization. The 1920s were the years of the first Labour government, whose ministers were surely more sensitive to unemployment than their Conservative shadow counterparts. The unemployment problem acquired new prominence and not merely by virtue of its magnitude. It is important to understand that the concept of unemployment as an aggregate phenomenon, distinct from being unemployed as an individual condition, only became current as late as the 1880s and after. Before that, being unemployed was regarded more as an individual failing than as a possible corollary of national economic policy.[16] By the 1920s, of course, things were very different.

The links from monetary policy to domestic economic outcomes had been highlighted by Keynes, of course, in "The Economic Consequences of Mr. Churchill," where he asked, "By what modus operandi does credit restriction" reduce labor costs, increase competitiveness, and restore external balance? "In no other way than by the deliberate intensification of unemployment" (1925, 16). Other well-known authors lent legitimacy to this view. As G. D. H. Cole wrote in the *Morning Post* on 13 June 1924, "There is a Great God named Par who is worshiped daily at the Treasury and in the magnificent temples the big five are building on every street. Par likes unemployment; it is his form of human sacrifice. And on Par's altars the Treasury daily burns incense in the form of currency and credit."

16. We refer readers to whom these arguments appear unfamiliar or implausible to Eichengreen and Hatton (1988).

One can question the depth of comprehension of these points by the man in the street or the MP in the back benches, but there is no question that such rhetoric worked to heighten at least superficial awareness of the links between monetary policy and unemployment.

Central bankers understood these links as well. In evidence to the Macmillan Committee on Finance and Industry (today, a comparable body would be given a name like the "Committee on Monetary Policy and Unemployment"), Norman and Harvey, the Bank of England's governor and deputy governor, were forced to defend their policies against the charge that these aggravated unemployment. Central bankers having every incentive to shroud themselves in ambiguity, there is no smoking gun—no statement that "we are reluctant to raise interest rates and defend the sterling parity for fear of aggravating unemployment." Still, their responses give away the game. Norman was first asked whether he took macroeconomic conditions—"the industrial position" in contemporary parlance—into account when raising or lowering Bank rate. In response, he gave a bit of ground. "I should answer by saying that we do have them in view, yes, but that the main consideration in connection with movements of the Bank Rate is the international consideration." H. P. Macmillan, the committee chairman, then asked whether a lower Bank rate would have eased the internal situation. Norman conceded the point: "I think the internal situation would have been much easier over the last few years if the rate had been x per cent instead of y per cent, say 4 per cent instead of 6 per cent." The chairman responded, "You mean there would have been less unemployment." Norman acknowledged, "I think there would." Keynes forced Norman to dig his hole deeper: "So it is of the essence of the case that the bank-rate should have an important effect, that when it is raised it should have an effect in the direction of unemployment. That is what you want. Am I right?" Norman was cornered: "Yes," he replied, "I should think it was." (See Sayers 1976, 178–80.)

Contemporaries drew the obvious conclusion. As Fraser put it, "A democratic government . . . cannot shut its eyes to such things [to complaints that monetary policy was aggravating unemployment], and, consciously or subconsciously, the British Government were influenced by them, and so they chose the policy that would minimize social unrest" (1933, 113). Hawtrey was more prosaic: "To raise the rate when unemployment among insured work people had risen to 22 per cent. was surely to gild the lily. If, in the language of 1848, the price of the convertibility of the note was to be a further disemployment of labour, the position had become untenable. And in fact it had" (1938, 143).

Subsequent generations of historians have generally agreed. Morton (1940) put it bluntly, that the Bank of England was constrained by the fear that a higher interest rate would worsen unemployment. Clay wrote that "the decline in employment and profits [following the onset of the depres-

sion] intensified the criticism of the monetary policy with which Norman was associated" (1957, 363). Pollard is equally to the point. In his words, "It was, in part, the depth of the slump and the level of unemployment which inhibited the raising of the bank rate to panic heights" (1969, 226). Palyi, while critical of the Bank of England's inaction, acknowledged that it is attributable to the unwillingness of "a depression-ridden country, with the number of unemployed rising from 1,455,000 at the end of 1929 to 2,500,000 at the end of 1930 . . . to countenance a severe deflationary move" (1972, 271). While he concluded that it would have been preferable for the British authorities to defend sterling rather than to cave in to domestic unemployment pressures, he admitted in a formulation that anticipates our model, that it is a question of "policy priorities." Kunz's conclusions are similar. "With business already very depressed," she wrote, "neither management nor labour nor their representatives in Parliament were willing to pay the price which such a high Bank rate would exact . . . in the prevailing investment climate either a large rise in Bank rate or a loss of gold would be interpreted as a sign of panic" (1987, 284).

Thus primary sources and the secondary literature alike support the view that the exchange rate peg, maintained in the face of a massive external disturbance, aggravated unemployment, while the rise in unemployment limited the willingness of the authorities to defend that exchange rate when it came under attack. Analyzing these issues further requires a formal model, to which we now turn.

1.3 Model

This section presents a model of currency crises in which the variable driving the crisis is unemployment. While this model will be discussed mainly with reference to sterling's interwar experience, it may be viewed more generally as an attempt to explore the logic of a particular class of currency crises, those in which unemployment is the key factor underlying the fragility of the currency.[17] This model may also provide insights into episodes of crisis in which unemployment, without being the main factor, played a role along with other more traditional fundamentals such as real overvaluation or the trade balance.

Unemployment-based currency crises involve the interaction of two aspects of the economy that are usually considered separately, the labor market and the foreign exchange market. Accordingly, our model has two parts, one describing the macrostructure of the economy and the other characterizing exchange rate policy. The macroeconomic part of the model is standard. The evolution of wages and prices is assumed to depend on

17. This class arguably includes also the 1992 sterling crisis (Eichengreen and Hsieh 1996) and the 1992–93 French franc crisis (Jeanne 1997b).

the unemployment rate through a traditional Phillips curve, and the unemployment rate is determined by the real wage and the real interest rate. The policy part of the model endogenizes exchange rate policy in the spirit of second-generation models of currency crises. The government decides whether to maintain the peg by minimizing a loss function that depends on the state of the economy.[18] The interesting properties of the model come from the two-way interaction of the two parts. While the level of unemployment affects the willingness of the government to defend the currency and so the credibility of the fixed peg, conversely the credibility of the fixed currency peg affects the level of domestic interest rates and economic activity. We study the response of the economy to an external deflationary shock and show that it can fit a number of stylized facts of sterling's interwar experience.

1.3.1 Assumptions

The macroeconomic structure is summarized by three equations for unemployment, wage, and prices:

$$u_t = a_1 u_{t-1} + a_2 \omega_{t-1} + a_3 r_t, \tag{1}$$

$$\Delta w_t = a_4 \Delta p_t - a_5 u_{t-1}, \tag{2}$$

$$p_t = a_6 w_t + (1 - a_6)(p_t^* + e_t), \tag{3}$$

where u_t, w_t, p_t, p_t^*, e_t, $\omega_t \equiv w_t - p_t$, and $r_t = i_{t-1} - \Delta p_t$ denote deviation of the unemployment rate from its natural level, nominal wage, domestic and foreign nominal prices, exchange rate, real wage, and ex post real interest rate, respectively, and Δ is the first-difference operator ($\Delta x_t = x_t - x_{t-1}$). With the exception of the interest rate, all variables are in logarithm.

Equation (1) states that the unemployment rate is increasing with the level of the real wage and the ex post real interest rate.[19] It is important to note that the monetary transmission channel at work here is different from the standard one. The interest rate appearing on the right-hand side is the ex post real interest rate, not the ex ante real interest rate $r_t^e = i_t - E_t(\Delta p_{t+1})$. A rise in the ex post real interest rate can depress economic activity by redistributing purchasing power from debtors to creditors, an idea originally put forward by Irving Fisher in his debt deflation theory of the Great Depression and referred to as the "balance sheet channel of

18. The government's loss function depends on the unemployment rate, as in Jeanne (1997b). The model in Jeanne's paper does not include, however, wage or price equations.

19. The assumption that the real wage enters with one lag simplifies the computations but is not crucial for the results. Adding the real exchange rate $q_t = p_t - (p_t^* + e_t)$ to the determinants of unemployment would not change significantly the properties of the model, since by eqs. (2) and (3) variations in the real exchange rate are proportional to those of the real wage under the fixed peg.

monetary policy" in the modern literature (see, e.g., Bernanke and Gertler 1995).[20]

Equation (2) is a naive Phillips curve, which takes the rate of wage inflation as increasing with the rate of change of the domestic price and decreasing with the unemployment rate. This relation is not constrained by the hypothesis that wage setters have rational expectations, a hypothesis that seems difficult to reconcile with the extreme nominal stickiness of wages in the interwar United Kingdom.[21] Equation (3) states that the domestic price level is a weighted average of the domestic wage and the cost of imported goods. Hereafter we assume that the foreign inflation rate, Δp^*, is constant.

We assume that the home country is initially committed to a fixed exchange rate arrangement designed to maintain the nominal exchange rate at a constant level. This commitment is not irreversible, however. In each period, the government may invoke an escape clause and devalue the currency by an exogenous amount d. We denote by π_t the probability estimated at t of a devaluation at $t + 1$. This is an important variable, which reflects the lack of credibility of the peg.

We assume that the domestic and foreign interest rates satisfy uncovered interest parity and that foreign exchange market participants form their expectations in a rational way. Under the fixed peg, the expected rate of depreciation is equal to the devaluation probability times the expected amount of the devaluation, and interest parity may be written

$$i_t = i^* + \pi_t d. \tag{4}$$

The foreign nominal interest rate, i^*, satisfies the Fisher relation:

$$i^* = r^* + \Delta p^*, \tag{5}$$

where r^*, the foreign real interest rate, is assumed to be constant.

The government decides whether to devalue by considering a trade-off between its internal and external objectives. We assume that devaluation makes it possible to reduce unemployment by an amount Δu,[22] but entails costs for the government. Some of these costs are borne by the policy-

20. Introducing the ex ante real interest rate in the unemployment equation is possible but would complicate the analysis of the equilibrium. The ex ante real interest rate in a given period depends on the market expectations of the government's decision at the following period, which themselves depend on the next-period expectations. By forward induction, the equilibrium depends on the expectations over the infinite horizon. Models of currency crises of this kind have been studied by Krugman (1996) and Jeanne and Masson (2000).

21. This does not mean that all agents have adaptive expectations: we assume that the expectations of foreign exchange market participants are rational.

22. A devaluation can reduce the unemployment rate by improving competitiveness, reducing the real wage (if the nominal wage is sticky), or allowing the government to set lower interest rates. While we do not model these channels explicitly, those relying on the wage and the interest rate are consistent with the unemployment eq. (1).

maker responsible for the devaluation, others by the country as a whole. In the case of the United Kingdom, devaluation might hasten sterling's loss of international currency status, dealing a blow not only to national pride but also to seigniorage revenue and the importance of London as a financial center.

Formally, we assume that the government decides to opt out or not so as to minimize a loss function that depends on the deviation of unemployment from its natural level and on the opting-out cost:[23]

$$L_t = u_t^2 + \delta_t C_t, \tag{6}$$

where $\delta_t = 1$ if it devalues (zero otherwise). We assume that the opting-out cost C_t follows an identically and independently distributed stochastic process. The stochastic nature of the opting-out cost may reflect unpredictable events in the social or political spheres, such as an election, the collapse of a political coalition, or a strike, that raise or lower domestic resistance to devaluation. We assume that the policy-making process can be in two states with different expected opting-out costs.[24] In state 1 the opting-out cost is given by $C_t = C_1 + \varepsilon_{1t}$; in state 2 it is $C_t = C_2 + \varepsilon_{2t}$, where ε_1 and ε_2 are i.i.d. normal shocks. The state with the lower C corresponds to a political or social situation that makes devaluation more likely. At any given period there is a probability 1/2 that the policy-making process is in state 1 and 1/2 that it is in state 2.

1.3.2 Reduced-Form Dynamics

Substituting out nominal variables from the structural equations yields the following reduced form for the dynamics of the unemployment and real wage rates:

$$\begin{pmatrix} u_{t+1} \\ \omega_{t+1} \end{pmatrix} = B \begin{pmatrix} u_t \\ \omega_t \end{pmatrix} + \alpha r^* + \beta \Delta p^* + \gamma \pi_t, \tag{7}$$

where $B = (b_{ij})_{i,j=1,2}$, $\alpha = (\alpha_1, \alpha_2)'$, $\beta = (\beta_1, \beta_2)'$, and $\gamma = (\gamma_1, \gamma_2)'$ are a 2×2 matrix and vectors, the coefficients of which depend on the structural parameters of the model (see the appendix). Equation (7) provides a convenient decomposition of the effects at work in the model. The first term on the right-hand side characterizes the adjustment of the economy toward

23. The loss function is instantaneous, i.e., not intertemporal. This assumption greatly simplifies the analysis, in particular because it allows us to characterize the dynamics of unemployment before a devaluation without making any assumption about the exchange rate regime following the devaluation. Since the opting-out cost may be interpreted as the discounted sum of expected flow costs, the myopia implied by eq. (6) is limited to unemployment. This may reflect the fact that voters determine their votes on the basis of the current unemployment rate or that the policymaker stays in office for a short time.

24. This assumption, while not necessary for the main properties of the model, is useful for estimation.

equilibrium when there are no foreign disturbances and the credibility of the exchange rate peg is perfect. The second and third terms correspond to the effects of foreign rates of interest and inflation on the domestic economy, the last term to credibility effects.

The devaluation probability is an endogenous variable of the model. It equals the probability that the benefit of devaluation in terms of reduced unemployment will exceed the opting-out cost in the next period. This probability is between zero and one, since the opting-out cost is stochastic,[25] and it depends on the level of unemployment. Because the government's loss function is convex in the unemployment rate, the incentive to devalue is stronger the higher the level of unemployment. It is shown in the appendix that the government's optimal decision is to devalue if the unemployment rate implied by the fixed exchange rate goes beyond a critical level and that the devaluation probability, π_t, may be written

$$\pi_t = \Pi(b_{11}u_t + b_{12}\omega_t + \alpha_1 r^* + \beta_1 \Delta p^*), \tag{8}$$

where $\Pi(\cdot)$ is an increasing function.[26] The intuition behind equation (8) is that the devaluation probability is increasing with the next-period unemployment rate, which in turn is a function of the current values of the unemployment rate, the real wage, and the foreign real interest rate.

The dynamics of the economy are characterized by equations (7) and (8). The main question of interest, for our purposes, is how the domestic economy responds to external shocks, in particular to changes in the foreign inflation rate, Δp^*. The response of the economy involves the labor, financial, and foreign exchange markets and the spillovers across these markets. The linkage from currency to labor is characterized by equation (7): devaluation expectations tend to generate unemployment by raising the real interest rate. Conversely, as equation (8) shows, a rise in unemployment or the real wage weakens the credibility of the fixed peg. This two-way interaction of the labor and foreign exchange markets is likely to affect the stability of the fixed exchange rate peg.

First, consider a steady state in which unemployment, the real wage, and the devaluation probability remain constant at levels denoted by $\bar{u}$, $\bar{\omega}$, and $\bar{\pi}$.[27] It is shown in the appendix that

25. The opting-out cost is the only source of uncertainty in this model, but it would not be difficult to add shocks in the structural eqs. (1), (2), and (3).

26. Note that the model may give rise to multiple equilibria, in which case the function $\Pi(\cdot)$ is not well defined. The multiplicity of equilibria, a generic property of second-generation models of currency crises, has been exploited by a number of authors to discuss self-fulfilling speculation (see, e.g., Obstfeld 1996; Velasco 1996; Jeanne 1997a). A discussion of this issue in the context of the present model may be found in the appendix.

27. The steady state properties we describe below are not *long-run* properties of the economy. In general the steady state devaluation probability is strictly positive, so that the domestic government devalues sooner or later with probability one.

$$\bar{u} = -\frac{1 - a_4}{a_5}\Delta p^*, \tag{9}$$

$$\bar{\omega} = -\frac{(1 - a_1)(1 - a_4)}{a_2 a_5}\Delta p^* - \frac{a_3}{a_2}(r^* + d\bar{\pi}). \tag{10}$$

The domestic economy is sensitive to the foreign inflation rate because of nominal wage stickiness, the extent of which is measured by $1 - a_4$. Foreign deflation, say, generates upward pressure in the real wage and increases unemployment, leading to a rise in devaluation expectations. An increase in the foreign real interest rate depresses the real wage in the long run by exerting upward pressure on unemployment.

The dynamics of the economy out of the steady state are complicated by their nonlinearity, but we can make some qualitative statements. In particular, it is easy to see that the devaluation expectations contribute to increase the persistence of unemployment. This persistence is the sum of two terms:

$$\frac{\partial u_{t+1}}{\partial u_t} = b_{11} + \gamma_1 b_{11}\Pi'. \tag{11}$$

The first term reflects structural persistence mechanisms that are independent of exchange rate policy. The second term comes from the exchange rate regime: an increase in unemployment in the current period raises the interest rate premium and the unemployment rate in the following periods.

To illustrate, the dynamics of the unemployment and real wage rates can be represented in (ω, u)-space for different degrees of credibility of the fixed peg (corresponding to different levels of the opting-out cost, C). In figure 1.6 we show how the economy converges to its steady state starting from an excessive real wage for two different degrees of credibility. In both cases the dynamics are stable, but they have very different shapes. When the peg is less credible, the real wage has to fall by a larger amount before unemployment starts to decline. As a result the unemployment rate scales higher levels and remains at those for longer, further weakening the currency.

1.3.3 External Shocks and Currency Crisis

In this subsection, we argue that external shocks, such as a change in the foreign inflation or interest rate, can reproduce some key features of the behavior of the U.K. economy in the interwar years, including the sterling crisis.

Assume that starting from a steady state with a constant foreign price level, the foreign inflation rate jumps from zero to $\Delta p^* < 0$. In the first period after the shock, imported deflation raises the real wage and un-

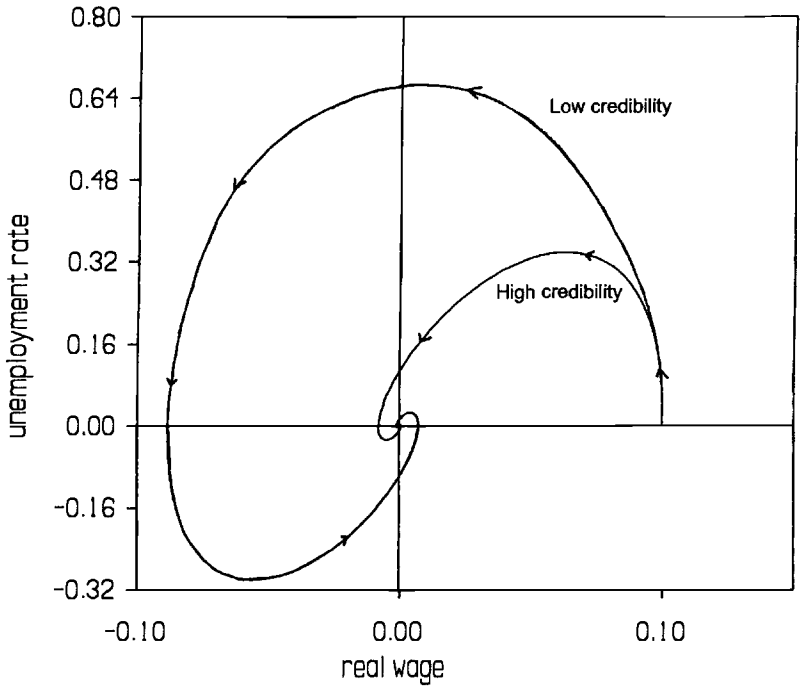

Fig. 1.6 Dynamics of unemployment and real wage

employment. From our steady state analysis, we know that the unemployment rate will converge toward a higher level, which progressively exerts downward pressure on the wage. Whether the long-term real wage is higher or lower than its initial level depends on the parameters. As the unemployment rate increases, devaluation expectations begin to rise. And because the relation between the unemployment rate and the devaluation probability is nonlinear, devaluation expectations may rise very little at first, but jump upward when unemployment reaches a critical level. An example of these dynamics is shown in figure 1.7.

1.4 Estimation

We estimated the model on monthly data for the period 1925:5–36:12, a sample covering sterling's participation in the interwar gold standard and the following five years. The choice of a sample period extending after the devaluation was dictated by our desire to analyze not only the period leading up to the sterling crisis but its consequences.

The unemployment, wage, and price equations were estimated using as many as six lags of each variable, with an instrument for the current values

of explanatory variables in order to avoid simultaneous equation bias. One term for each variable turned out to be sufficient, and current-period values were never significant. The exogeneity assumption could not be rejected using Hausman tests, which is not surprising given that we use relatively high frequency data. As an additional check, we also report the results of two-stage least squares estimation.

Details about sources and definitions are found in the appendix. We took the logarithms of all variables except the interest rate and the devaluation probability.

1.4.1 Unemployment Equation

The explanatory variables for this equation are the real wage, the real interest rate, and the lagged unemployment rate. The real wage is defined as the (log of the) nominal wage divided by the CPI. Since there are generally thought to be lags in the transmission of interest rates to economic activity, we measured the real interest rate as a moving average of the three-month nominal interest rate net of CPI inflation over the preceding twelve months.

Results of OLS estimation are shown in table 1.1. The full specification (col. [1]) reveals the coefficient on the real exchange rate to be insignifi-

Fig. 1.7 Impact of foreign deflation

Table 1.1 **Unemployment Equation**

Variable	Dependent Variable: Unemployment Rate (u)			
	(1)	(2)	(3)	(4)
Constant	0.259	0.292	0.315	0.305
	(0.203)	(0.136)	(0.136)	
u_{-1}	0.935	0.934	0.931	0.933
	(0.029)	(0.028)	(0.028)	
ω_{-1}	0.296	0.294	0.333	0.293
	(0.158)	(0.158)	(0.158)	
r_{-1} ($\times 10^2$)	0.507	0.484	0.524	0.171
	(0.197)	(0.165)	(0.166)	
$(e + p - p^*)_{-1}$ ($\times 10^2$)	1.450			
	(6.994)			
$\bar{R}^2$	0.958	0.958	0.959	
DW	1.912	1.906	1.902	
Durbin's h	0.552	0.590	0.610	

Note: Numbers in parentheses are standard errors. The coefficients for the real interest rate and the real exchange rate have been multiplied by 100.

cantly different from zero. Removing it (as in col. [2]) does not change the other results. Column (3) reports the results of two-stage least squares estimation, which are not significantly different from those of OLS.[28] A Chow test provides no evidence of a structural break following Britain's departure from gold; testing for a break in September 1931 yields $F(4,127) = 1.082$, well below the 10 percent significance level. The coefficients on the real wage and the real interest rate are significant and positive, as anticipated. Permanent changes in these variables have little impact in the short run but sizable effects in the long run due to the persistence of unemployment. The long-term elasticity of the unemployment rate with respect to the real wage is 4.43, implying that a permanent 1 percent increase in the real wage raises unemployment from, say, 10 percent to 10.44 percent in the long run. A permanent 1 percent rise in the real interest rate raises unemployment from 10 to 10.74 percent.

The statistical significance of these results should be qualified by the fact that the variables in this equation are not clearly stationary. An augmented Dickey-Fuller (ADF) test with six lags does not reject a unit root in unemployment, the real wage, and the real interest rate at the 10 percent level. The importance one should give to nonstationarity, as always, is debatable: on theoretical grounds, unemployment and the real interest rate should be stationary, and while a unit root in the real wage could be attrib-

28. We used two lags of unemployment, the real wage, and the real interest rate as instruments.

Table 1.2 **Wage Equation**

	Dependent Variable: Change in Nominal Wage (Δw)			
Variable	(1)	(2)	(3)	(4)
Constant ($\times 10^2$)	0.181	2.519	2.999	2.495
	(0.190)	(0.711)	(0.711)	(0.732)
Δp_{-2} ($\times 10^2$)	4.900	5.158	8.817	5.157
	(1.950)	(1.878)	(2.325)	(1.878)
u_{-1} ($\times 10^2$)	−0.073	−0.243	−0.296	−0.241
	(0.071)	(0.084)	(0.085)	(0.085)
b ($\times 10^2$)		0.934	1.099	0.924
		(0.275)	(0.276)	(0.283)
$\bar{R}^2$	0.041	0.111	0.147	0.111
DW	1.946	2.112	2.136	2.112

Note: Numbers in parentheses are standard errors. All coefficients are multiplied by 100.

uted to technological progress, it is actually due to price deflation in our data. There is some evidence that unemployment, the real wage, and the real interest rate are cointegrated,[29] which allows us to estimate the unemployment equation as an error correction model: the results are reported in column (4) of table 1.1. The estimated coefficients are not significantly different from those obtained from OLS, except that for the real interest rate, which is lower.

Previous authors estimating models of the interwar economy have obtained broadly similar results. Dimsdale and Horsewood (1995) reported a quarterly equation for employment rather than unemployment, obtaining rather similar real wage coefficients up to a sign change.[30] Also using quarterly data, Hatton (1988) found a significant negative effect of the real wage (lagged twice) on employment. Beenstock and Warburton (1986) found small but statistically significant effects of real wages on both labor supply and labor demand. Broadberry's (1983) estimates of labor supply and demand provide less support for the importance of real wages, although his sample is limited to fifteen annual observations for the period 1924–38.

1.4.2 Wage Equation

Results are in table 1.2. Those in column (1) limit the set of explanatory variables to inflation and unemployment, as in the simple Phillips curve of the model. The coefficient on inflation, while significant, is low, imply-

29. The ADF t-test applied to the residuals of the cointegrating regression (as described by Hamilton 1994, 599) rejects the absence of cointegration at the 10 percent level.

30. They include two lags of the real wage and normalize money wages by the GDP deflator.

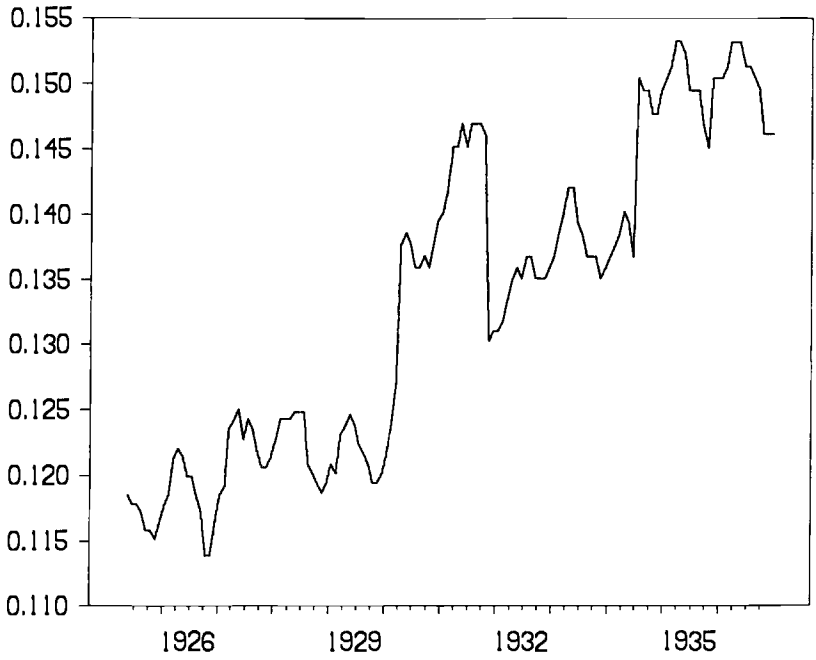

Fig. 1.8 Real unemployment benefit (*blp*)

ing that less than 5 percent of price variation is reflected in the nominal wage. The unemployment rate, on the other hand, is not significant. The weak explanatory power of the equation is consistent with the conclusion of authors such as Sargan (1964) and Hatton (1988) that a simple Phillips curve performs poorly for the interwar years, a period during which prices and unemployment fluctuated widely but nominal wages moved sluggishly.

A standard treatment of this problem is to add the replacement rate (the ratio of unemployment benefits to wages) as a shift variable for unemployment. In theory, in the presence of unemployment benefits, wage setters place less weight on employment and more weight on the level of compensation when setting the reservation wage. Indeed, Britain had a relatively generous unemployment insurance system between the wars (Burns 1941), and previous authors utilizing the level of benefits in time-series estimation tend to identify a large effect, albeit somewhat smaller in more recent studies (contrast Benjamin and Kochin 1979 with Dimsdale and Horsewood 1995). But the sharp increase in the real level of benefits when price levels fell in the Great Depression (fig. 1.8) admits of alternative interpretations: is the coefficient on the real benefit really capturing the impact of more generous benefits on job search, or is it in fact picking

up the effects on unemployment of the collapse of prices and demand that set in starting in 1929? Be this as it may, the elasticity of long-run equilibrium unemployment with respect to the benefit is 3.84, implying that a 1 percent increase in the benefit is sufficient to raise the natural rate of unemployment from 10 to 10.4 percent, an effect only about half the size of that obtained by Dimsdale and Horsewood.[31] With the addition of the benefit variable, the coefficient on unemployment is now significant as well, and the coefficient on lagged prices, plausibly, is larger than before. A Chow test provides some evidence of a structural break in September 1931: $F(4, 129) = 2.895$, which is significant at the 5 percent level.[32] This is due to a fall in the elasticity of wages with respect to prices after the devaluation of sterling in 1931. (It is impossible to reject the null of no structural break in the other coefficients.) On its face, the direction of this change is surprising: following Alogoskoufis and Smith (1991), one would expect wages to respond less powerfully to prices under a fixed exchange rate, when the price level should show stronger mean reversion, than under a floating rate, when it is likely to exhibit greater persistence. A possible reconciliation is that wage setters anticipated the persistent deflation that characterized the relatively restrictive global monetary environment of the interwar gold standard and in contrast did not expect the Bank of England to make powerful reflationary use of monetary policy once the gold standard was abandoned.[33] Column (3) reports the result when the coefficient for price inflation is allowed to differ before and after the sterling crisis, as suggested by the results of this stability test. Column (4) reports the results of two-stage least squares estimation.

While the rates of change of wages and prices are stationary, unemployment and real benefits are not, and an ADF t-test does not produce any evidence of cointegration between them. Thus the strategy of estimating the equation as an error correction model, which we implemented in the case of the unemployment equation, is impossible here. We tried to solve this problem in several ways—distinguishing between short-term and long-term unemployment (as in Crafts 1989), adding Bain and Price's (1980) annual index of union membership density to the explanatory variables, and adding a time trend—but still found no evidence of cointegration.[34]

31. The long-run or "natural" rate of unemployment is that consistent with zero wage and price inflation.

32. This result contrasts with Hatton (1988), who found no evidence of a structural break in his wage equation estimates on quarterly data.

33. This is consistent with interpretations that emphasize the reluctance of central banks to make aggressive use of reflationary monetary policy following the abandonment of the gold standard (e.g., Eichengreen 1992).

34. This prompted us to reestimate the entire model as an unrestricted vector autoregression in the differenced variables; we discuss these results below. Fortunately, the main results were not changed.

Table 1.3 **Price Equation**

Variable	Dependent Variable: CPI Inflation (Δp)			
	(1)	(2)	(3)	(4)
Constant ($\times 10^3$)	−0.609			
	(0.853)			
Δw_{-1}	0.374	0.733	0.762	0.731
	(0.340)	(0.057)	(0.060)	(0.057)
Δp^w_{-1}	0.255	0.267	0.238	0.269
	(0.058)	(0.057)	(0.060)	(0.057)
$\bar{R}^2$	0.119	0.122	0.560	0.125
DW	1.548	1.573	1.948	1.580

Note: Variable p^w denotes the wholesale price index. Numbers in parentheses are standard errors. The constant has been multiplied by 1,000.

1.4.3 Price Equation

In our model, the rate of change of the CPI is a weighted average of the rates of change of the nominal wage and the cost of imported factors of production. Following Capie and Collins (1983), we use the wholesale price index, which is dominated by internationally traded goods, as a proxy for the latter. The unrestricted regression is given in column (1) of table 1.3. The wage and import price coefficients are both positive as expected, as in such previous work as that of Dimsdale et al. (1989). It is impossible to reject the joint hypothesis that the constant is zero and that the coefficients for the nominal wage and the CPI sum to unity, as anticipated. These restrictions are imposed in column (2). Now the greater weight is placed on the wage component, as predicted by neoclassical production and pricing theory. In view of the low Durbin-Watson statistic, we also estimated this equation under the assumption of an MA(1) error, but this did not alter the result significantly (see col. [3]). Evidence of a structural break is weak; a Chow test yields $F(1,136) = 2.762$, which is marginally significant at the 10 percent level. To the extent that there is evidence of a break, this takes the form of a lower weight on import prices and a correspondingly higher weight on wages after sterling's devaluation.[35] As column (4) shows, the two-stage least squares estimates are not significantly different from those of OLS.

1.4.4 Devaluation Probability

The model specifies the devaluation probability as a nonlinear function of the unemployment rate. We estimated this equation using nonlinear

35. This may in turn reflect the collapse of international trade and Britain's imposition of a general tariff in 1932, which could have reduced the weight of imported inputs in the price equation.

Table 1.4 **Devaluation Expectation Equation**

Variable	Dependent Variable: Devaluation Probability (π)
ν_1	10.922
	(8.253)
σ_1	4.343
	(4.295)
ν_2	3.153
	(0.020)
σ_2	0.032
	(0.016)

Note: Table reports estimation of eq. (12). Numbers in parentheses are standard errors.

least squares over the period 1925:5–31:8. Estimation requires an empirical measure of the dependent variable; this was obtained using the drift-adjustment method under the assumption that the expected magnitude of devaluation was 10 percent.

The specification takes the devaluation probability as equal to the predicted value plus a forecast error:

$$\pi_t = \tfrac{1}{2} F_{\sigma_1}(u_{t+1} - \nu_1) + \tfrac{1}{2} F_{\sigma_2}(u_{t+1} - \nu_2) + \eta_t, \tag{12}$$

where $F_\sigma(\cdot)$ is the cumulative of a normal distribution with variance σ^2 (see the appendix).

The results are reported in table 1.4 and figure 1.9. While the model does not explain month-to-month fluctuations in the devaluation probability, it does capture the sharp increase in devaluation expectations toward the end of the estimation period, coinciding with the sterling crisis.

1.5 Causes of the Sterling Crisis

The results of section 1.4 are consistent with the view that the proximate cause of the sterling crisis was the dramatic rise in unemployment in 1929–31. The model is compatible with a number of different interpretations of this rise. These include the rise in real interest rates when the worldwide deflation set in starting in 1929 and the fall in the price of imported goods once world price levels began to plummet. These external disturbances affected the real economy through their interaction with slowly adjusting nominal wages and unemployment benefits. In addition, in our model the impact of external shocks is amplified by the response of financial markets: the rise in unemployment increases the exchange risk premium, further elevating domestic interest rates and further depressing unemployment. The question is how much weight to attach to these different elements. To shed some light on it, we ran three counterfactual simulations, one that indexed unemployment benefits, one that eliminated the

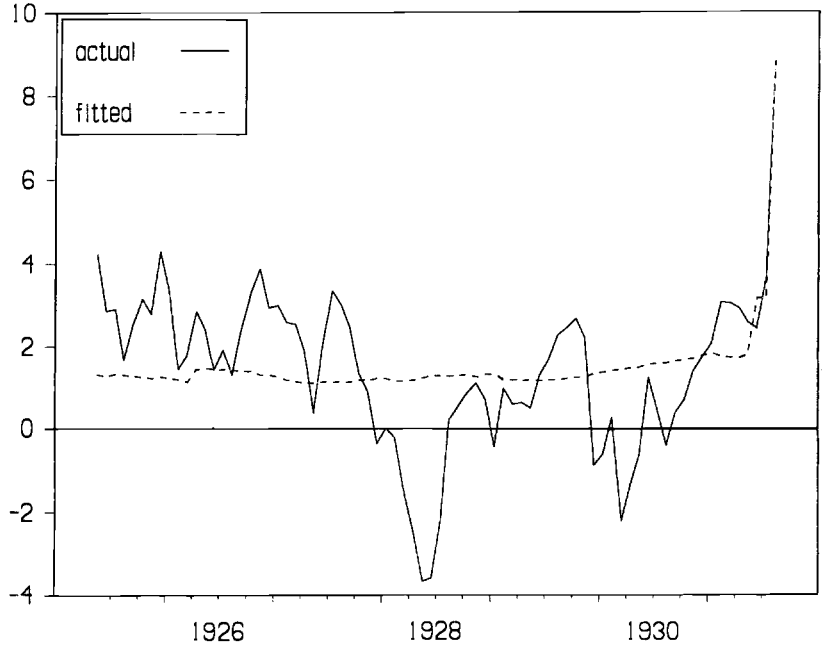

Fig. 1.9 Devaluation probability (percent)

interest rate shock, and one that eliminated imported deflation.[36] This exercise requires some assumptions about the path that would have been followed by the wholesale price index and the real interest rate had Britain not gone off gold. We assumed that the variations in the wholesale price index would have been the same in the United Kingdom as in France, which maintained its gold peg until 1936, and the real interest rate was set at a constant level equal to its average value over the fixed rate period.

Counterfactual 1: Indexing Unemployment Benefits. Figure 1.10 shows the evolution of the unemployment rate and the devaluation probability over the period 1925:5–32:12 under the assumption that real unemployment benefits were held constant at their 1925:5 level. The unemployment rate exhibits the same upward march as in the historical data, and by mid-1932 the devaluation probability jumps to a level of the same order of magnitude as during the sterling crisis. This suggests that the sterling crisis might have been postponed by a few months had unemployment benefits been indexed but that the course of this history would have been little changed otherwise.

36. These simulations are run using the equations in col. (2) of table 1.1, col. (3) of table 1.2, and col. (3) of table 1.3 and the equation in table 1.4.

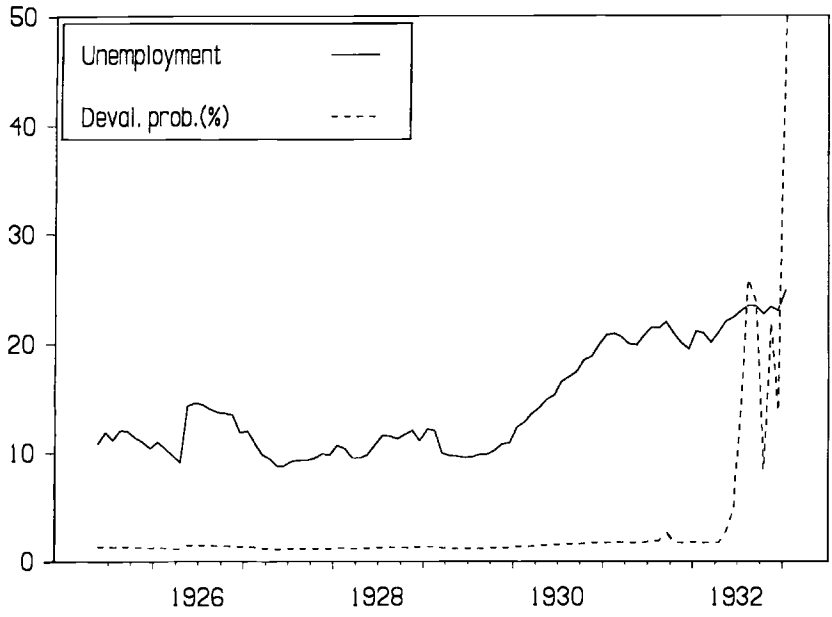

Fig. 1.10 Counterfactual 1: constant real benefit

Counterfactual 2: No Interest Rate Shock. Figure 1.11 shows the evolution of unemployment with the world real interest rate held constant at its 1928:12 level. The effect of removing the interest rate shock on unemployment is large but transitory. The unemployment rate would have been **4** percentage points lower than in the historical data in the summer of 1931. It would have grown at a quicker pace afterward, however, so that sterling would have been devalued at the beginning of 193**4**.

Counterfactual 3: No Imported Deflation. Figure 1.12 shows the unemployment rate and devaluation probability holding the price of imported goods constant at its May 1925 level. The unemployment rate is now 6 percentage points lower in mid-1931 than in the historical data and decreases afterward. As a result the sterling crisis would have been permanently postponed.

The reader may worry that our counterfactual results hinge too sensitively on the structural assumptions of our model or the estimation method. In order to check this, we reestimated the model as an unrestricted vector autoregression in the differenced variables with six lags and included the residuals of the cointegrating relation between unemployment, the real wage, and the real interest rate as an error correction term. Again, we found that removing the real interest rate shock would have postponed the sterling crisis by a few months, while removing the foreign price shock

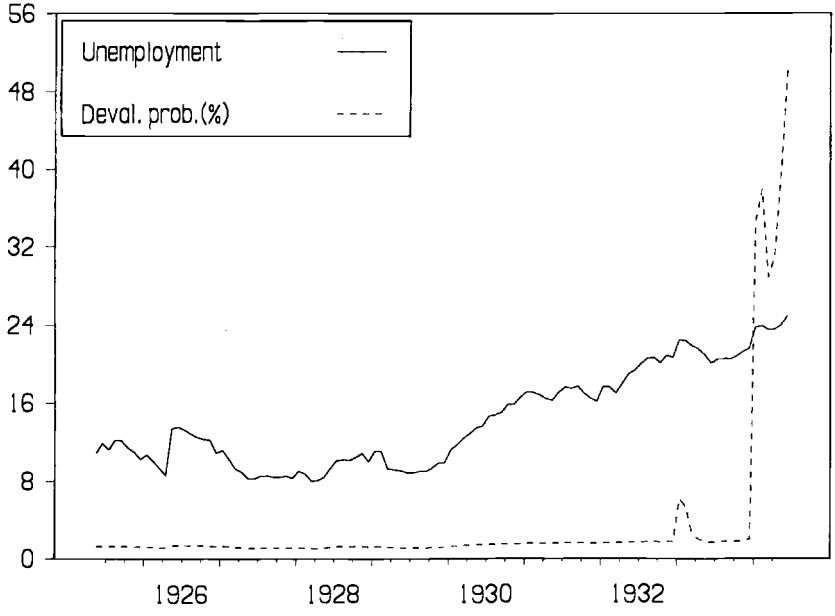

Fig. 1.11 Counterfactual 2: no interest rate shock

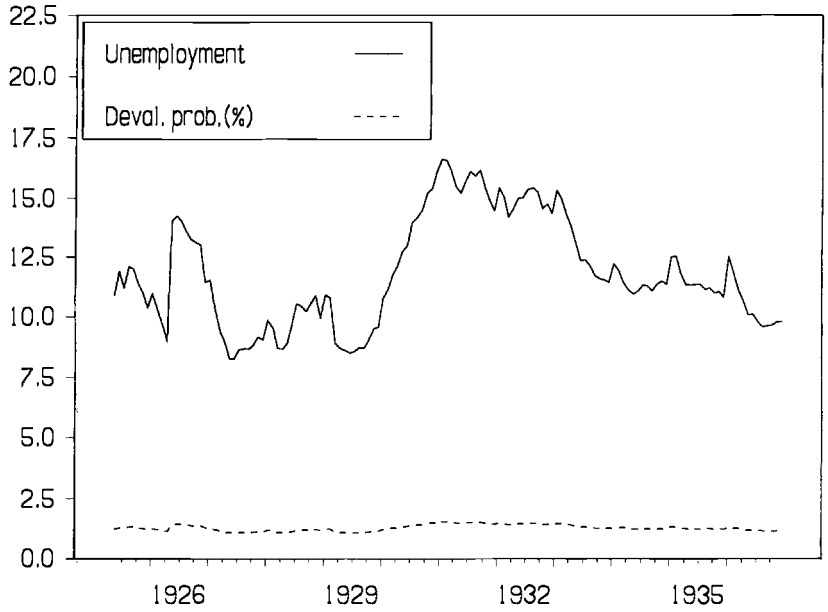

Fig. 1.12 Counterfactual 3: no imported deflation

would have postponed it permanently. This confirms that imported deflation was the main factor driving the rise in unemployment that in turn precipitated the sterling crisis.

1.6 Conclusion

In this paper we have analyzed currency crises in a model of unemployment, where the two-way interaction of devaluation expectations and unemployment gives rise to a rich set of dynamic possibilities. In our model, unemployment can heighten devaluation expectations, given the knowledge that the government may be prepared to pay the costs of opting out of its exchange rate commitment when a high level of joblessness increases the urgency it attaches to the pursuit of reflationary policies. Heightened devaluation expectations can in turn increase unemployment by adding a devaluation premium to interest rates. It is straightforward to see how an external shock can have a major impact through these feedback effects on both unemployment and the stability of the currency.

We have presented qualitative and quantitative evidence supporting this interpretation of the 1931 sterling crisis. Qualitative accounts, for their part, lay considerable weight on the pressure that a high and rising unemployment rate placed on British governments to pursue policies designed to stimulate recovery from the Great Depression, and on how the reluctance of those governments to raise interest rates in the face of speculative pressure undermined confidence in their commitment to the maintenance of the sterling parity. Our econometric estimates and simulations provide quantitative support for this interpretation. They suggest that the 1931 sterling crisis should be understood in terms of the pressure brought to bear on fragile governments by large foreign shocks superimposed on less than credible domestic policy commitments. We suspect that a similar model can shed light on currency crises in a variety of other times and places.

Appendix

Reduced-Form Dynamics

Taking the first difference of equation (3) and using equation (2) to substitute out the nominal wage gives

$$\text{(A1)} \qquad \Delta p_t = -\frac{a_5 a_6}{1 - a_4 a_6} u_{t-1} + \frac{1 - a_6}{1 - a_4 a_6} \Delta p^*.$$

Equation (2) gives an expression for the rate of change of the real wage

$$\Delta\omega_t = \Delta w_t - \Delta p_t = -(1 - a_4)\Delta p_t - a_5 u_{t-1},$$

which, using the equation for Δp_t, may be written like the reduced-form equation for the real wage given in equation (7) with

(A2) $$b_{21} = -\frac{a_5(1 - a_6)}{1 - a_4 a_6},$$

(A3) $$b_{22} = 1,$$

(A4) $$\alpha_2 = 0,$$

(A5) $$\beta_2 = -\frac{(1 - a_4)(1 - a_6)}{1 - a_4 a_6},$$

(A6) $$\gamma_2 = 0.$$

Using $r_t = i_{t-1} - \Delta p_t = r^* + \Delta p^* + d\pi_{t-1} - \Delta p_t$ to substitute out the real interest rate in equation (1), the unemployment equation may be rewritten

(A7) $$u_t = a_3 r^* + \left(a_1 + \frac{a_3 a_5 a_6}{1 - a_4 a_6}\right) u_{t-1} + a_2 \omega_{t-1} + \frac{a_3(1 - a_4)a_6}{1 - a_4 a_6}\Delta p^* + a_3 d\pi_{t-1}.$$

Whence the reduced-form equation for unemployment is given by equation (7) with

(A8) $$b_{11} = a_1 + \frac{a_3 a_5 a_6}{1 - a_4 a_6},$$

(A9) $$b_{12} = a_2,$$

(A10) $$\alpha_1 = a_3,$$

(A11) $$\beta_1 = \frac{a_3(1 - a_4)a_6}{1 - a_4 a_6},$$

(A12) $$\gamma_1 = = a_3 d.$$

Devaluation Probability

The government devalues if this lowers the loss function (6); that is, $u_{t+1}^2 > (u_{t+1} - \Delta u)^2 + C_{t+1}$, or

$$u_{t+1} > \frac{1}{2}\left(\frac{C_{t+1}}{\Delta u} + \Delta u\right),$$

where u_{t+1} is the unemployment rate at $t + 1$ conditional on no devaluation. The right-hand side of this inequality is the threshold level of unemployment above which the government prefers to devalue.

The devaluation probability at t is equal to the probability that the next-period unemployment rate (conditional on no devaluation) is above the threshold triggering a devaluation; that is,

$$\text{(A13)} \qquad \pi_t = \text{Prob}_t\left[\frac{1}{2}\left(\frac{C_{t+1}}{\Delta u} + \Delta u\right) < u_{t+1}\right] = F(u_{t+1}),$$

where $F(\cdot)$ is the cumulative distribution function of $(1/2)(C_{t+1}/\Delta u + \Delta u)$.

Given our assumptions about the stochastic process followed by the opting-out cost, $F(\cdot)$ takes the form

$$\text{(A14)} \qquad F(u) = \tfrac{1}{2}F_{\sigma_1}(u - \nu_1) + \tfrac{1}{2}F_{\sigma_2}(u - \nu_2),$$

where $F_{\sigma_k}(\cdot)$ is the cumulative of a normal distribution of variance $\sigma_k^2 = \text{Var}(\varepsilon_k)/4\Delta u^2$ and $\nu_k = C_k/2\Delta u + \Delta u/2$ $(k = 1,2)$.

Using the reduced form (7) to substitute out u_{t+1}, one obtains a relation between the devaluation probability and current macroeconomic variables:

$$\text{(A15)} \qquad \pi_t = F(b_{11}u_t + b_{12}\omega_t + \alpha_1 r^* + \beta_1 \Delta p^* + \gamma_1 \pi_t).$$

This equation implicitly defines π_t as a function of the economic fundamentals u_t and ω_t. Note that the right-hand side is increasing with π_t and may thus intersect the left-hand side in several points. If this is the case the devaluation probability is not determined uniquely by the economic fundamentals, and the beliefs of foreign exchange market participants may become self-fulfilling. The logic of this multiplicity is that high devaluation expectations validate themselves by increasing unemployment in the home country.

A sufficient condition for uniqueness is that the slope of the right-hand side of equation (A15) be everywhere lower than one; that is,

$$\text{(A16)} \qquad \gamma_1 \max F' < 1.$$

If the condition above is satisfied, the devaluation probability is given by equation (8), where function $\Pi(\cdot)$ is increasing and satisfies $\lim_{-\infty}\Pi = 0$ and $\lim_{+\infty}\Pi = 1$.

Steady States

In steady state the real wage is constant:

$$\text{(A17)} \qquad \Delta\omega_t = b_{21}\bar{u} + \beta_2 \Delta p^* = 0,$$

so that the steady state level of unemployment is given by equation (9).

In steady state the reduced-form equation for unemployment is

$$\text{(A18)} \qquad \bar{u} = b_{11}\bar{u} + b_{12}\bar{\omega} + \alpha_1 r^* + \beta_1 \Delta p^* + \gamma_1 \bar{\pi},$$

which, using equation (9), implies (10).

Data

All data are monthly, from May 1925 to December 1936. Many are extracted from the *International Abstract of Economic Statistics* (IAES 1934) for the period 1925–30 and the *Recueil International de Statistiques Economiques* (RISE 1938) for the period 1931–36.

- u Percentage of insured persons unemployed, males and females (IAES+RISE, Great Britain).
- w Index of average weekly wages (IAES+RISE, Great Britain).
- p Cost of living index (IAES+RISE, Great Britain).
- p^w Wholesale price index (IAES+RISE, Great Britain).
- i U.K. three-month nominal interest rate (Einzig 1937, app. III).
- i^* U.S. three-month nominal interest rate (Einzig 1937, app. III, New York).
- p^* U.S. consumer price index (Sayre 1948, table 1, column "All items").
- e Dollar-sterling exchange rate (IAES+RISE, United States).
- b Weighted index of benefit rates (Burns 1941, 368). Weights are the same as in Hatton (1988).

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Comment Michael D. Bordo

In this fascinating paper, Eichengreen and Jeanne extend the logic of the recent second-generation currency crisis models to explain the sterling crisis of 1931, a crisis that precipitated the demise of the interwar gold exchange standard. In simplest terms, the story they tell is that the United Kingdom abandoned gold convertibility on 20 September 1931 because the monetary authorities were unwilling to raise the discount rate sufficiently to defend convertibility. The authorities were concerned that such actions would increase the level of unemployment from its already high level. The explanation works through a model in which the monetary authority has a loss function that balances the costs of rising unemployment against the costs of lost credibility (including the benefits from sterling's role as a reserve currency and London's position as a financial center).

As unemployment rises the costs of abandoning convertibility decline relative to the political costs of not doing so. Exchange market participants understand this, so that the probability of devaluation increases. The level of unemployment is driven by the external shocks of the Great Depression via two channels: the effect of deflation on real wages in the face of nominal rigidities and the effect of deflation on ex post real interest rates via a credit market channel. Estimating the model and solving for the probability of devaluation gives the result of a marked jump in the probability of devaluation in the late summer of 1931, thus anticipating the crisis. A counterfactual displayed in figure 1.12 shows that in the absence of the external deflationary shocks of the Great Depression, the probability of sterling devaluation in 1931 would have been negligible.

The model is neat, easy to understand, and, if you believe the assumptions on which it is based, very compelling. The problem is that I am not convinced that it *was* the authorities' concern over rising unemployment that led them to throw in the towel on parity at $4.86. This is not to say that it was not the shocks of the Great Depression that pushed the United Kingdom over the edge.

My first concern is over the issue of credibility. It is not obvious that the 1992 U.K. loss function—that the authorities were unwilling to persist

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