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EXCHANGE RATES AND ECONOMIC
RECOVERY IN THE 1930s

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Exchange Rates and Economic Recovery in the 1930s

ABSTRACT

Currency depreciation in the 1930s is almost universally dismissed or condemned. It is credited with providing little if any stimulus for economic recovery in the depreciating countries and blamed for transmitting harmful beggar-thy-neighbor impulses to the rest of the world economy. In this paper we argue for a radically different interpretation of exchange-rate policy in the 1930s. We document first that currency depreciation was beneficial for the initiating countries. It worked through both the standard supply- and demand-side channels suggested by modern variants of the Keynesian model. We show next that there can in fact be no presumption that currency depreciation in the 1930s was beggar-thy-neighbor policy. Rather, an empirical analysis of the historical record is needed to determine whether the impact on other countries was favorable or unfavorable. We conclude provisionally on the basis of this analysis that the foreign repercussions of individual devaluations were in fact negative — that the depreciations considered were beggar-thy-neighbor. As we point out, however, this finding does not support the conclusion that competitive devaluations taken by a group of countries were without benefit for the system as a whole. We argue to the contrary that similar policies, had they been even more widely adopted, would have hastened recovery from the Great Depression.

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Whether they are concerned with the magnitude of the initial contraction or the retardation of the subsequent recovery, most analyses of the Great Depression attach considerable weight to the effects of economic policy. The misguided actions of the Federal Reserve and the unfortunate commercial initiatives of the Executive and Legislative Branches are blamed for transforming the American recession into an unprecedented depression.¹ Perverse monetary and fiscal responses in such countries as Germany and France are blamed for reinforcing the deflationary pressures transmitted from the United States to the rest of the industrial world.² In desperate attempts if not to promote recovery then at least to provide insulation from destabilizing foreign shocks, national authorities took recourse to currency devaluation and tariff escalation. Such initiatives are typically characterized as counterproductive beggar-thy-neighbor policies. Individually they are seen as attempts to better a country's position at the expense of its neighbors; together, it is argued, they disrupted international economic relations and, by impeding foreign trade, destroyed one of the only remaining sources of autonomous demand.³

Despite notable exceptions, such as "cheap money" in Britain after 1931, fiscal expansion in Sweden, and industrial policy giving way to central control in Germany, policy receives little credit for helping the economies of Europe find their way out from the Great Depression.⁴ One can conceive of various counterfactual policy packages that these nations might have pursued: the components include devaluation, protection, monetary expansion and fiscal

stimulus. In practice, however, there was little scope for significant policy initiatives within the institutional and intellectual framework inherited from the 1920s. Fiscal policy, except in Sweden, would continue to be guided by the principle of balanced budgets until the adoption of Keynesian approaches to taxation and spending in subsequent decades.⁵ Even had there existed a belief in the efficacy of countercyclical fiscal policy, it might have been of little practical consequence on the national level so long as the fixed parities of the gold-exchange standard continued to serve as an external constraint. The potential of monetary initiatives, although more widely recognized and acknowledged, was equally inhibited by this gold standard constraint.

The critical decision for national economic authorities therefore concerned the stance of external policy. Not only might currency devaluation, exchange control, tariff protection or quantitative trade restrictions have macroeconomic effects of their own, but by changing the external constraints they opened the way for initiatives on other fronts. Some have argued, however, that these policies provided a country relief from the Depression only at the expense of its neighbors, and that by eliciting retaliation, these policies only exacerbated the Depression for all involved. Thus, many studies of the Depression which do not dismiss the effects of policy as negligible condemn them as positively harmful.

In our view, a proper understanding of the role of external economic policy must begin with a sharp analytical distinction between protectionist measures (such as tariffs and quotas) and exchange rate management. Tariffs and devaluation are often spoken of as two sides of the same coin, both being

policies designed to shift demand from foreign countries to the domestic economy. In fact, the general equilibrium implications of the two sets of policies are very different. Tariff changes inevitably create output price distortions, while a series of devaluations in many countries can leave relative output prices unchanged. (Exchange control is effectively a combination of tariff and devaluation policy, in the sense that it both changes the relative prices of national currencies and causes distortions in output prices.) On tariffs, we endorse the traditional view: a tariff escalation in one country is likely to reduce economic welfare in other countries and provoke retaliation; and a global round of tariff escalation is likely to reduce welfare in all countries.⁶ When it comes to exchange rate management, the implications are far more complex. One country's devaluation need not beggar the remaining countries, and a series of devaluations can easily leave all countries better off.

We will argue that currency depreciation was clearly beneficial for the initiating countries. In this regard, our work supports the findings of Choudri and Kochin (1980).⁷ Even this point is controversial, since it has recently been argued, in the spirit of the new classical macroeconomics, that the effects of depreciation were in some instances negligible.⁸ The new classical macroeconomics insists that pure monetary changes in an economy, such as a change in the nominal value of gold, can have no real effects since all other nominal prices will merely adjust to the monetary change. We believe that the experience of the 1930s provides a wonderful case to refute this dogma.

Somewhat more controversial are our conclusions concerning the foreign repercussions of depreciation and the impact of competitive devaluation. After

showing that currency depreciation was clearly beneficial for the initiating country, we show that there is in fact no theoretical presumption that depreciation in the 1930s was a beggar-thy-neighbor policy. To determine whether the impact on other countries was favorable or unfavorable, one must turn to the historical record. Although we do find evidence that the foreign repercussions of individual devaluations were negative -- that policy had beggar-thy-neighbor effects -- this finding does not support the conclusion that competitive devaluations taken by a group of countries were without benefit for the system as a whole. Although it is difficult to determine whether the devaluations which actually took place had on balance an expansionary or contractionary impact on the world economy, there is little doubt that similar policies, had they been adopted even more widely and coordinated internationally, would have hastened economic recovery from the Great Depression.

I

What are the principal channels through which the currency depreciations of the 1930s could have affected domestic and foreign economies? Our analysis focuses on three potential channels of transmission from policy to performance: real wages, international competitiveness, and the level of world interest rates. In Appendix A we present a simple two-country model, drawing on the work of Mundell (1964) and Fleming (1962) but extended to encompass the determinants of aggregate supply and the gold-standard constraints, which can be used to analyze formally the role of these variables in linking together

currency depreciation and economic growth. However, the effects of these variables can be readily understood without recourse to this formal model.

We have in mind a model of national economies linked together by international flows of commodities and assets. We adopt Keynes' characterization of labor and output markets: in each country nominal wages adjust only slowly due to inertia in labor markets, but prices adjust with sufficient speed to clear commodity markets. Aggregate supply in each country depends on profitability, as measured by the ratio of product prices to wages. Thus, we assume the standard upward-sloping supply curves suggested by economic theory. Aggregate demand in each country depends on competitiveness (or the ratio of domestic to foreign prices) and on interest rates (which determine the division of spending between current and future periods). As in the Mundell-Fleming model we take money demand to be a function of output and interest rates, where the latter are linked internationally by the open interest parity condition. For the present we neglect expectations of exchange-rate changes; hence domestic and foreign interest rates can be taken as equal, and we need make no distinction between real and nominal interest rates.

In such a model, currency depreciation will increase output and employment in the devaluing country. By raising the price of imports relative to domestic goods, it switches expenditure toward the home country. This increased domestic demand will tend to drive up domestic commodity prices, moderating the stimulus to aggregate demand and by reducing real wages stimulating aggregate supply, until the domestic commodity market clears. The same shift in relative prices that switches demand toward domestic goods switches demand away from foreign

goods, exerting deflationary pressure on the foreign economy. However, whether currency depreciation is beggar-thy-neighbor policy depends not only on adjustment in commodity markets but on conditions in asset markets as well. The devaluation will tend to reduce world interest rates and thereby stimulate demand in the foreign country. The stimulus from lower interest rates can exceed or fall short of the contractionary shift of demand away from foreign goods and towards the devaluing country. Thus foreign output may rise or fall after the devaluation.

The overall impact on foreign economies depends on the home-country measures that accompany devaluation. The devaluing country's central bank gold reserves rise in value by the extent of the devaluation. This capital gain can be put to various uses by the central bank. If the monetary base is expanded by the percentage devaluation, the gold backing of the base remains unchanged (with gold valued at the new parity).⁹ Alternatively, the central bank might choose to leave the monetary base unchanged, in which case the effective gold backing rises. This is the case when capital gains on gold are transferred to the treasury and then used to retire treasury debt held by the central bank. Thus, devaluation may be accompanied by a corresponding rise in the monetary base, by a rise in gold cover, or by some combination of the two.

The greater the accompanying expansion in monetary base, the more likely is a rise in foreign output after the devaluation. World interest rates fall further, and this fall in world interest rates provides the stimulus needed to expand foreign demand. It is theoretically ambiguous whether the favorable impact on the foreign country of lower interest rates outweighs the unfavorable

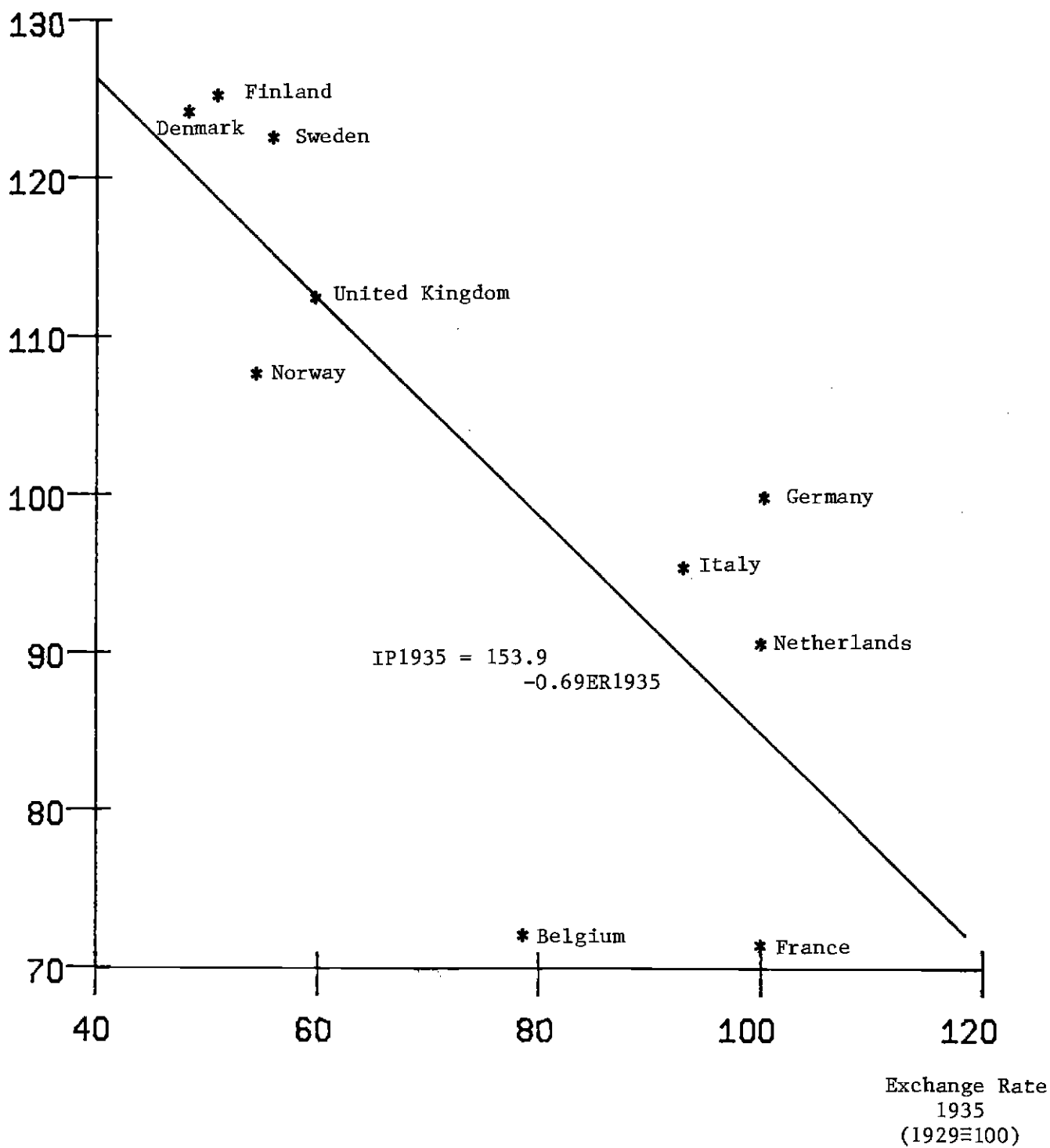
effects of its loss of competitiveness. We show in Appendix A that a necessary, though not sufficient, condition for a positive "locomotive effect" is that the foreign country gains gold reserves and the devaluing country loses gold reserves after the devaluation. Thus, if the devaluing country keeps the monetary base tight enough to prevent any loss of gold reserves, devaluation is surely beggar-thy-neighbor.

Clearly, our analysis is premised on a framework in which monetary variables are non-neutral. Before becoming deeply enmeshed in analysis it is important therefore to pause and consider whether this is an appropriate framework for analysis. We show in Figure 1 an example of the relationships which led us to this perspective (all data employed in this paper are detailed in Appendix B). Figure 1 shows the relationship of the percentage change in the exchange rate between 1929 and 1935 to the percentage change in industrial production over the same period. We choose 1935 as the terminal date in order to permit exchange-rate changes as much time as possible to work their effects.¹⁰ We include all the economies of Western Europe for which comparable data could be obtained.¹¹ The change in exchange rates, plotted along the horizontal axis, is expressed as the gold price of domestic currency in 1935 as a percentage of the 1929 parity; a value of 100 for France indicates no change in the rate, while a value of 59 for the United Kingdom indicates a 41 percent depreciation. The change in industrial production, plotted along the vertical axis, is the ratio of production in 1935 to 1929 multiplied by 100. There is a clear negative relationship between the height of the exchange rate and the extent of recovery from the Depression.¹² The countries of the Gold Bloc,

Figure 1

The Exchange Rate and Industrial Production

Industrial Production
1935
(1929=100)



Note: The exchange rate is in units of gold per unit of domestic currency.

represented here by France, the Netherlands and Belgium, had by 1935 failed to recover to 1929 levels of industrial production. Countries which devalued at an early date (the United Kingdom, Denmark and the Scandinavian countries) grew much more rapidly. Moreover, there appears to be a positive relationship between the magnitude of depreciation and the rate of growth between 1929 and 1935. Germany and Belgium are outliers in terms of this relationship, Belgium presumably because she devalued only at the end of the period, leaving relatively little time for exchange rate changes to influence growth, and Germany presumably because of the influence of capital controls whose effects were analogous to an explicit depreciation.¹³

It can be objected that both the exchange rate and industrial production are endogenous variables, so that we should not attribute variations in economic growth to movements in exchange rates rather than vice versa. We prefer our interpretation for several reasons. First is the matter of timing. In all cases, devaluation preceded the beginning of recovery, judged on the basis of annual data. Second is a matter of logic. It is hard to make a case for reverse causation, that faster growing countries were pushed into devaluation. Indeed, we will demonstrate that the faster growing countries were absorbing, not losing, gold, so that it would be tricky indeed to make the case that fast growth forced countries off their gold parities. Third, and most important, exchange rates in the 1930s depended not just on economic pressures but on national attitudes toward the monetary standard, where the latter are predetermined relative to the events of the early 1930s. Countries' allegiance to their gold standard parities appear to have been largely a function of their

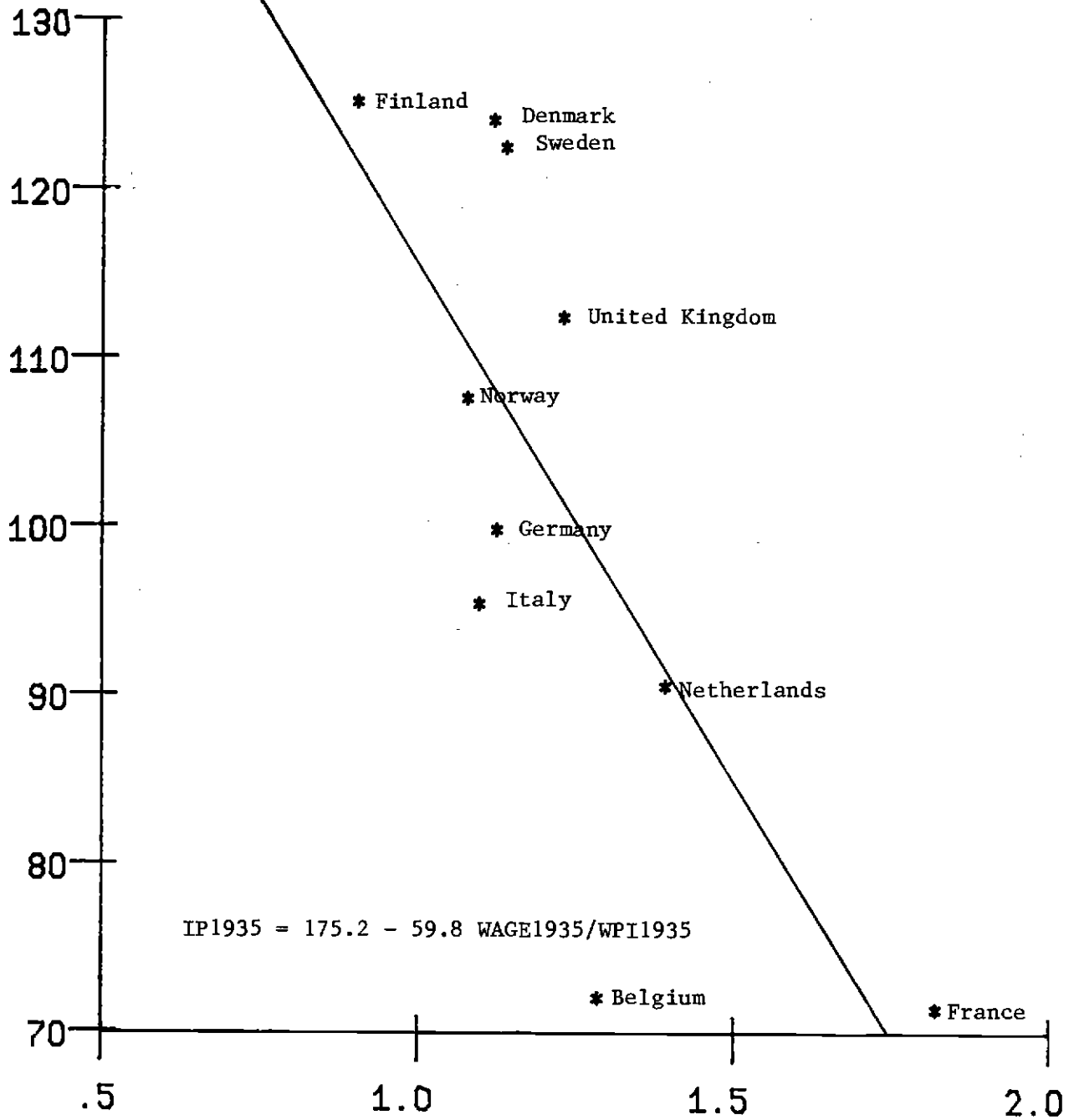
stabilization experiences in the early 1920s. Ironically, those nations which made the most concerted efforts to restore prewar gold standard parities in the early 'twenties showed the least hesitation to devalue in the early 'thirties. Conversely, those countries which failed to restore prewar parities in the 'twenties, typically in the wake of an inflationary episode varying from the moderate to the extreme, made the most strenuous efforts to defend and maintain the gold parities which they finally established. The obvious contrast is between Britain and France, although the point applies generally. French opinion was so traumatized by the successive "battles of the franc" that took place between 1922 and 1926 that neither the public nor policymakers were willing to even contemplate the option of devaluation before 1936.¹⁴ In Britain, where the decision to return to the prewar parity was little questioned in 1925, there was nearly no mention of a return to the gold standard once convertibility was suspended in the wake of the 1931 financial crisis.¹⁵ The important point for our analysis is that the decision of whether to devalue the currency in the 1930s was heavily influenced by considerations exogenous to our macroeconomic model, namely the historical experience of the 1920s.

Figures 2 through 5 show various aspects of the mechanism linking exchange rates to economic activity. In Figure 2 the change in real wages (on the horizontal axis) is plotted along with the change in industrial production (on the vertical axis). The clear negative relationship indicates that supply considerations strongly influenced the rate of economic recovery.¹⁶ Countries which succeeded in reducing real wages enhanced profitability and boosted aggregate supply. Again, Belgium appears as something of an outlier, since the

Figure 2

The Real Wage and Industrial Production

Industrial Production
1935
(1929=100)



$IP_{1935} = 175.2 - 59.8 \text{ WAGE}_{1935}/\text{WPI}_{1935}$

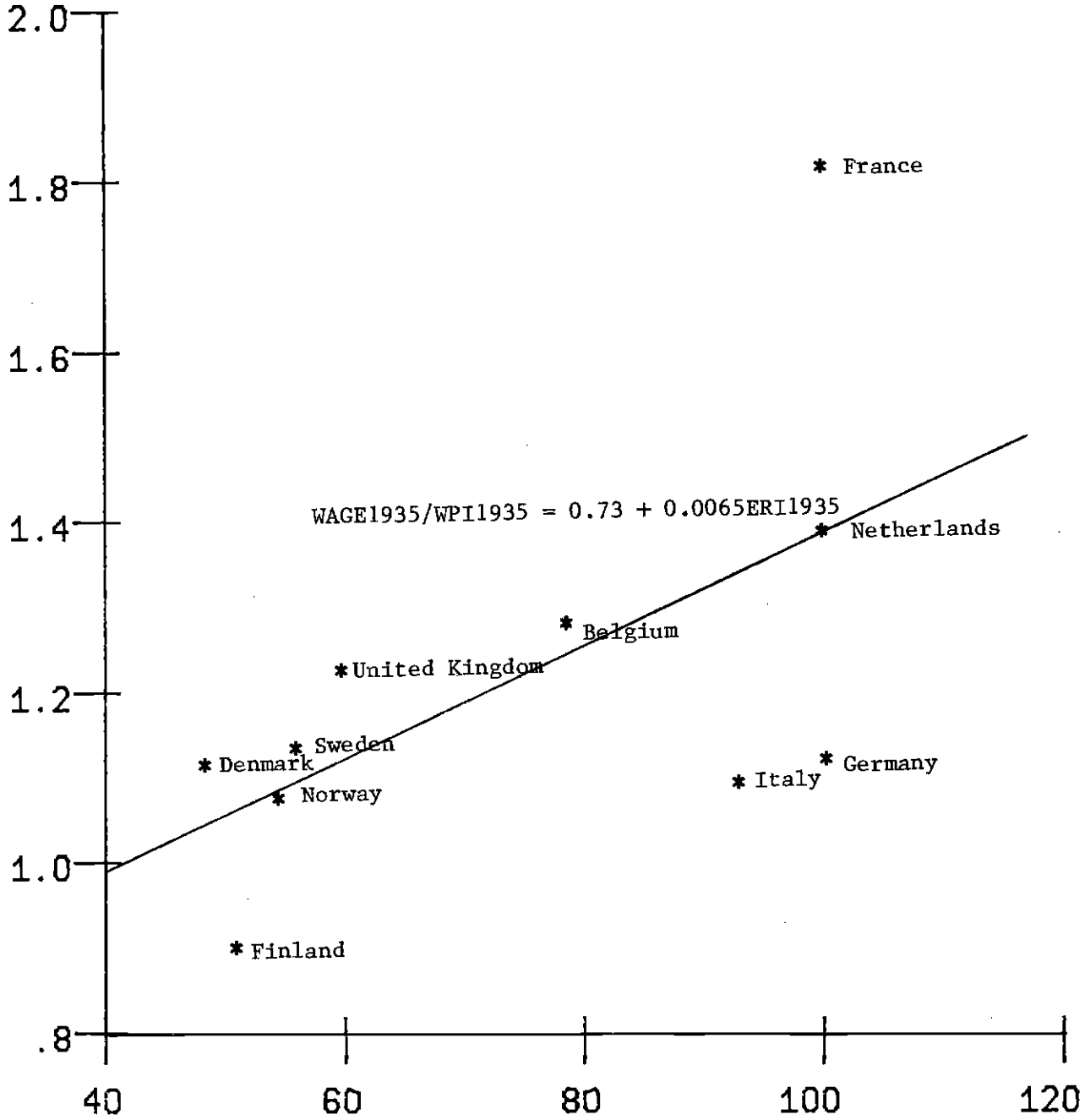
Real Wage
1935
(1929=100)

Note: The real wage is the nominal wage deflated by the wholesale price index.

Figure 3

The Exchange Rate and the Real Wage

Real Wage, 1935
(1929=100)



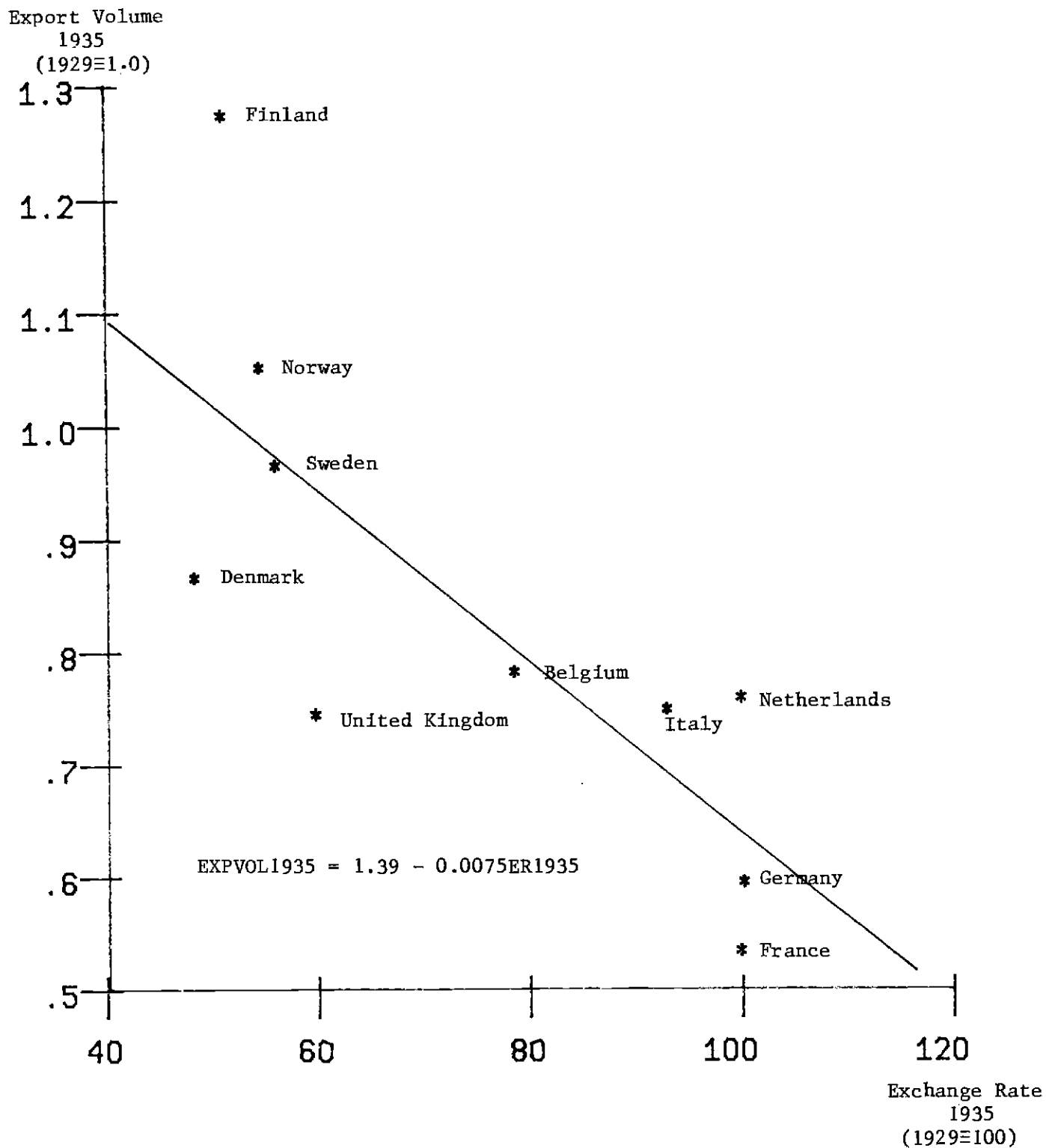
Exchange Rate
1935
(1929=100)

late date of devaluation there left little time for its effects. Figure 3, which shows the relationship between the change in the exchange rate and the change in the real wage, suggests that depreciation, by putting upward pressure on prices, contributed to the reduction in the real wage which stimulated supply in devaluing countries.¹⁷ Of course, other factors in addition to exchange-rate policy influenced the evolution of real wages. These other factors appear to have played relatively large roles in Germany, Italy, Finland and France. In Italy and especially in Germany, the labor market came under increasingly strict government regulation as the 1930s progressed; it is not surprising that the change in real wages only moderately reflects the market forces we consider.¹⁸ The extent to which French wage growth was stimulated and Finish wage growth restrained by factors other than external economic policy is an important topic for further research.

The impact of exchange rate changes on demand is apparent in Figure 4, where the change in the exchange rate is plotted along with the change in export volume (expressed in ratio form). The negative relationship is undeniable: countries which depreciated succeeded in promoting the recovery of export volume. compared with countries that remained on gold.¹⁹ This result may or may not be consistent with the beggar-thy-neighbor characterization of exchange-rate policy, but it clearly shows that a single devaluation, taken in isolation, increased demand in the devaluing country. The same picture would emerge were we to construct measures of the real exchange rate and plot them against export volume, since each country's real exchange rate is dominated by the movement of its nominal exchange rate. In Figure 4, France and Finland are the noticeable outliers, reflecting perhaps the impact of the same supply-side factors causing

Figure 4

The Exchange Rate and Export Volume



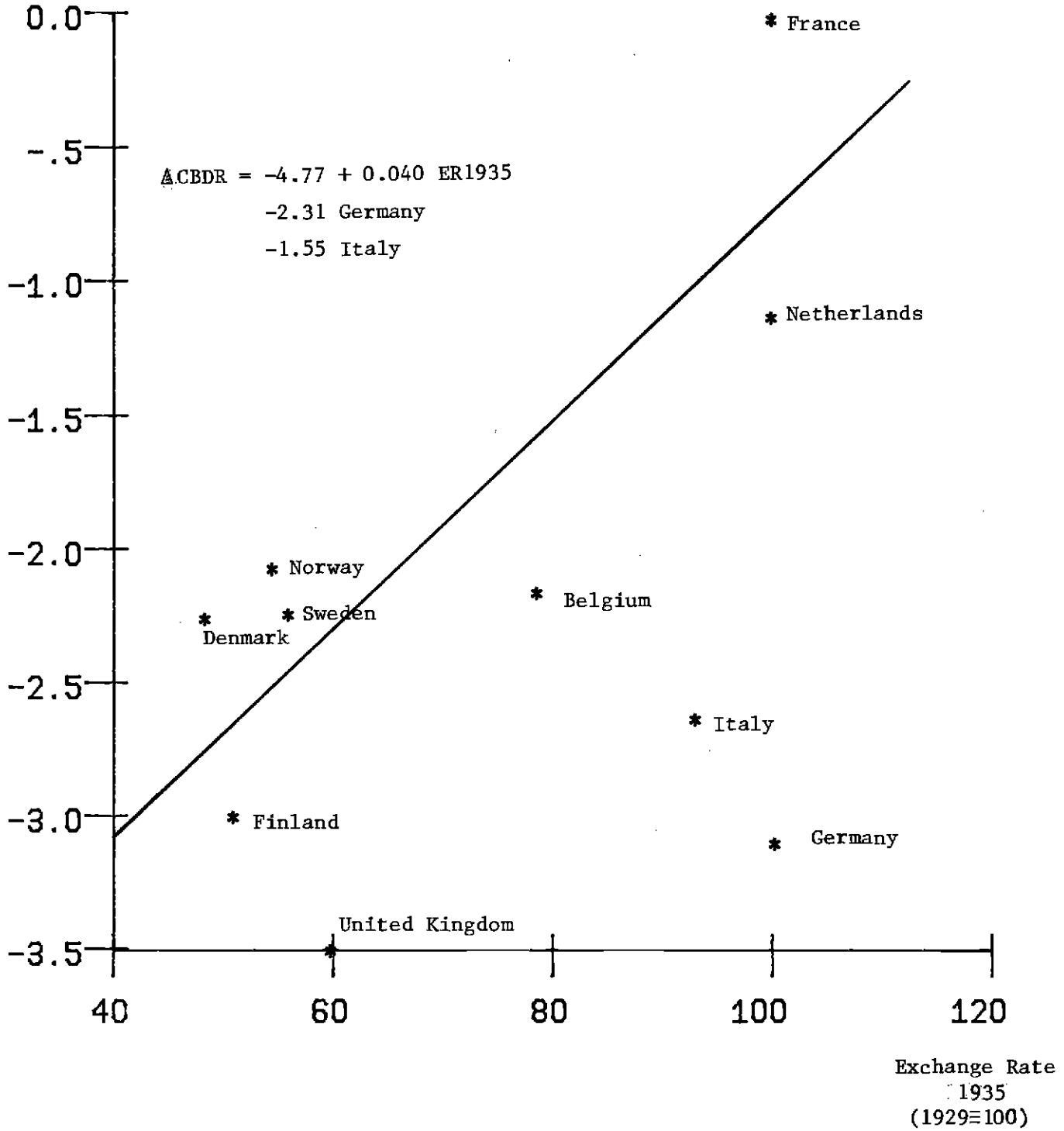
these countries to be outliers (in Figure 3) in terms of wage performance.

The other major channel through which exchange-rate changes could have influenced demand is via the level of interest rates. Countries that devalued could have taken advantage of the relaxation of gold-standard constraints and engineered a reduction in interest rates through the adoption of accommodative money and credit policies. In our formal model, depreciation and accompanying monetary initiatives affect only the overall level of world interest rates. In a more general model, depreciation might give rise to interest-rate differentials among countries, creating not only the expenditure-changing effect emphasized in Appendix A but also an additional expenditure-switching effect. In practice it is difficult to marshal evidence concerning the impact of exchange-rate policy on interest rates. Interest rates on assets with even approximately comparable maturities and risk characteristics are available for only a subset of European countries.²⁰ In Figure 5 we therefore plot the change in the exchange rate along with the change in the central bank discount rate. Obviously, the discount rate is an administered price rather than a direct measure of market conditions. Yet in market economies the discount rate could not diverge markedly from freely-determined rates, since central banks which discounted the eligible paper of the private sector could not afford to do so at rates far out of line from market levels. Figure 5 suggests a positive relationship between the height of the exchange rate and the discount rate, once account is taken of the extent of controls in Italy and Germany.²¹ When currencies were devalued, central banks were able to capitalize on the increased strength of the external position by reducing interest rates.

Figure 5

The Exchange Rate and the Discount Rate

Change in
Discount Rate
1929 to 1935

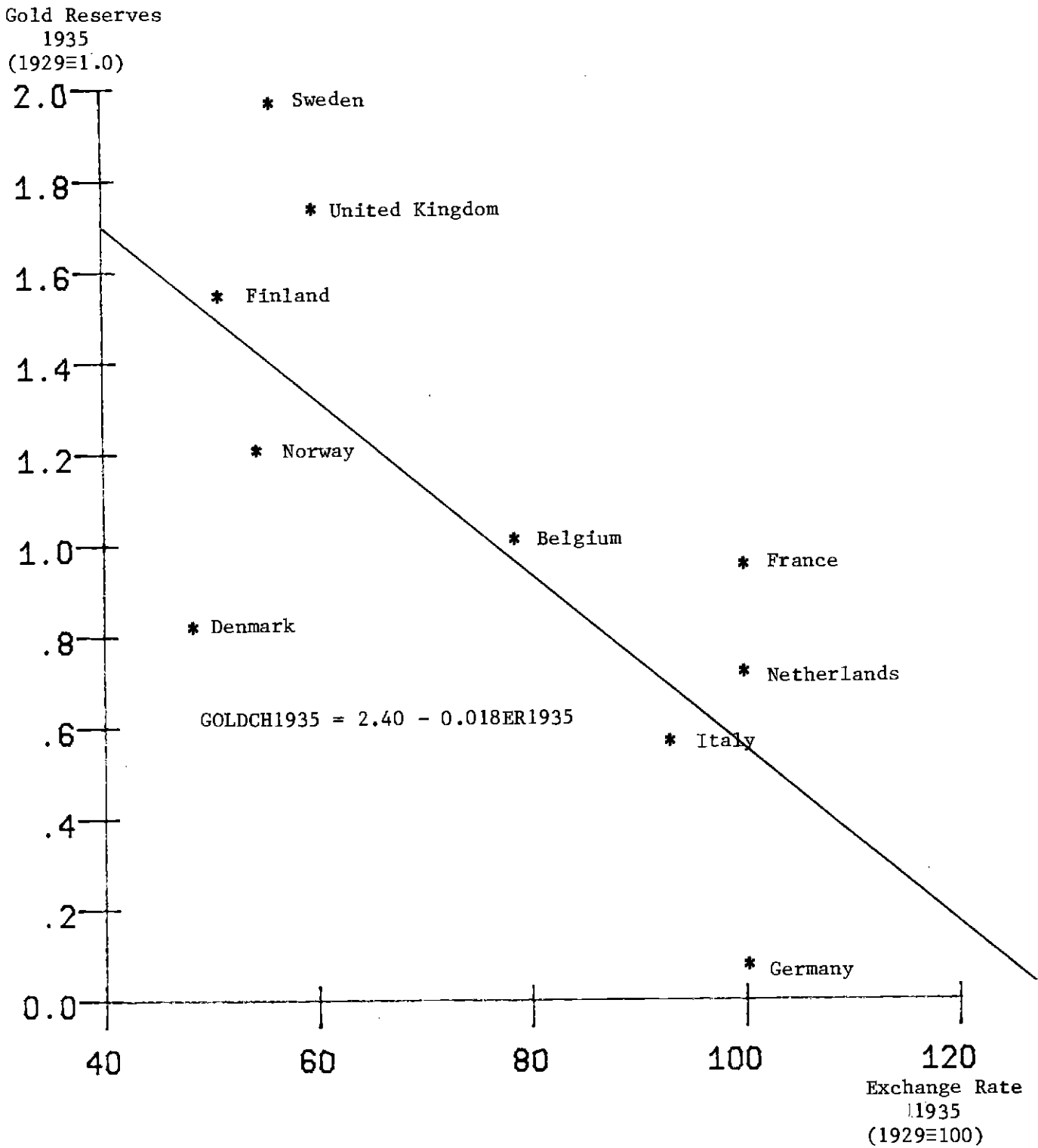


Together this evidence suggests that the relationship between exchange-rate changes and economic recovery depicted in Figure 1 is not a spurious correlation. The new classical dogma of short-run monetary neutrality seems to be decisively refuted by the data. Exchange-rate policy promoted growth not through one but through each of the major channels: by reducing real wages, enhancing competitiveness, promoting exports, and permitting a reduction of interest rates. Whether the gain to devaluing countries had as its counterpart a loss to those which remained on gold -- in other words, whether this policy was beggar-thy-neighbor -- depends on the precise form of the devaluations. We show in the appendix the variety of forms which devaluation might take. As described earlier, if the money supply in the devaluing country is not expanded to reflect the capital gains on gold reserves accruing to the central bank, gold must flow in to satisfy the growing domestic demand for money. In this case, the reduction in world interest rates is insufficient to overwhelm the beggar-thy-neighbor competitiveness effect. In fact, world interest rates fall precisely because foreign activity declines to such an extent that world money demand is reduced relative to supply. If, in contrast, the devaluing country increases its money supply sufficiently to induce an outflow of gold, the stimulus to demand of lower interest rates abroad will be more likely to expand the foreign economy. A gold outflow is a necessary but not sufficient condition for the foreign expansion. Thus, the direction of gold flows provides an indicator of whether devaluation was necessarily beggar-thy-neighbor.

In Figure 6 we plot the change in the exchange rate against the change in gold reserves (where the latter is expressed in ratio form). The negative

Figure 6

The Exchange Rate and Gold Reserves



Note: In this figure, gold reserves are measured in physical volumes.

relationship is apparent: depreciating countries gained rather than lost gold reserves.²² Currency depreciation, if beneficial from the individual country's point of view, was in fact beggar-thy-neighbor.

Whether the gain to the devaluing countries outweighed the loss to their neighbors is an extremely difficult historical question. Regardless of the answer, it remains true that these policies, had they been adopted even more widely and in a coordinated fashion, could have been beneficial for all the countries involved. In our model, a simultaneous devaluation taken by all countries may have no immediate effects; simply raising the domestic-currency price of gold in each country affects none of the equilibrium conditions in goods or asset markets.²³ However, if money supplies are expanded to reflect the capital gains on gold reserves (thus holding the gold cover ratio constant), then the reduction in interest rates stimulates activity both at home and abroad.

The cogent criticism of exchange-rate depreciation in the 1930s is not, therefore, that it was used unfairly, but that the policy was pursued sporadically and was avoided altogether by some major countries. Often, exchange rates were adjusted in the wake of a crisis, although this was not uniformly the case.²⁴ Financial crises shifted from one country to another, for each time a country known to be in a delicate position devalued, a new country was elevated to the position of being the next one expected to fall. Nurkse (1944) labels this sequential pattern the "devaluation cycle" of the 1930s. The resulting uncertainty about exchange rate stability seems to have led international investors (including central banks) to liquidate a portion of

their foreign exchange holdings and replace them with gold. In our model, the effects of such actions are captured by a rise in the gold cover ratio. The same world stock of gold can then support only a smaller money supply, raising interest rates and exerting deflationary pressure. To the extent that demands for gold were increased by the "sequential" or "successive" nature of the devaluations of the 1930s, the benefits of an "all-round" devaluation were reduced.

Thus, we do not present here a blanket endorsement of the competitive devaluations of the 1930s. While it is indisputable that currency depreciation conferred macroeconomic benefits on the initiating country, because of accompanying policies the depreciations of the 1930s had beggar-thy-neighbor effects. While it is likely that currency depreciation, had it been even more widely adopted, would have worked to the benefit of the world as a whole, the sporadic and uncoordinated approach taken to exchange-rate policy in the 1930s tended, other things equal, to reduce the magnitude of the benefits.

As we noted in the introduction, the contrast between exchange-rate and commercial policies provides perhaps the best perspective on how the currency devaluations of the 'thirties should be viewed. Both depreciation and protection, by switching expenditure toward the initiating country, exert expansionary effects at home.²⁵ Both depreciation and protection can have beggar-thy-neighbor effects abroad, although in the case of exchange-rate policy this need not be the case. But while the adoption of tariffs by all countries is likely (by reducing producer prices, lowering output and employment, and creating a deadweight loss) to leave everyone worse off, coordinated devaluation

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both at home and abroad together with accomodative monetary measures will likely leave everyone better off.²⁶ Too often competitive devaluation and tariff protection have been viewed interchangeably in the literature on the 1930s.²⁷ We have suggested here that these two policies must be viewed in a very different fashion.

II

Our purpose in this paper has been to urge a reassessment of economic policy in the 1930s. Taking the case of exchange-rate policy, we have argued that policy exerted an important influence over the pattern of recovery from the Great Depression. Moreover, we have indicated the channels through which policy operated, and presented evidence as to its effects.

Given the number of unanswered questions posed along the way, our paper has been as much an agenda for future research as a statement of results. This research should be extended to encompass still other aspects of external economic policy not yet mentioned. The theoretical framework can readily incorporate the effects of fiscal policy, but the empirical analysis awaits the construction of adequate measures of fiscal stance.²⁸ The extent to which devaluation invites retaliation -- strategic aspects of exchange-rate policy -- needs to be explicitly analyzed.²⁹ Currency depreciation was only one of several instruments of external economic policy, along with exchange control and trade restrictions. These instruments, which could be viewed either as substitutes or complements both for countries initiating policy and for those contemplating

retaliation, and need to be analyzed in a consistent fashion. The development of currency areas and their effects require a separate analysis. The dynamics of adjustment to exchange rate changes -- dynamics which permit the short run and long run impacts of depreciation to differ -- can and should be incorporated into the model. Above all, we have taken the formulation of policy as exogenous to our analytical framework. A full understanding of the role of policy in the economic recovery of the 1930s requires an integrated analysis of both policy's formulation and effects.

Appendix A

In this appendix, we present a two-country model of macroeconomic equilibrium under the gold standard. The model is an adaptation of the two-country Mundell-Fleming framework (see Mundell, 1964; and Bruno and Sachs, 1985), with a special emphasis placed on aggregate supply behavior and on the monetary links to gold. For simplicity, we present the case of two symmetric economies, with identical coefficients in the structural equations.

Aggregate supply is given as a negative function of the product wage. Letting q be the log of GDP, w the log wage, and p the log price of domestic output, we write:

$$(A.1) \quad q = -\alpha(w-p)$$

Thus, α is the elasticity of output with respect to the product wage. Note that a symmetric equation, $q^* = -\alpha(w^*-p^*)$, applies for the foreign country (with an asterisk representing foreign). We will present only the home-country equations in the text, and show the complete, two-country model in Table A.1.

We adopt the Keynesian assumption of nominal wage rigidity:

$$(A.2) \quad w = \bar{w}$$

With \bar{w} fixed, nominal demand expansion (e.g. via a currency devaluation) raises p relative to w , depresses $w-p$, and thereby raises aggregate supply.

The home country fixes the domestic currency price of gold. We let G signify the number of ounces of gold per unit of domestic currency (i.e. $1/G$ is the price per ounce of gold). A rise in G therefore signifies a currency

Table A1: Two-Country Model of the Gold Standard

Aggregate Supply

$$q = -\alpha(w-p) \quad (\text{note: } a = 1/\alpha)$$

$$q^* = -\alpha(w^*-p^*)$$

$$w = \bar{w}$$

$$w^* = \bar{w}^*$$

Aggregate Demand

$$q = -\delta(p+g-g^*-p^*) - \sigma i$$

$$q^* = -\delta(p^*+g^*-g-p) - \sigma i^*$$

Asset Markets

$$m - p = \phi q - \beta i$$

$$m^* - p^* = \phi q^* - \beta i^*$$

$$i = i^*$$

Gold Stocks

$$m = r - g - \psi$$

$$m^* = r^* - g^* - \psi^*$$

$$0 = \gamma dr + (1-\gamma)dr^*$$

revaluation, and a fall in G , a currency devaluation. Furthermore, we set $g = \log G$. Abroad, G^* is the number of ounces of gold per unit of foreign currency, and $g^* = \log G^*$. The exchange rate E , equal to the number of units of foreign currency per unit of home currency, is equal to G/G^* . Again, a rise in E signifies a domestic revaluation. We also set $e = \log E$, so that $e = g - g^*$.

We write aggregate demand in each country as a decreasing function of the country's relative output price, and a decreasing function of the nominal interest rate i (in a dynamic model, we would distinguish the nominal and real interest rate). Thus, with domestic prices P , and foreign prices in domestic currency P^*/E , the relative price of home goods is PE/P^* , or in logs, $p + g - g^* - p^*$. Aggregate demand is written as:

$$(A.3) \quad q = -\delta(p+g-g^*-p^*) - \sigma i$$

Now, consider the asset markets. We write the demand for money in standard transactions-balance form:

$$(A.4) \quad m - p = \phi q - \beta i$$

Here m is the log of nominal money balances. We assume that interest arbitrage leads to the equality of home and foreign interest rates:

$$(A.5) \quad i = i^*$$

In a more complete model, we should expand (A.5) to reflect expectations of exchange rate changes and risk premia arising from portfolio balance considerations.

Under the gold standard, it is useful to measure the gold backing of the domestic currency. Let R be the value of gold reserves held by the central bank. With a gold price $1/G$, the domestic currency value of the gold reserves is simply R/G . Define $\Psi = (R/G)/M$ as the degree of gold backing of the currency. This can be re-arranged, after taking logs, as:

$$(A.6) \quad m = r - g - \psi$$

where the lowercase variables are logarithms of uppercase counterparts. Note that (A.6) is solely a definition, at this point. It is converted to a statement about policy by assuming that ψ is fixed, for example, or that r is fixed. We discuss these two alternative cases below.

The world gold stock R^W is assumed to be fixed, and divided between the holdings of the two central banks, with $R^W = R + R^*$. Since $dr = d \log (R) = dR/R$, we have that:

$$(A.7) \quad \gamma dr + (1-\gamma)dr^* = 0$$

where $\gamma = R/R^W$ at an initial equilibrium.

The full model is written in Table A1. There are twelve equations to solve for twelve endogenous variables: q, w, p, i, m, r and $q^*, w^*, p^*, i^*, m^*, r^*$. In each country, we assume that there are two policy instruments, the price of gold ($1/G$), and the degree of gold backing (Ψ). (In logs, g and ψ are the policy instruments). In this specification, the level of money balances, m , and the gold reserves, r , are endogenous.

We now consider five types of changes. First, the home country undertakes a devaluation ($dg < 0$), but allows the gold backing (ψ) to change

enough so that reserves are unchanged ($dr = 0$). This may be termed a "sterilized" devaluation. The foreign country does not undertake any policy actions ($dg^* = 0 = d\psi^*$). In the second case, the home country devalues, but with an unchanged gold backing ($dg < 0, d\psi = 0$). Again, $dg^* = 0 = d\psi^*$. In the third case, both countries devalue by an equal amount, at an unchanged gold backing ($dg = dg^* < 0, d\psi = d\psi^* = 0$). In the fourth case, both countries devalue by an equal amount, but sterilize the capital gains on gold reserves so that $dm = dm^* = 0$. Finally, in the fifth, both central banks raise their gold backing, at unchanged parities ($dg = dg^* = 0, d\psi = d\psi > 0$).

Case I: Sterilized Devaluation ($dg < 0, dr = 0$)

In this case, it is easiest to reconsider the home policy instruments as r and g (with m and ψ endogenous). Since $dr = 0$, we have $dr^* = 0$. Since $m^* = r^* - g^* - \psi^*$, with $d\psi^* = dg^* = 0$ by assumption, we see that dm^* also equals zero. Upon solving the entire model we find:

$$dq = (1/\Delta)[\delta\beta + 2\sigma\delta(a+\phi)]dg > 0$$

$$dq^* = (\beta\delta/\Delta)dg < 0$$

$$d(w-p) = (-1/\alpha\Delta)[\delta\beta + 2\sigma\delta(a+\phi)]dg < 0$$

$$di = (-1/\Delta)[\delta(a+\phi)]dg < 0$$

$$\text{where } \Delta = -(1+\delta a)[\beta(1+\delta a) + \sigma(a+\phi)] + \delta a[\delta a\beta - \sigma(a+\phi)] < 0$$

Thus, the devaluation raises output at home but necessarily reduces the output abroad. As expected, the devaluation reduces the domestic product wage (so that aggregate supply increases) and reduces the world nominal interest rate.

Case II: Unsterilized Devaluation ($dg < 0$, $d\psi = 0$)

In this case, gold reserves in the home country (r) may rise or fall after the devaluation. Since $dr^* = -[\gamma/(1-\gamma)]dr$, a fall in r produces a rise in r^* . Since $dm^* = dr^*$ (assuming $d\psi^* = dg^* = 0$), it is possible that the home devaluation raises the foreign money stock, which was ruled out in Case I. Now, it becomes possible that $dq^* > 0$ if the rise in r^* is large enough.

Specifically,

$$dq = (-1/\Omega)[\beta + 2\phi\delta(a+\phi) + \Gamma\beta + \Gamma\sigma(1+a\delta) + 2\Gamma a\delta]dg > 0$$

$$dq^* = (1/\Omega)[\delta\beta(\Gamma+1)]dg + \sigma dr^*/[\beta + \sigma(a+\phi)] \geq 0$$

$$dr^* = (1/\Omega)[\beta + \sigma(a+\phi)][2\phi\delta - 1]\Gamma dg \geq 0$$

$$di = (1/\Omega)[\Gamma(1+a\delta) + (1-\Gamma)(a+\phi)\delta]dg \leq 0$$

where

$$\Omega = [1/(1-\gamma)]\{\beta[1 + 2a\delta] + (a+\phi)[2\sigma a\delta + \sigma]\} > 0$$

$$\Gamma = \gamma/(1-\gamma)$$

Note that if $dr^* < 0$ then dq^* is necessarily negative for $dg < 0$. In other words, $dr^* > 0$ is a necessary condition for $dq^* > 0$. Clearly, $dr^* > 0$ is not a sufficient condition, since dq^* can still be negative even when $dr^* > 0$. An example of positive transmission of the devaluation is for δ and β very small. With $\delta = \beta = 0$, for example, $dq^* = dr^*/(a+\phi)$ and $dr^* = -\gamma dg > 0$.

Case III: Simultaneous Devaluation, Unchanged Gold Backing
($dg = dg^* < 0$, $d\psi = d\psi^* = 0$)

In this case, the devaluation is expansionary for the world as a whole, and reduces product wages and nominal interest rates. By symmetry, neither country gains or loses reserves. Specifically,

$$dq = dq^* = (-\sigma/\Lambda)dg > 0$$

$$di = (1/\Lambda)dg < 0$$

$$d(w-p) = (\sigma/\alpha\Lambda)dg < 0$$

where $\Lambda = \beta + \sigma(a+\phi) > 0$

Case IV: Simultaneous Devaluation, Unchanged Monetary Base
($dg = dg^* < 0$, $dm = dm^* = 0$)

In this case, the devaluation has no effects on output or interest rates. The only effect is a rise in gold backing of each country's monetary base.

$$dg = dg^* = 0$$

$$di = 0$$

$$d(w-p) = 0$$

Case V: Simultaneous Rise in Gold Backing ($dg = dg^* = 0$, $d\psi = d\psi^* > 0$)

The rise in ψ and ψ^* causes a proportionate fall in the monetary base, $dm = dm^* = -d\psi = -d\psi^*$. This monetary contraction has effects exactly opposite to the effects of simultaneous devaluation in Case III:

$$dq = dq^* = (-\sigma/\Lambda)d\psi < 0$$

$$di = (1/\Lambda)d\psi > 0$$

$$d(w-p) = (\sigma/\alpha\Lambda)d\psi > 0$$

where $\Lambda = \beta + \sigma(a+\phi) > 0$.

Appendix B

All series used in our empirical analysis are normalized to 100 in 1929. Definitions and sources of these data follow.

1. Industrial production: National indices of industrial production, from Mitchell (1975) and Methorst (1938).
2. Exchange rate: Gold value of currencies as a percentage of 1929 gold parity, from League of Nations (1938).
3. Real wage: Nominal wage deflated by wholesale price index. Wages, from Mitchell (1975), measure hourly, daily or weekly wages, depending on country. Note that wages for Belgium are for males in transport and industry only, that wages in France are for men only. Wholesale price indices are from Mitchell (1975).
4. Export volume: Special trade, merchandise only, measured in metric tons, from League of Nations (1936, 1937).
5. Discount rate: From League of Nations (1937).
6. Gold reserve: Gold stock valued in constant dollars of 1929 gold content, as of December of the year. From Hardy (1936) and Federal Reserve Bulletin (various issues).

Footnotes

1. The classic indictment of the Fed is of course Friedman and Schwartz (1963). For analyses which emphasize also the effects of protectionist initiatives, see Meltzer (1976) and Saint-Etienne (1984).
2. See for example Kindleberger (1973), Hardach (1976) and Sauvy (1984). We do not mean to imply that the Great Depression in Europe was solely a reflection of the downturn in the United States. (On Europe's difficulties in the 1920s, see Svernilson (1954) or Temin (1971).) All that is necessary for our argument is that the Depression in Europe was heavily affected by concurrent developments in America. Space limitations unfortunately do not permit us to address the causes of the Depression in Europe.
3. The beggar-thy-neighbor argument so appears widely in the literature that its origins are difficult to trace. For a reasoned statement of this view, see Nurkse (1944).
4. Even these cases have been disputed. Jonung (1981) has questioned the role of fiscal policy in Swedish growth, while Beenstock, Griffiths and Capie (1984) have attempted to show that policy had little role in Britain's recovery. The German situation is in many ways special and will be given relatively little attention here.
5. There exists a large literature on the extent to which public officials, especially in Britain, may have been converted to Keynesian views in the 1930s. See for example Howson and Winch (1977), Peden (1980) and Booth (1983). Similarly, there exists a literature on the extent to which rearmament expenditures in the 1930s provided effective fiscal stimulus (Thomas, 1983); it is unclear, however, whether these programs should be viewed as macroeconomic policy.
6. See Johnson (1953-54) for one of the original game-theoretic analyses of tariff wars. Johnson shows that all countries suffer from a tariff war with retaliation if their economies are symmetric, while some countries may be better off, relative to free trade, in an asymmetric environment.
7. Choudri and Kochin document the relationship between exchange depreciation and relative national price levels and outputs for several European countries. They do not, however, work with a formal macroeconomic model, as we do in this paper, and thus they do not attempt to describe the structural mechanisms linking exchange rates with other aggregate variables. They also do not discuss the foreign repercussions of exchange rate changes.
8. Beenstock, Griffiths and Capie (1984), passim.

9. To keep the percentage of gold backing unchanged, open market operations are required not just to inject into circulation currency in the amount of the capital gains on gold reserves but also to increase the domestic credit component of the monetary base by the proportion of devaluation.
10. Still later dates are undesirable because by 1936 all countries had devalued and there hence remain no gold standard countries with which to compare, but also because the course of recovery becomes increasingly dominated by rearmament expenditure.
11. We purposely excluded the United States on the grounds that the Depression to a large extent originated there rather than being imported from abroad and therefore would have had very different implications for the characteristics of both the downturn and the recovery. We did no experimentation with different samples of countries but hope to increase the size of the sample in future work.
12. The relationship is statistically significant at standard confidence levels. The regression line shown in Figure 1 is derived from the equation:

$$IP_{1935} = 153.9 - 0.69 ER_{1935} \quad \bar{R}^2 = .56$$

(10.06) (3.51)

where t-statistics are shown in parentheses. The critical values are 2.31 and 3.36 at the 95 and 99 percent confidence levels, respectively.

13. Belgium's participation in the Gold Bloc and her decision to leave in 1935 are discussed in detail by van der Wee and Tavernier (1975). A detailed description of German exchange control is provided by Ellis (1941).
14. French opinion on monetary and financial questions, along with British comparisons, is reviewed by Perrot (1935). Political aspects of the French debate are ably summarized by Sauvy (1984).
15. The definitive analysis of the decision to return to par in 1925, which highlights the role of the few dissenters such as Keynes, is Moggridge (1969). An account which emphasizes the implications of the 1925 decision for attitudes toward depreciation in 1931 is Cairncross and Eichengreen (1983).
16. The regression is:

$$IP_{1935} = 175.2 - 59.8 (WAGE_{1935}/WPI_{1935}) \quad \bar{R}^2 = .50$$

(7.39) (3.14)

A variety of instrumental variables estimates, designed to better distinguish the aggregate supply and demand curves, show basically the same relationship.

17. The regression is:

$$\text{WAGE1935/WPI1935} = \begin{matrix} 0.73 & - & 0.0065 & \text{ER1935} \\ (3.00) & & (2.07) & \end{matrix} \quad \bar{R}^2 = .27$$

18. Control of the German labor market has been analyzed by Nathan (1944) and, more recently, by Kim (1983).

19. The regression is:

$$\text{EXPVOL1935} = \begin{matrix} 1.39 & - & 0.0075 & \text{ER1935} \\ (8.30) & & (3.46) & \end{matrix} \quad \bar{R}^2 = .55$$

20. The available interest rate series are neatly summarized in League of Nations (1938).

21. The absence of the conventional relationship in German and Italy reflects both the imposition of exchange controls in Germany and increasingly draconian measures designed to circumvent both domestic and international capital markets. The regression line is:

$$\text{ACBDR} = \begin{matrix} -4.77 & + & 0.040 & \text{ER1935} & - & 2.31 & \text{GERMANY} & - & 1.55 & \text{ITALY} \\ (5.37) & & (4.19) & & & (2.73) & & & (1.92) & \end{matrix} \quad -$$

22. The regression is:

$$\text{GOLDCH1935} = \begin{matrix} 2.40 & - & 0.018 & \text{ER1935} \\ (4.84) & & (2.79) & \end{matrix} \quad \bar{R}^2 = .43$$

23. We should stress immediate effects. By raising the price of gold in terms of commodities, an increased flow supply of new gold could be elicited in the long run. For contemporary discussion of this mechanism, see Gold Delegation (1932).
24. An obvious contrast is between the successive financial crises in Austria, Germany and Britain in the summer of 1931, which gave rise to either devaluation or the imposition of exchange control, and the voluntary decisions of many of the countries which decided to follow Britain off gold in the course of subsequent months.
25. For a formal analysis of these effects, see Eichengreen (1981).
26. The precise conditions under which tariffs-cum-retaliation may actually increase output and employment both at home and abroad are discussed by Eichengreen (1984a).
27. Revealingly, the devaluations of the 'thirties were often referred to as "exchange-rate protection."

28. To date, constant employment measures of the government budget have been constructed only for the United States and Britain. See Brown (1956) and Middleton (1981).
29. Eichengreen (1984b) presents an analysis of strategic behavior under the interwar gold standard, but only for the fixed exchange rate case.

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