ANDREA SOMMARIVA
& GIUSEPPE TULLIO

# GERMAN MACRO-ECONOMIC HISTORY 1880-1979

A STUDY OF THE EFFECTS OF ECONOMIC POLICY ON INFLATION, CURRENCY DEPRECIATION & GROWTH

# GERMAN MACROECONOMIC HISTORY, 1880–1979

*Also by Giuseppe Tullio*

THE MONETARY APPROACH TO EXTERNAL ADJUSTMENT: A Case Study of Italy

MONETARY POLICY, FISCAL POLICY AND ECONOMIC ACTIVITY: The Italian Experience (*co-edited with Francesco Spinelli*)

# German Macroeconomic History, 1880–1979

## A Study of the Effects of Economic Policy on Inflation, Currency Depreciation and Growth

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Palgrave Macmillan UK

ISBN 978-1-349-06593-6 ISBN 978-1-349-06591-2 (eBook)
DOI 10.1007/978-1-349-06591-2

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Foreword © Clifford Wymer, 1987
Softcover reprint of the hardcover 1st edition 1987 978-0-333-34518-4

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Scholarly & Reference Division,
St. Martin's Press, Inc., 175 Fifth Avenue, New York, NY 10010

First published in the United States of America in 1987

ISBN 978-0-312-32588-6

Library of Congress Cataloging-in-Publication Data
Sommariva, Andrea.
German macroeconomic history, 1880–1979.
Bibliography: p.
Includes index.
1. Germany—Economic conditions. 2. Germany—
Economic Policy. I. Tullio, Giuseppe, 1948–
II. Title.
HC283.S56 1987 339'.9043 86–10193
ISBN 978-0-312-32588-6

To Adele and Claudia

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# Foreword

In the post-1945 period, economic developments in Germany have been characterised by a remarkable degree of price stability and sustained economic growth. Germany's economic performance, particularly in the 1970s, contrasts with the experience of other industrial countries in the same period and especially with its own experience between the two world wars. This book tries to provide some answers to the role that policy, especially macroeconomic policy, played in the determination of price behaviour, economic growth and balance payments or exchange rate developments.

In recommending policies for stabilising an economy some economists have emphasised the linkages running from the rate of domestic monetary expansion to price inflation, while others have emphasised the effects of wage demands on the domestic price level. Each of these approaches, at least in its extreme form, stresses one part of the inflationary process to the exclusion of others and tends to obscure important elements of an advanced industrial economy. Even if inflation cannot continue without monetary expansion, the money supply in itself is not necessarily determined independently of the behaviour of the private sector because the authorities respond to market developments in determining the stance of their policies.

This book shows that the two major inflationary experiences in the last hundred years in Germany were not independent of fiscal policies. The large government budget deficit during the First World War and the objective of the authorities of maintaining employment in the early of 1920s, and especially in the first months of 1923, led to an extremely rapid increase in the fiscal deficit, monetary expansion and hyperinflation. Correspondingly, the rapid monetisation of the large government budget deficits during the Second World War was a major cause of the repressed inflation in 1945–7.

This book also indicates that, despite the massive price and monetary fluctuations in Germany, a stable relationship between money and prices exists in long-run equilibrium. Moreover, while the foreign exchange repercussion of domestic policy caused major fluctuations in the exchange rate, the theory of purchasing power parity also appears to hold in the long run. Major fluctuations in the real exchange rate occurred during the hyperinflation. The nominal exchange rate depreciated much more than by what was justified by

relative price differentials in the years 1919 to 1922 and rebounded at the end of 1923. This study also provides some evidence that the growth of the ratio of government debt to Net National Product (NNP) has adversely affected the long-run growth of the economy and that the behaviour of the German fiscal authorities was one of the main factors behind the high variability in the growth of NNP.

Finally, this book presents disequilibrium models of the German economy and of the hyperinflation. It was necessary to develop a formal analysis of the last 100 years of German economic history within a framework of a dynamic model which did not assume that the economy was continuously in equilibrium. If the data used in estimation were in fact generated by a disequilibrium system, estimates of an equilibrium system would cause biases owing to incorrect specification. Embedding the equilibrium structure appropriately within a disequilibrium system makes it possible for the model to have these equilibrium properties in the steady state, if it exists. The model can then be estimated in a way that does not preclude the system being in equilibrium and hence provides a test of the degree of disequilibrium as well as unbiased estimates of the equilibrium structure. Such models have been estimated for hypothesis testing and for policy purposes for the United Kingdom (Bergstrom and Wymer, 1976; Jonson, 1976; Knight and Wymer, 1978), Australia (Jonson *et al.*, 1977), Germany (Willms, 1975; Sassanpour and Sheen, 1976), Italy (Tullio, 1981; Gandolfo, 1984; Chiesa, 1979); France (Sassanpour and Sheen, 1976); and Sweden (Sommariva, 1981).

The methodology used in these studies and in this book provides a consistent approach to the specification and estimation of macroeconomic models and to their use for hypothesis testing and analysis. Economic theory and institutional knowledge can be integrated in a model which can exhibit not only short- or medium-term fluctuations but has the plausible long-run properties which are necessary for policy analysis and prediction. While the theoretical properties of macroeconomic models have been well developed within an equilibrium framework, less work has been done on the disequilibrium nature of economic systems. It is hoped that this book will encourage further research into these areas.

*Washington* CLIFFORD WYMER

# Acknowledgements

We would like to express our deepest gratitude to Cliff Wymer who helped us in several ways to complete this book. When we joined the International Monetary Fund (IMF), he helped us become familiar with the structure of neoclassical growth models he had been working on and with the methods of estimating systems of differential equations he had developed at the London School of Economics, and elaborated further at the IMF. These methods are applied in this book to analyse the hyperinflation (Chapter 3), and to estimate a long run growth model from 1880 to 1979 (Chapter 5). He was also of great help when we were working on the specification and estimation of the two models and, after the first draft of the 100-year macroeconomic model was ready back in 1980, he encouraged us to write this book.

We would also like to give particular thanks to Denis Richard for continuous help at all stages of the work, especially from 1981 to 1983 when he was with us at the Ministry of the Budget in Rome. Furthermore, we would like to thank for their useful comments Charles Goodhart, the members of the Institute of International Economic Studies of the University of Stockholm, in particular John Cuddington, Thorvaldur Gylfason and Assar Lindbeck, and the participants in the Konstanz Seminar of Monetary Theory and Policy of 1984, in particular Hans Loef and Manfred Neumann. Finally, we are grateful to Otmar Emminger, Hans Möller, Götz Uebe and especially Knut Borchardt for valuable comments on German economic history and developments.

We acknowledge generous financial assistance from the Italian National Science Foundation (Consiglio Nazionale delle Ricerche) which paid most of our research assistance, computer expenses and travel and from the Institute for International Economic Studies of the University of Stockholm. Useful research assistance from Per Skedinger in Stockholm and Giovanni Aliverti in Rome and Maria Peart in Brussels in acknowledged.

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GIUSEPPE TULLIO

# Introduction

This book contains five essays on various aspects of German economic history from 1880 to 1979. There are three reasons why Germany, rather than another industrial country, was chosen for this study. First, the German economy was subject to larger shocks than most other industrial countries during the period under analysis. The largest shocks were the very great destruction caused by the two world wars and the ensuing territorial losses and the hyperinflation of 1919 to 1923. Thus German developments and their accurate measurement represented in some periods almost a controlled experiment and can therefore be considered as ideal to study and test economic theories. Because of the slow adjustment of the private sector to these shocks, the German economy experienced long periods of disequilibrium; therefore in building the models and in formulating the hypothesis to test, disequilibrium was introduced explicitly. The three-equation monthly model of inflation, exchange rate changes and money supply growth built to study the hyperinflation of the early 1920s (Chapter 3), the four-equation quarterly model to explain changes in nominal income before and during the great depression of 1929–33 (Chapter 4) and the sixteen-equation annual macroeconomic model estimated for one hundred years (Chapter 5), all rely heavily on Wymer's (1972, 1976) and Bergstrom and Wymer's (1976) work on the specification and estimation of disequilibrium growth models with neoclassical long-term properties. The dynamic properties of these three models are determined by the adjustment of actual quantities and prices to partial equilibrium levels. Lags are assumed to be related to transaction costs, uncertainty and, in general, all real-world frictions.

Second, Germany is today the European country which carries the greatest economic weight and its economic developments are very important for neighbouring countries. German economic events have rightly attracted considerable attention abroad during this century, both at the academic and policy making level, even when the degree of integration of Germany with other European economies was much smaller. The fundamental work of Cassel (1923) on the behaviour of foreign exchanges after 1914 and especially of Bresciani-Turroni (1924, 1937) on the German hyperinflation period are two examples of this interest at the academic level. Third, German historical

statistics are known to be fairly accurate and detailed so as to provide a relatively solid basis for the kind of empirical work presented in this book. Furthermore, historical statistics are collected in a few relatively accessible publications.[1]

The main economic developments are described in Chapter 1. Per capita figures or ratios are generally used so that comparisons through time are still meaningful, despite the changes in territory and population which occurred during the period. For the period after the end of the Second World War and the split of Germany, the data bank used refers to the Federal Republic (West Germany) only. While particular attention has been devoted to the description of the main long-term developments in the first chapter and to shorter run developments relating to the main subperiods in the first sections of the following chapters, no claim is made to provide a comprehensive study of macroeconomic developments in Germany over the one hundred years under analysis. Rather the main focus of the essays contained in Chapters 2–5 and of the Appendix to Chapter 1 is on hypothesis testing by means of econometric techniques.

It is believed that these techniques allow a deeper knowledge of the actual working of the German economy and that conclusions can be reached that have a validity for similar economies as well. Thus interesting conclusions are arrived at on the working of the gold standard (chapter 2), on the working of economic systems during hyperinflations (Chapter 3), on the causes of the great depression of 1929–33 (Chapter 4), on the short- and long-run effects of monetary and fiscal policy and the validity of economic laws such as the Fisher equation, the quantity theory of money and the purchasing power parity theory (Chapters 3 and 5). Therefore this collection of essays is not felt by the authors to be exclusively a contribution to German economic history, but also to macroeconomic theory and its empirical testing.

The sequence of the five essays and the structure of the book follow a chronological order. Economic developments within the last one hundred years suggest a division of the period under analysis into a number of main subperiods characterised by a very similar institutional and political environment and similar behaviour of the main macroeconomic aggregates and economic policies:

(1) the gold standard, stretching from 1876 to 1913 characterised by low and stable government expenditures and budget deficits, low inflation and steady growth of the real stock of capital and real net national product (henceforth, NNP):

(2) the First World War and the early postwar period during which economic life was still disorganised lasting from 1914 to 1919, followed by the hyperinflation up to the end of 1923. During this period inflation peaked at 618.9 per cent per week in the week ending on November 13, 1923;
(3) the politically highly unstable period from 1924 to 1938 which includes the great depression of 1929–32 and its recovery. In this period inflation reached a low of minus 13 per cent in 1931 and real NNP fell by 22.6 per cent from its post war peak of 1928 to its depression trough in 1932;
(4) the Second World War and its aftermath lasting from 1939 to 1948/49;
(5) a long period of relative price stability and stable growth of the real stock of capita and real NNP after 1949.

A chapter is devoted to each of the above five subperiods with the exception of the Second World War and the years immediately following it. The monetary and real disturbances created by the Second World War were more serious than the ones caused by the First World War. However, hyperinflation was prevented from materialising by a rigid system of price and wage controls which was not lifted until after the monetary reform of June 1948. Owing to this system of controls, an econometric analysis of the consequences of the monetary and real disturbances would have been very difficult. In addition since a rather abundant literature on the monetary reform of 1948[2] already exists both in German and in English, it was not considered useful to devote a chapter to this period.

Chapter 2 is devoted to the gold standard period. The focus of the Chapter is the discount rate policy of the Reichsbank (Section 2.2). It analyses to what extent the Reichsbank followed the so-called 'rules of the game' of the classical gold standard. By way of simplification, three criteria can be distinguished in the literature to check whether a central bank was following the 'rules of the game'. The first criterion implies that a central bank followed the rules if it changed the discount rate in response to changes in its liquidity ratios (Goodhart, 1972); the second, if it changed its domestic assets in the same direction as its foreign assets (Bloomfield, 1959); the third, if its domestic assets and liabilities moved anticyclically (McGouldrick, 1982). Changes in the balance sheet items in the weeks just preceeding the 132 discount rate changes which occurred from 1876, when the Reichsbank began operations, to 1913, were used in this analysis. The data are ideal because the table from which they were drawn was

probably used by the Reichsbank to decide changes in the discount rate and because they are free of reverse causation. The tests using these data are supplemented by tests on annual data to study the connection between discount rate policy and the business cycle. The econometric tests performed suggest that liquidity considerations were *de facto* the main preoccupation of the Reichsbank. The tests are performed separately for the period of falling prices (1876–1895) and the period of rising prices (1896–1913) and it is shown that the system was working better in the second period than in the first, probably due to more developed financial markets and more experience on the part of the Reichsbank. The analysis of this chapter also shows that the negative correlation between domestic assets and foreign assets of the Reichsbank observed by Bloomfield (1959) had not much to do with whether the Reichsbank was observing the rules of the game or not. The direction of causation was mostly from domestic assets to foreign assets as predicted by the monetary approach to the balance of payments (Section 2.3), rather than the reverse as implied by Bloomfield.

The degree of financial market integration of Germany with the rest of the world and the degree of correlation of domestic and foreign prices and output is very important for the analysis of the discount rate policy of the Reichsbank as well as for the tests of the monetary approach to the balance of payments. Section 2.1 is therefore devoted to the study of the synchronisation of German and foreign variables and their changes from 1876 to 1913. Financial market integration was very high while the year-to-year correlation of inflation was substantial but far from perfect. Long-term movements of prices, especially consumer prices, were instead quite different between Germany and abroad, with a more substantial increase or a more moderate fall recorded in Germany. A similar development was observed in Japan in the post-Second World War period. This phenomenon can be explained by the more rapid pace of economic growth in Germany than abroad recorded during the period, thus supporting Balassa's hypothesis[3] that a productivity bias can explain the real appreciation of the German Mark.

Chapter 3 is devoted to the period from 1914 to 1923. It is divided into two main parts: (1) a description of the main economic events and policy actions from 1914 to 1923 (Sections 3.1 to 3.4); and (2) a brief survey of the econometric literature on the German hyperinflation followed by an analysis of the dynamics of the exchange rate and prices by means of a three-equation monthly econometric model

(Section 3.5). Section 3.1 deals with the financing of war expenditures, price controls and inflation from 1914 to 1918. Section 3.2 deals with fiscal policy, monetary growth, inflation and exchange rate changes from 1919 to 1923. Section 3.3 concentrates on the monetary developments during the last stages of the hyperinflation and the monetary reform covering the period from August to December 1923. Section 3.4 is devoted to the analysis of the behaviour of real economic variables and their relationship to monetary and financial developments during the period from 1919 to 1924. This historical overview and the survey of the main theoretical and empirical works on German hyperinflation are important in understanding the assumptions on which the estimated model is based and especially why it is a disequilibrium model.

The model has been estimated simultaneously by a full information maximum likelihood estimator developed by C. R. Wymer. In the model, the equilibrium exchange rate is assumed to be determined according to the monetary approach to exchange rate determination. Similarly, the equilibrium price level is assumed to be determined by the supply of nominal currency in circulation and the real demand for it, as implied by the quantity theory of money. Thus the model explains the deviations of the actual exchange rate from purchasing power parity by allowing prices and the exchange rate to adjust at different speeds to monetary shocks. Once it is recognised that, for a given foreign price level, the rate of change of the exchange rate differs in the short run from the rate of inflation, it becomes necessary to take into account substitution with foreign goods or currency in the demand for currency. The estimates of the model confirm that monetary disturbances were very important for price and exchange rate movements, and that their speed of adjustment was quite different. It also confirms that an important cause of the growth of currency in circulation was the government budget deficit.

Chapter 4 deals with the period from 1924 to 1933. It focuses on domestic and external disturbances to the German economy during the period. The first section of the chapter describes the developments prior to and during the depression, and aims at isolating those factors which put the German economy in a weak position in the face of the United States depression, namely the low competitiveness of German products in world markets due to the large increases in real wages from 1925 to 1929, the large German foreign indebtedness and the related problem of reparation payments and the burning experience of hyperinflation. Other aggravating factors of the German

depression were the inability of the United Kingdom and the reluctance of the United States to provide countercyclical lending and an open market for goods. The German economy was first affected by the halt in international lending in 1929 and then by the fall in United States output, and the widespread increase in protectionism and competitive depreciations leading to an additional negative effect on the German current account. This was particularly destabilising for the German economy, since the unwillingness of authorities to devalue the currency caused the German government to react to these developments with highly deflationary measures, which aggravated and prolonged the depression.

The second section presents a quantitative analysis of the effects of domestic monetary and fiscal policies and of the international business cycle on the developments of German nominal income from 1924 to 1933.

The main conclusion derived from this chapter is that international developments were the major factor in starting the recession in Germany in 1929 and they exerted a strong negative impulse throughout the depression. However, the monetary policy pursued by Germany aggravated considerably the depression and determined its length and depth, while fiscal policy did not have significant effects on output, at least for the period as a whole.

In Chapter 5 a disequilibrium macroeconomic model of the German economy is presented (Section 5.1). The model is estimated using data from 1880 to 1979 (Section 5.2). The model is specified in continuous time and estimated on annual data using Wymer's programmes. It explains the trends and fluctuations in the rate of capital accumulation, output, employment, prices and the balance of payments. In order to take into account changes in territory and population, all scale variables were expressed in per cent of the labour force. The long-run properties of the model are founded in neoclassical theory. The model contains nine stochastic equations and seven identities. The main aims of the analysis in this chapter are: first, to explain the interdependence between the main economic aggregates in Germany during the last one hundred years and to show that, despite enormous structural changes in the economy and changes in territory, the behaviour of the German private sector from 1880 to 1979 can be characterised satisfactorily by the same behavioural equations; second, to test the validity of the quantity theory of money and of the Fisher equation within the structural model presented, following Lucas' (1980) suggestion; third, to test by means of simula-

tions of the model to what extent the remarkable rate of growth of German real NNP per capita from 1950 to the end of the 1960s can be explained by wartime destructions and losses of territory (Section 5.3).

The main conclusions which can be drawn from the analysis of this chapter are the following. First, despite the substantial changes in the institutional and political environment and the large shocks to which the German economy was subjected and the ensuing long periods of disequilibrium, the German private sector seems to have behaved in a consistent and stable way. Significant changes in behavioural patterns would have resulted in systematic residuals appearing in the equations of the model; and the explanatory power of the various equations would have been much less satisfactory. Similar conclusions were arrived at by Uebe (1982) in a study on the stability of some key macroeconomic functions in Germany, including the investment and the consumption function before the First World War and after the Second World War. Second, the quantity theory of money and the Fisher equation are found to be valid in the medium run and are far from true in the short run. This result coincides with what Lucas (1980) obtained for the quantity theory using post-Second World War United States data. The lack of instantaneous adjustment of prices and of the nominal interest rate to monetary shocks implies that, during the sample period, monetary policy in Germany was a powerful instrument to influence real economic activity in the short run. Third, turning to the results of the simulation performed with the model, it is shown that the sharp reduction of the stock of capital caused by the Second World War and by the following losses of territory had a significant positive effect on the growth rate of real NNP per capita in the 1950s and also in part of the 1960s (Section 5.3).

While the model presented in Chapter 5 contains a great deal of information about the determinants of private consumption, investment, the demand for currency and for labour, the balance of payments, the interest rate, inflation and long-term growth, it says very little about how these aggregates actually behaved during the sample period. Chapter 1 is devoted to the descriptions of the behaviour of the main macroeconomic aggregates, generally by decade, and fills this gap. The chapter was written with four main objectives in mind. First, it provides the background information necessary for a fuller understanding of the 100-year econometric model and of the hypotheses tested in other chapters. Second, it

highlights the considerable similarities which existed before the First World War and after the Second World War in terms of moderate shocks to the economy, moderate and stable growth of money and government expenditure, high and stable economic growth and low inflation. Third, it analyses the causes of economic growth in the various periods (Section 1.1). Fourth, it discusses the role of government in promoting the observed stability during these periods and the observed instability in the other ones and isolates the long-term effects of the large growth of the public sector which occurred during the one hundred years (Section 1.4). In the appendix to Chapter 1 an attempt is made to isolate the long-term effects of the growth of fiscal variables on the growth of NNP per capita. Although it is difficult to reach firm conclusions, the results seem to suggest that the sharp rise of the ratio of government expenditure to NNP and the ensuing increase in taxation did not affect employment and economic growth negatively, with the possible exception of the last decade or two of the sample period. The tests suggest instead that the ratio of public debt to NNP has had a significant and negative effect on economic growth.

In the tables and charts of Chapter 1 the periods for which no official data or no data published by Hoffmann (1965) exist are generally left out or estimates appear in parentheses. These estimates are the same as those used to test the 100-year econometric model of Chapter 5. Appendix 1 contains a description of the sources of the annual data used for the 100-year model and of how the estimates for the two world wars and the immediate postwar and the hyperinflation periods were obtained.[4] It also contains a description of the sources of the monthly data used to estimate the model of the hyperinflation contained in Chapter 3 and of the quarterly data used to estimate the model of Chapter 4. The data used for the 100-year model and the quarterly model of Chapter 4 are published in Appendix 2. The data used to estimate the model of the hyperinflation are not published since they are readily available from official sources and other empirical studies of the hyperinflation.

Finally, Appendix 3 contains the English translation of a letter written by the President of the Reichsbank, Schacht, to Hitler on 7 January 1939 and signed by all the members of the board of the bank. The letter complains in a very harsh, and, given the circumstances, courageous tone about the excessive increase in military expenditure, which was endangering price stability. The authors decided to include this letter because they considered it is quite a remarkable document in the history of central banking.

For the sake of completeness it is perhaps useful to summarise the main currents of thought which have influenced the authors in conceiving and writing this book. First and perhaps the most important innovation which has occurred in economics in this century has been the fact that data have become more plentiful and refined and that the development of statistics and econometrics has made it possible to test theories and hypotheses. The techniques developed have been applied by economists mostly to post-Second World War data because the most recent past is, or is thought to be, of more immediate interest, the data are more plentiful and reliable and the basic information about the institutions and the working of economic systems is more readily available to the researcher. The authors feel that a great deal can be learned from more distant economic history as well, and that when the data are available and sufficiently reliable it can be very constructive for the understanding of present-day developments to see what the remote past can tell. This is especially true for the German pre-Second World War economic history for the reasons given earlier in this introduction. A gap still exists today between traditional economic historians who are generally not very familiar with statistical techniques developed more recently and macroeconomists, who are familiar with the techniques but unfamiliar with the economic history. Although there has been, in the 1960s and 1970s, a tendency to fill this gap, the authors feel that all too often modern economists use the data from the distant past without sufficient knowledge of economic and policy developments during those years. The plentiful empirical literature which has developed especially in Anglo-Saxon countries on the German hyperinflation provides perhaps the best example of an episode which has attracted a lot of attention but often with insufficient background knowledge of economic and policy developments of the time. A description of the events leading to hyperinflation in Sections 3.1 to 3.4 and a survey of the empirical literature on the German hyperinflation in Section 3.5.1 substantiate this criticism.

Second, the authors have been particularly influenced by the work done by C. R. Wymer (1972, 1976) at the London School of Economics in the late 1960s and early 1970s and at the International Monetary Fund later. The specification and estimation of the models of Chapters 3, 4 and 5 rely heavily on his published and unpublished work. Third, the method of presentation of the historical material, especially in Chapter 1 but also in the first sections of Chapters 2–4, has been heavily influenced by the rigorous structure of country reports of the International Monetary Fund, where both authors

have worked for several years.

Fourth, as regards the role of money in the inflationary process, the theory of the balance of payments and the exchange rate, and the role of fiscal policy both authors belong more to the classical or neoclassical tradition rather than the Keynesian one. This is even more so on such fundamental issues as the belief in the relative stability of the private sector, the concern for large government intervention and for substantial growth of the share of government expenditure and taxation to NNP, and for the consequences for individual freedom which these trends entail.

Despite the fact that the German economy had been managed very well before the First World War and after the Second World War, with inflation and budget deficits being kept at reasonable levels, one is left with the impression that towards the end of the sample period German government expenditure and taxation might have grown to the point of reducing the potential rate of growth of the economy and the growth of employment. If this hypothesis about the role of government in influencing the current low growth and high unemployment in Germany discussed in Chapter 1 is correct, clear implications for fiscal policy would follow for the rest of the century. It is not enough to stabilise or reduce government budget deficits and to stabilise the ratio of public debt or of tax revenues to NNP. Action would be required to bring these ratios back towards a level compatible with full employment and higher economic growth and to change the composition of expenditures and the tax structure. It would be useful for all European countries to follow this course, since the long-term beneficial effects of Germany acting alone would probably be much more limited than if all European countries acted in a concerted way.[5] Low economic growth, high levels of unemployment or underemployment and an excessive role of government and increasing rigidities go often hand in hand with the fall in civilisations. The poor performance of the European economy in the early 1980s compared to the United States and Japan, where in the last twenty-five years government expenditure increased much more slowly[6], could be a premonitory sign of where Europe is heading to if all European governments do not take bold action in the direction suggested here. There are two factors which in the opinion of the authors make the substantial growth of government expenditure which has occurred in Europe since 1960 more worrisome. First, in some countries, governments are more inefficient and the value of government services to the general public is smaller than in well-

managed countries: second, European countries taken individually are small compared to the United States and Japan. It follows that the consequences of the growth in the role of government for individual economic freedom and for freedom in general could be more damaging in Europe. Hence a more united Europe with no restrictions to movement of labour, capital and goods would reduce the degree of monopoly power of large individual governments.

**Notes**

1. Among them should be mentioned: Statistisches Reichsamt (1925), Vergleichende Notenbankstatistik (1925), Caasen (1953), Hoffmann (1965) and Deutsche Bundesbank (1976).
2. Gottlieb (1957); Grotius (1949); Gurley (1953); Klopstock (1949); Mendershausen (1949); Möller (1976); Pesek (1958).
3. See Balassa (1964).
4. All estimates of the annual national accounts and balance of payments statistics for the two world wars and immediate postwar years are to be taken with great caution since they are generally based on relatively simple assumptions.
5. The channels through which the growth in government transfers, taxation and public debt since 1960 could have affected negatively private employment, capital accumulation and economic growth in the European Community are surveyed in Tullio (1986).
6. Increases in government expenditure and taxation in relation to NNP in most European countries have been very similar to those recorded in Germany in the 1960s and the 1970s, while in the United States and Japan their growth has been much more moderate.

# 1 Long-term Growth, Money and Inflation in Germany, 1880–1979: an Historical Overview

## INTRODUCTION

This chapter analyses by means of simple charts and tables the long-term economic development of the German economy from 1880 to 1979. Section 1.1 describes the various phases of economic growth in relation to developments of factors of production (labour and capital). Other factors influencing economic growth, as technical progress, changes in the degree of openness of the economy, investment in human capital and changes in the terms of trade and in taxation are also dealt with in this section. Section 1.2 analyses structural changes in aggregate demand while Section 1.3 describes developments of the major items of the balance of payments in the various stages of economic growth. Section 1.4 deals with the changing role of government in the economy, and structural changes in the fiscal system, while Section 1.5 concentrates on the changes in the structure of the monetary system, on monetary policy and inflation.

This chapter is also intended to provide background information for a better understanding of the hypotheses tested in the following chapters and especially in the macroeconomic model of the German economy presented in Chapter 5. Historical developments suggest a broad division of the last 100 years into three main periods:

(1) the gold standard, stretching from 1880 to 1913, characterised by low and stable government expenditures and budget deficits, inflation fluctuating within relatively narrow margins and a steady growth of the real stock of capital and real net national product (henceforth, NNP);
(2) a highly unstable period stretching from 1914 to 1949 characterised by a high and variable level of government expenditure and budget deficits in connection with the two world wars, inflation fluctuating between a low of minus 13 per cent in 1931 to a peak

of about $1.473*10^9$ per cent in the period November 1922 to November 1923,[1] and NNP fluctuating widely in the aftermath of the two world wars, the hyperinflation period and the depression of the 1930s;

(3) a period of relative price stability and stable growth of the real stock of capital and NNP starting in 1949.

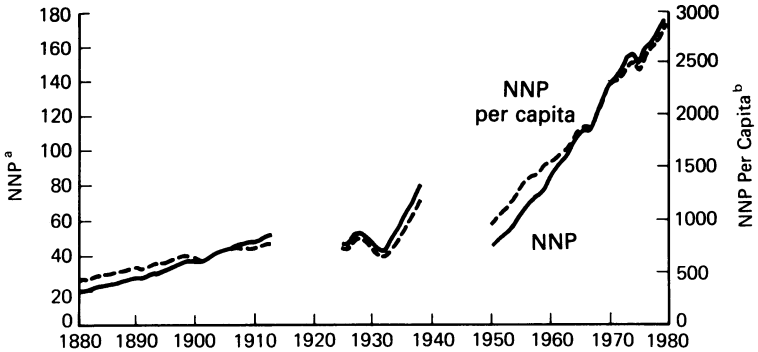
The behaviour of the fiscal and monetary authorities was one of the main factors leading to a high variability of growth rates of real NNP and of inflation in the interwar period. An expansion of government expenditure not financed by taxation led to pressures on financial markets and eventually excessive monetary growth. The ensuing growth in financial variables, and long and variable adjustment lags led to deviations of the real financial interest rate from its equilibrium level, thereby affecting real economic activity, as occurred in the early 1920s, before and during the hyperinflation period. However, the analysis of the behaviour of the government and of monetary authorities and the observed time profile of prices suggest that a stable relationship between money and prices existed in the long run, while economic activity did not seem to be positively affected by monetary and fiscal policies. On the contrary there is some evidence that the growth in the ratio of government debt to NNP has adversely affected the long-run growth rate of real NNP and that in the last ten years or so of the sample period the excessive growth in the size of government has adversely affected the supply side and caused unemployment of labour and lower growth rates of real output.

## 1.1 THE LONG-TERM GROWTH OF THE GERMAN ECONOMY (1880–1979)

Figure 1.1 shows the time profile of real NNP (left scale) and of real NNP per capita (right scale) from 1880 to 1979. NNP grew at an average annual rate of 2.9 per cent[2] during the gold standard (1880–1913). It fluctuated sharply during the period between the two world wars with sharp decreases in 1919, 1923, between 1929 and 1931, and during and in the aftermath of the Second World War. From 1950 to 1979 the rate of growth of NNP averaged 4.7 per cent per year, a much higher rate compared with the gold standard, but similar to the one prevailing in the 1920s and 1930s (Table 1.1).

Higher rates of growth of an economy can be explained by higher

*Figure 1.1* Real NNP and real NNP per capita, 1880–1979




[a] In billions of 1913 Marks.
[b] In 1913 Marks.
For the years 1914 to 1924 and 1939 to 1949 official data on NNP are not available.

*Table 1.1* Long-term growth rates of real NNP, stock of capital and civilian employment (geometric growth rates), 1880–1979

| | *Real NNP* | *K* | $L^a$ | $\lambda^b$ | $\frac{p_x}{p_i}$ |
|---|---|---|---|---|---|
| 1880–1913 | 2.9 | 3.0 | 1.4 | 0.9 | –0.7 |
| 1921–39 | 4.5 | 2.1 | 1.3 | 2.9 | –[c] |
| 1950–79 | 4.7 | 4.9 | 0.7 | 2.5 | 1.5 |
| 1970–79 | 2.7 | 4.4 | –0.5 | 1.5 | –0.6 |

[a] Number of employed persons, not corrected for hours worked.
[b] Total factor productivity has been estimated assuming a Cobb-Douglas production function with constant returns to value,

$$NNP = A\ K^{\alpha}\ L^{1-\alpha}\ e^{\lambda t}$$

and taking the derivative and solving for $\lambda$ to give:

$$\lambda = \Delta \ln NNP - \alpha \Delta \ln K - (1 - \alpha)\ \Delta \ln L$$

where $\alpha$ was assumed equal to 0.35. A Cobb-Douglas production function for Germany has been estimated in Chapter 5 from 1880 to 1979.
[c] Owing to the disturbances of the hyperinflation period and especially trade barriers in the 1930s, changes in the terms of trade have little economic significance in this period.
*Source*: Hoffmann (1965) and Statistisches Bundesamt, *Statistisches Jahrbuch für die Bundesrepublik Deutschland,* various issues.

rates of growth of the factors of production, and of total factor productivity. The latter in turn can be explained by investment in human capital, by favourable long-term developments of the terms of trade and greater efficiency in the allocation of resources resulting from greater integration in the world economy. The real net stock of capital in Germany grew at an average annual rate of 3 per cent during the gold standard, while civilian employment grew at an average annual rate of 1.4 per cent. In the period 1921–39 the corresponding growth rates were 2.1 and 1.3 per cent while they were 4.9 and 0.7 per cent respectively in the years 1950–79. The lower growth rate of the real stock of capital in the interwar period can be partly explained by the greater uncertainty due to the political situation and to the greater variability in monetary and fiscal policy.

The effect of the lower rate of growth of the stock of capital on NNP growth during the interwar period was more than compensated by the higher rate of growth of total factor productivity. During the periods after the two world wars, total factor productivity of labour and capital increased at similar rates of 2.9 and 2.5 per cent per year respectively, while it grew at only 0.9 per cent from 1880 to 1913. These developments can partly be explained by the fact that, after the low levels of investment and the extensive destruction of physical capital during the wars, the new equipment installed was probably more efficient and more responsive to technical progress. Furthermore, the increase in the level of investment in human capital as represented by the share of university graduates to civilian employment[3] contributed to raise total factor productivity, particularly after the Second World War.

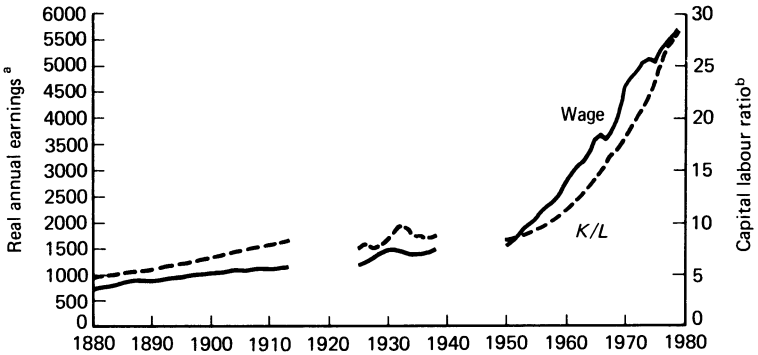
After the Second World War important factors explaining the rapid increase in NNP were the pressure for greater competitiveness inserted into the economy by the trade liberalisation measures after years of isolation and abnormal international relations and the favourable development of the terms of trade in the 1950s and the 1960s. It is important to note that the production function underlying the calculation of the parameter $\lambda$ included only two factors of production with the exclusion of raw materials. The exclusion of changes in the price of imported raw materials with respect to the price of output can introduce a bias in the above calculation of factor productivity of labour and capital.[4] Table 1.1 shows that changes in the terms of trade account partly for the differences in the values of $\lambda$ during the gold standard and after the Second World War.[5]

In the 1970s, the rate of growth of NNP fell below the post-Second World War average to 2.7 per cent per annum, mainly because the rate of growth of employment fell to minus 0.5 per cent and the terms of trade worsened following the two oil crises. The rate of growth in employment fell partly as a result of the sharp slowdown in the rate of growth of population and partly as a result of the emergence of classical unemployment. The large and sudden changes in relative prices which occurred in the 1970s made part of the stock of capital economically obsolete. Furthermore, the increased competition from newly industrialised countries generated the need for additional structural adjustment. These two factors, coupled with the rapid rise in real labour costs, contributed to the slowing down of economic growth, while at the same time giving an incentive to substitute capital labour.

Furthermore, the large growth of the government sector and the ensuing high level of taxation may have contributed at the same time to the high substitution of capital for labour and the slowdown of the rate of growth of the economy in the last decade of the sample period. High levels of taxation can reduce the rate of growth of the economy if workers are not willing to accept a cut in after-tax real wages in exchange for increased public services. If they shift forward the increased taxes and social security contributions, profits will fall, reducing capital accumulation of the non-labour substitution type and the demand for labour by firms.[6] If the shifting forward is only partial, real net wages fall and the supply of labour can also fall. Thus a higher level of government, if it is undesired by the labour force can lead to a lower growth rate of employment and output. These forces might have been at work in the 1970s along with the other factors.

The behaviour of the capital labour ratio in the hundred years is shown in Figure 1.2 along with the real annual wage rate. The chart suggests a high positive correlation between the two variables as implied by neoclassical theory. Table 1.2 shows the rates of growth of real NNP, and of the real stock of capital per capita and of civilian employment divided by population.[7] The deflation of real NNP and of the factors of production by population is important for comparisons over time because of changes in territory which occurred during the period under analysis.[8] NNP per capita grew at an average geometric rate of 1.7 per cent during the gold standard, 3.9 per cent in the interwar period and 3.8 per cent after the Second World War. Thus the acceleration in the growth rate of NNP after the First World

*Figure 1.2* Real annual wage and the capital labour ratio, 1880–1979




[a] Average real annual earnings of self-employed, in 1913 Marks.
[b] In thousands of 1913 Marks.
For the years 1914 to 1924 and 1939 to 1949 official data on earnings and the stock of capital are not available.

War is more pronounced when corrected by the growth rate of population. In addition, the average growth rates of NNP per capita were about the same in the interwar period and after the Second World War despite substantial differences in monetary and fiscal policies and in the general political and international environment.

Per capita figures in Table 1.2 show better than the uncorrected figures in Table 1.1 that the strong acceleration in the growth rate of NNP per capita in the postwar periods, with respect to the gold standard, is largely due to the negative growth rates of the war years. The average geometric growth rate in the years 1914–79 is 2.2 per cent, only slightly higher than during the gold standard. It appears, therefore, that the destructions of the wars have given rise to long phases of higher than average growth rates, bringing the stock of capital and NNP per capita back to the level which would have prevailed in the absence of the wars. This hypothesis will be analysed thoroughly in Chapter 5, with the aid of an econometric model which is simulated for this purpose. It is shown that the effect of the destructions due to the Second World War could have lasted until about the end of the 1960s. It appears therefore that in the 1970s the growth rate of NNP per capita in Germany would have slowed down even in the absence of the oil price shocks and the growth of the

*Table 1.2* Growth rates of NNP and the stock of capital per capita and standard deviations by major subperiods, 1880–1979

| | *NNP per capita* | | *Stock of capital per capita* | | *Civilian employment divided by population* | |
|---|---|---|---|---|---|---|
| | *Geometric average growth rate* | *Standard deviation*[a] | *Geometric average growth rate* | *Standard deviation*[a] | *Geometric average growth rate* | *Standard deviation*[a] |
| 1880–1913 | 1.73 | 2.70 | 1.84 | 0.67 | 0.18 | 0.66 |
| 1921–39 | 3.93 | 9.71 | 1.52 | 1.63 | 0.68[b] | 3.37 |
| 1950–79 | 3.78 | 2.66 | 3.94 | 1.17 | –0.24 | 2.79 |
| 1880–1979 | 1.89 | — | 1.74 | — | –0.07 | — |
| 1914–79 | 2.22 | — | 1.77 | — | –0.21 | — |
| 1970–79 | 2.57 | — | 4.26 | — | –0.58 | — |

[a] From arithmetic average.
[b] The ratio increased by 0.12 per cent a year during the period 1925–39.
*Source*: See Table 1.1.

public sector. Thus, barring major improvements in the terms of trade, in the rate of growth of technical progress, and major increases in the participation rate and reductions in the size of the public sector, German NNP per capita in the 1980s should not be expected to grow as in the 1950s and 1960s, but continue to grow at an average geometric rate somewhere around 2.5 per cent.

Table 1.2 shows that the ratio of civilian employment to population increased slightly during the gold standard despite the sharp drop in the share of agricultural employment in total employment[9] and the fact that the participation rate of women is usually higher in agriculture. It increased at about 0.7 per cent per year in the period 1921–39, averaging 46.2 per cent as opposed to 45.0 per cent during the gold standard. The participation rate was particularly high during the period 1925–29 averaging 49.3 per cent and from 1936 to 1939 when it averaged 48.7 per cent. In the post-Second World War period, the ratio fell on average by 0.2 per cent per year. It increased from 43.6 per cent in 1950 to a peak of 49.0 per cent in 1957 as a result of immigration, particularly from Eastern Europe, and fell steadily thereafter to a postwar minimum of 39.8 per cent in 1976 and 1977. The drop was particularly sharp in 1960 when the population increased by about four million.

Table 1.2 also shows the standard deviations of NNP per capita of the stock of capital per capita and of the participation rate in the various periods. It shows that the ratio of civilian employment to population was more stable during the gold standard, when the variability of real wages was highest (Table 1.3), while net national product per capita was more stable in the post-Second World War period, partly owing to the greater concern of the government with stabilisation of income.[10] It also indicates that while economic fluctuations were similar during the gold standard and the post-Second World War period they differed markedly in the interwar period. The standard deviation of all ratios is much higher in the interwar period reflecting a high variability in fiscal and monetary policies in Germany[11] and abroad.[12]

As to the effect of the high variability of monetary and fiscal policy on the average rate of growth, the hypothesis is that monetary fluctuations make the real rate of return on investment projects uncertain, with a consequent slowdown of investments and hence growth.

The likely effects of the greater variability of monetary and fiscal policy on the growth rate of NNP per capita and of the stock of

*Table 1.3* Variability of prices and wages by major subperiods (calculated on annual rates of changes), 1880–1979

| | *Consumer prices* | | | *Wages* | | | *Real wages* | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Standard deviation (1)* | *Arithmetic mean[a] (2)* | *(1)/(2)* | *Standard deviation (3)* | *Arithmetic mean[a] (4)* | *(3)/(4)* | *Standard deviation (5)* | *Arithmetic mean[a] (6)* | *(5)/(6)* |
| 1880–1913 | 2.48 | 1.94 | 1.28 | 1.22 | 2.07 | 0.59 | 1.99 | 1.69 | 1.18 |
| 1926–39 | 4.18 | 2.90 | 1.44 | 5.94 | 6.67 | 0.89 | 2.99 | 2.74 | 1.09 |
| 1952–79[b] | 1.89 | 3.05 | 0.62 | 5.46 | 12.13 | 0.45 | 3.23 | 5.13 | 0.63 |
| 1952–70[b] | 1.20 | 2.11 | 0.57 | 2.85 | 7.70 | 0.37 | 2.72 | 5.23 | 0.52 |

[a] Arithmetic mean of absolute values. If the standard deviations were simply divided by the arithmetic mean rather than the arithmetic mean of absolute values the variability of prices, wages and real wages during the gold standard would be even larger due to the long phase of falling prices and wages in the early gold standard period.
[b] The year 1952 has been chosen as the initial year in order to remove the disturbance caused by the Korean war.
*Source*: See previous Table 1.1.

*Table 1.4* Average productivity of labour and investment in education in selected years, 1880–1979

| | *Average productivity of labour (in 1913 Marks)* | *Study in secondary schools and in universities*[a] | |
|---|---|---|---|
| | | *Secondary schools* | *Universities* |
| 1880 | 1013 | — | 0.11 |
| 1890 | 1243 | — | 0.13 |
| 1900 | 1429 | — | 0.19 |
| 1910 | 1611 | 0.6 | 0.24 |
| 1920 | 1538 | 4.4 | 0.49 |
| 1930 | 1585 | 3.3 | 0.42 |
| 1940 | 2472 | 3.1 | 0.16 |
| 1950 | 2195 | 3.9 | 0.57 |
| 1960 | 3348 | 4.8 | 0.83 |
| 1970 | 5292 | 8.0 | 1.48 |
| 1979 | 7024 | 10.4 | 3.78 |

[a] In per cent of total civilian employment.
*Source*: Hoffmann (1965), Mitchell (1975) and Statistisches Bundesamt, *Statistisches Jahrbuch für die Bundesrepublik Deutschland*, various issues.

capital per capita in the interwar period should be assessed in the light of the finding that the expansionary effect of the destructions caused by the Second World War had ended by the end of the 1960s (Chapter 5). Assuming that the period of adjustment after the destructions of both wars was not more than eighteen years, the growth rate of NNP per capita of 3.9 per cent per year recorded from 1921 to 1939 has to be compared with the rate of 4.2 per cent recorded from 1950 to 1968 and the interwar growth rate of the stock of capital per capita of 1.5 per cent with the growth rate of 3.7 per cent from 1950 to 1968. Thus the greater variability of economic policy and the greater political uncertainty in the interwar period may have contributed to bring about a lower average rate of growth of NNP and of the stock of capital per capita.[13] This and the other important question, whether the average long-term rate of growth of the economy can be increased by a continuing undiscriminating[14] increase in government expenditure or in the rate of growth of money will be explored in more detail in Sections 1.4 and 1.5 and in the Appendix to this chapter.

In discussing the causes of long-term economic growth in Germany and in particular the causes of the high growth rate of NNP from 1950 to 1970 several factors have been mentioned; among them the increased investment in human capital and the gains from trade deriv-

*Table 1.5* The degree of openness of the German economy, by decade. (Nominal imports and exports of goods divided by NNP), 1880–1979

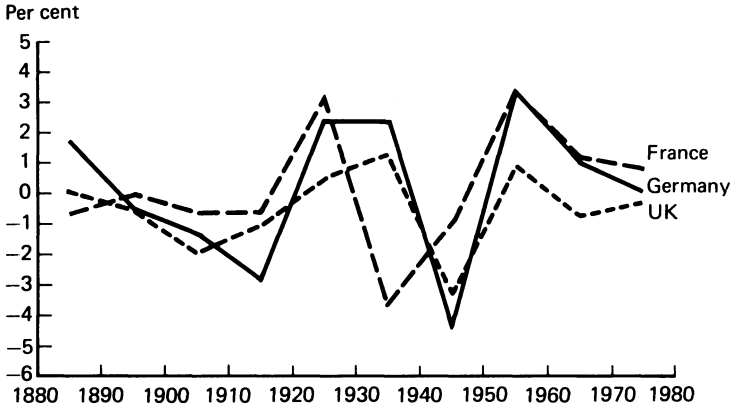
| | |
|---|---|
| 1880–89 | 34.01 |
| 1890–99 | 31.15 |
| 1900–09 | 34.37 |
| 1910–13 | 38.23 |
| 1920–29 | 43.62[a] |
| 1930–39 | 17.08 |
| 1950–59 | 29.84 |
| 1960–69 | 34.13 |
| 1970–79 | 43.47 |
| | |
| 1980–13 | 33.77 |
| 1920–39 | 30.34[b] |
| 1950–79 | 35.81 |

[a] Owing to the large real depreciation of the exchange rate in 1922 this figure overestimates probably the degree of openness. Excluding 1922, the average for the decade is 36.68.
[b] Excluding 1922 the average for the period is 26.36.
*Source*: Deutsche Bundesbank (1976), Hoffmann (1965) and Statistisches Bundesamt, *Statistisches Jahrbuch für die Bundesrepublik Deutschland*, various issues.

ing from the increased integration of Germany in the world economy. Table 1.4 shows the long-term development of the average productivity of labour and of the number of students enrolled in secondary schools and universities. The latter two variables are used here as a proxy of investment in human capital. The average productivity of labour increased on average by 1.5 per cent per year from 1880 to 1910, by 2.4 per cent per year from 1920 to 1940 and by 4.0 per cent from 1950 to 1979. These changes are positively related to changes in the number of students enrolled in universities, whose ratio to civilian employment increased at an average geometric rate of 2.4 per cent during the first period and of 6.5 per cent in the third period. In the last decade of the sample period the average geometric growth rate of the productivity of labour slowed down to 3.1 per cent per year for the reasons already mentioned,[15] despite the acceleration of the rate of investment in human capital.[16]

The other important factor in the economic development of Germany has been the specialisation in production deriving from greater integration in the world economy. A measure of the degree of integration of the German economy is given in Table 1.5 and Figure

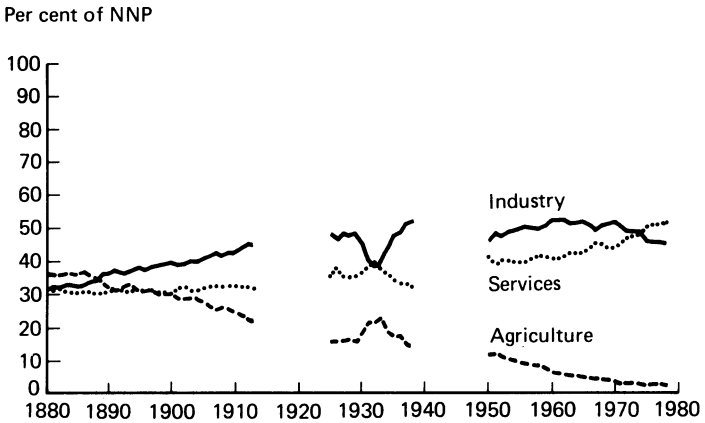
*Figure 1.3* Degree of openness of the German economy, 1880–1979




For the years 1914–24 and 1939–49, official data to calculate the ratio are unavailable.

1.3 by the ratio of nominal imports and exports to NNP. The ratio increased by 0.5 per cent per year on average during the gold standard and by 2.9 per cent per year from 1950 to 1970. In the period from 1970 to 1979 the growth of the degree of openness slowed down slightly to 2.7 per cent per year. During these three periods the behaviour of the measure of the degree of openness of the economy was positively related with the growth rates of NNP. In 1880, the ratio of nominal imports and exports to NNP was 34.4 per cent and it reached a maximum of 40.9 per cent in 1913. After a sharp fall during the First World War the ratio reached again a maximum of 34.4 per cent in 1929 and declined sharply to 20.9 per cent in 1932 and to 16.3 per cent in 1933, following a sharp fall in real income and the introduction of exchange controls and trade barriers. The autarchic policy was continued and extended by the Nazi government thus inducing a decline in the ratio to a peace-time minimum of 12.3 per cent in 1938. This policy did not impede a high growth rate of real NNP, although it probably affected the welfare of the population.[17] After the Second World War the degree of openness increased steadily but even with the reopening of trade in the 1950, and the creation of the Common Market in 1958 only in 1968 did it reach the level of 1912. After the oil price shock of the 1970s the degree of

*Figure 1.4* Net national product by sector[a], 1880–1979




[a] Industry includes construction and mining.
For the years 1914 to 1924 and 1939 to 1949, official data to calculate the ratios are unavailable.

openness of Germany reached an historical maximum of 49.0 per cent in 1979.
openness of Germany reached an historical maximum of 49.0 per cent in 1979.

Figure 1.4 shows the development of NNP by sector from 1880 to 1979. The gold standard is characterised by a strong increase of the share of industry in NNP which grew from 28 per cent in 1870 to 32 in 1880 and to 43 per cent in 1910. At the same time, the share of agriculture fell from 40 per cent in 1870, to 36 per cent in 1880 and 25 per cent in 1910. The share of services remained stable. This pattern is a characteristic of many countries in the early stages of industrialisation. On the contrary, after the Second World War the share of industry increased until 1961 and fell thereafter by 6.6 per percentage points. The decline occurred almost entirely in the 1970s. The share of services instead increased very rapidly from 42 per cent in 1950 to 52 per cent in 1979, while the share of agriculture continued to decline reaching 2 per cent in 1979.

Contrary to the prediction of Ricardian–Marxian theories of economic stagnation, the average productivity of labour in agriculture, reported in Table 1.6, grew at a substantial rate of 2.1 per cent on average from 1880 to 1979, only slightly less than the average pro-

*Table 1.6* Average productivity of labour by sector in selected years (1880 = 100), 1880–1979

| | *Agriculture*[a] | *Industry*[b] |
|---|---|---|
| 1880 | 100 | 100 |
| 1890 | 120 | 115 |
| 1900 | 151 | 145 |
| 1913 | 157 | 194 |
| 1925 | 109 | 186 |
| 1930 | 147 | 207 |
| 1938 | 169 | 258 |
| 1950 | 135 | 258 |
| 1960 | 261[c] | 503[c] |
| 1970 | 474[c] | 853[c] |
| 1979 | 778[c] | 1201[c] |

[a] Including forestry and fisheries.
[b] Excluding mining, including construction.
[c] Calculations based on development of gross domestic product by sector at constant prices.
*Source*: Hoffmann (1965) and Statistisches Bundesamt, *Statistisches Jahrbuch für die Bundesrepublik Deutschland*, various issues.

ductivity of labour in industry which grew at 2.5 per cent. The slower average growth rate of productivity in agriculture was probably due to the losses of fertile land caused by the two world wars. Indeed during most of the gold standard and after the Second World War the average productivity of labour grew faster in agriculture than in industry. From 1880 to 1900, the average productivity of labour grew at 2.1 per cent on average in agriculture as opposed to 1.9 in industry. This coincided with a substantial acceleration of the exodus of labour from agriculture. The share of employment in agriculture fell by over 10 percentage points from 48.7 in 1880 to 38.2 in 1900 (Table 1.7). During the post-Second World War period the average productivity of labour in agriculture grew at an average geometric rate of 6.0 per cent per year, as opposed to 5.3 per cent in industry. Again, this coincided with a sharp decline of employment in agriculture. Thus the agricultural sector did not constitute an impediment to overall growth of income per capita. This was probably due to the transfer of technology from industry to agriculture, an hypothesis which was not considered in the Ricardian–Marxian model. In the 1970s, a slowdown in productivity growth occurred in both sectors which, while modest in agriculture (from an average of 6.3 per cent from 1950 to 1970 to 5.5 per cent in the 1970s), was quite substantial in industry

*Table 1.7* Employment by sector in selected years (as per cent of total employment), 1861–1979

| | *Agriculture* | *Industry*[a] |
|---|---|---|
| 1861 | 51.7 | 26.2 |
| 1871 | 49.3 | 27.5 |
| 1880 | 48.7 | 28.0 |
| 1890 | 42.8 | 32.8 |
| 1900 | 38.2 | 35.0 |
| 1913 | 34.6 | 35.1 |
| 1925 | 31.5 | 37.7 |
| 1930 | 30.5 | 35.4 |
| 1938 | 26.7 | 40.7 |
| 1950 | 24.5 | 39.3 |
| 1960 | 14.1 | 45.4 |
| 1970 | 8.7 | 46.6 |
| 1979 | 6.2 | 42.1 |

[a] Including construction, excluding mining.
*Source*: Hoffmann (1965) Statistisches Bundesamt, *Statistisches Jahrbuch für die Bundesrepublik Deutschland*, various issues, and OECD, *Labour Force Statistics*, various issues.

(from an average of 6.0 per cent from 1950 to 1970 to 3.8 per cent in the 1970s).

Table 1.8 and Figure 1.5 show the development of real output per capita in Germany and other major industrial countries from 1880 to 1979.[18] In 1880, real output per capita in the United States was the highest at 774 dollars in 1963 prices, above that of the United Kingdom, France, Germany and Italy. The average geometric growth rates of the five countries over one hundred years are very similar, with the exception of the United Kingdom. During the gold standard, output per capita in Germany, the United States and France grew at an average geometric rate of around 1.6–1.7 per cent, while in the United Kingdom and Italy it grew at much lower rates (1 per cent and 0.9 per cent respectively). The growth rate of output per capita in Germany outpaced those of France and the US partly because countries with lower 'initial' output per capita grow faster initially.[19] The lower growth rates in the United Kingdom and Italy can be partly explained by the fact that the United Kingdom was already in a more mature stage of industrialisation, while Italy, although in a very early stage of industrialisation, retained a higher degree of protection,[20] and hence had fewer gains from trade.

In the period 1925–39 the growth rates of real output per capita

*Table 1.8* Real GNP/NNP per capita in Germany and other industrial countries (1880 = 100), 1880–1979

| | *Germany* | *United States* | *United Kingdom* | *Italy* | *France* |
|---|---|---|---|---|---|
| 1880[a] | 401 | 774 | 664 | 308 | 449 |
| 1880 | 100 | 100 | 100 | 100 | 100 |
| 1890 | 128 | 108 | 108 | 99 | 101 |
| 1900 | 148 | 131 | 124 | 105 | 122 |
| 1910 | 166 | 168 | 130 | 120 | 147 |
| 1920 | 116 | 170 | 118 | 144 | 140 |
| 1930 | 168 | 193 | 141 | 148 | 217 |
| 1940 | 246 | 222 | 185 | 164 | 174 |
| 1950 | 217 | 303 | 182 | 173 | 215 |
| 1960 | 351 | 349 | 229 | 295 | 343 |
| 1970 | 514 | 459 | 278 | 521 | 511 |
| 1979 | 648 | 570 | 336 | 617 | 686 |
| | | *Average geometric changes in per cent* | | | |
| 1880–1913 | 1.73 | 1.69 | 0.98 | 0.86 | 1.55 |
| 1925–39 | 3.45 | 0.22 | 1.05 | 1.14 | 0.52 |
| 1950–79 | 3.78 | 2.18 | 2.11 | 4.38 | 4.00 |
| 1970–79 | 2.57 | 2.41 | 2.11 | 1.88 | 3.27 |
| 1880–79 | 1.89 | 1.76 | 1.22 | 1.84 | 1.95 |

[a] In 1963 dollars.
*Source*: Mitchell (1975); Hoffmann (1965); Perroux (1955), Istituto Centrale di Statistica, *100 anni di sviluppo economico e sociale dell Italia 1861–1961* (1962) and US Department of Commerce (1979).

differed markedly among the five countries with the highest average geometric growth rate in Germany (about 3.5 per cent) and the lowest in the United States (about 0.2 per cent). These differences are due partly to the very low level of German real output per capita in 1925 as compared to other countries, to the previous greater destructions and losses of capital and land during and after the war, and possibly to the different intensities with which expansionary fiscal policies were pursued by the various governments in the later part of this period under analysis.[21] Furthermore, from 1933 to 1939 the incentives to work were altered in Germany by direct interventions of the Nazi government in the labour market.

In the post-Second World War period, Italy, France and Germany grew at very high rates with respect to the United States and the United Kingdom. This can be attributed to the reasons already mentioned to explain the higher German growth rate after the world wars and to the gains from trade arising from the establishment of the

*Figure 1.5* Average geometric growth rates of real GNP/NNP per capita of major European countries relative to the United States, by decade, 1880–1979

European Economic Community. For Italy there was also a catching-up effect after a much longer period of high protectionism and lower growth. In the last decade (1970–79), the rate of growth of real output per capita slowed down in Germany, Italy and France, while it accelerated in the United States and remained stable in the United Kingdom. This development is probably linked to the oil shock and the different availability of oil and other raw materials in the various countries, and to the different growth in the size of government. The slowdown has been more marked for Italy because of its greater dependence on imported oil and other raw materials, the lack of policies directed at structural adjustment and a greater and more disorderly increase in the role of government. On the contrary, structural policies in France, which included a more coherent energy policy and a lower increase in the size of government, allowed higher growth rates.

## 1.2 THE STRUCTURE OF AGGREGATE DEMAND

This section analyses developments of the major components of aggregate demand. It suggests that the private components of aggregate demand were characterised by a certain degree of stability and responded to changes in their determinants according to predictions of economic theory.[22] It suggests also that the major

*Table 1.9* Private consumption and its determinants (averages by decade), 1880–1979

| | $\frac{c}{f} \cdot 100$ | $\frac{c}{\text{NNP}} \cdot 100$ | $r - \pi$ | $\frac{g}{\text{NNP}} \cdot 100$ |
|---|---|---|---|---|
| 1880–89 | 17.8 | 82.6 | 2.8 | 7.0 |
| 1890–99 | 17.5 | 79.6 | 2.6 | 7.4 |
| 1900–09 | 16.1 | 76.8 | 1.8 | 8.4 |
| 1910–13 | 14.9 | 73.8 | 1.5 | 9.1 |
| 1925–29 | 16.2 | 63.4 | 3.1 | 12.5 |
| 1930–39 | 14.8 | 75.1 | 6.0 | 21.0 |
| 1950–59 | 18.6 | 68.8 | 4.1 | 16.0 |
| 1960–69 | 19.9 | 71.9 | 1.3 | 16.8 |
| 1970–79 | 18.4 | 73.8 | 0.7 | 16.1 |

*Legend*: $c$ = real private consumption
$f$ = real private financial and non financial wealth (see model of Chapter 5)
$r$ = nominal interest rate on government bonds
$\pi$ = rate of inflation measured by the consumer price index
$g$ = central and local government expenditure, excluding transfers; national accounts definition.

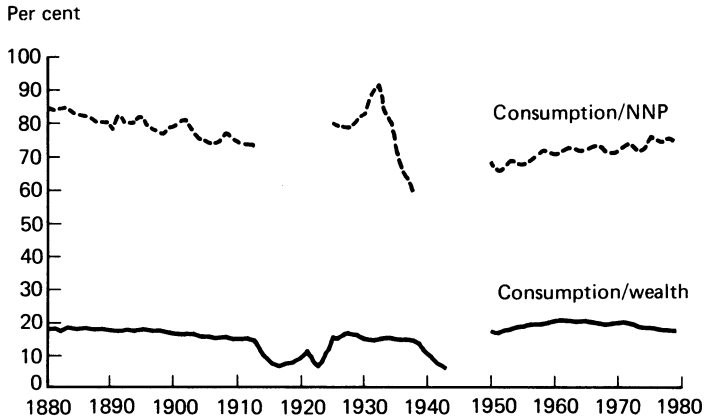
*Source*: Hoffmann (1965), Deutsche Bundesbank (1976) and Statistisches Bundesamt, *Statistisches Jahrbuch für die Bundesrepublik Deutschland*, various issues.

influences on the Germany economy originated from an unstable predictions of economic theory.[22] It suggests also that the major influences on the Germany economy originated from an unstable government sector. Moreover, it appears that the private sector reacted with long and variable time-lags to the shocks which it was subject to. Thus unstable government behaviour led to long periods of disequilibrium of the private sector. The political and social consequences of such disequilibria are not dealt with in this book, but they are very well known to students of German history of the interwar period.

## Private consumption and wealth

Table 1.9 and Figure 1.6 show the development of the ratios of private consumption and wealth[23] to NNP. The first ratio did not have a clear trend over the one hundred years, while the second one declined. The variability of the ratio of private consumption to wealth is smaller than the one of the ratio to NNP as predicted by the permanent income hypothesis.

*Figure 1.6* Ratios of private consumption to wealth and NNP 1880–1979




For the years 1914 to 1924 and 1939 to 1949, official data on NNP to calculate the ratios are unavailable. Consumption for the years 1914 to 1924 is estimated by the authors.

Real private consumption in Germany, as a ratio of both real private wealth and NNP, showed a declining trend during the gold standard. As a ratio of real private wealth it fell from an average of 17.8 per cent in the decade 1880–89 to 14.9 per cent in the last four prewar years. Similarly, as a ratio of NNP, it fell from 82.6 per cent in the first decade to 73.8 in the period from 1910 to 1913. Real interest rates were also declining. The high rate of economic growth and the increase in the size of the public sector could have played an important role in these developments. An increase in government current expenditures, excluding transfers, leads to a fall in private consumption if the consumer considers some of the public expenditures as equivalent to private consumption and is willing to substitute the former for the latter.[24] If the growth in government current expenditures leads to a higher government debt and if the private sector discounts to some extent future tax liabilities, then the ratio of consumption to wealth may fall also because real private financial wealth as defined here includes central government debt, which increased substantially during the gold standard. Furthermore as the public sector grew, the tax system created incentives in favour of saving and investment. The heavy reliance by the central government on custom duties, on taxes on exchanges and on consumption during the gold standard (Table 1.27 on page 59) and the increase in the ratio of net

investment to NNP (Table 1.11 on page 34) suggests that the German tax system was actually discouraging consumption in favour of investment during the gold standard.

During the hyperinflation period the economic and political uncertainties and the desire to rebuild the stock of domestic real financial wealth depressed private consumption. From 1925 to 1929, the ratio of consumption to wealth exceeded the pre-First World War levels following a shift in the distribution of income in favour of wage earners, despite the large level of public expenditure and high real interest rates. In the 1930s special circumstances depressed the ratio of consumption to wealth. During the great depression, consumption fell in real terms more than real wealth while during the second half of the decade government policies contributed to prevent consumption from rising as fast as real wealth. Private consumption was on average 14.9 per cent of wealth from 1930 to 1934, and it was 14.7 per cent from 1933 to 1939 with very little variability within the two periods. Consumption as a ratio to NNP fluctuated instead sharply and averaged 85.7 per cent from 1930 to 1934, with a peak of 91.4 per cent in 1932. It averaged 63.6 per cent from 1935 to 1939 and exhibited a strong declining trend during the period. In the post-Second World War period the ratio of consumption to wealth was very stable at levels slightly above the early gold standard period. In relation to NNP consumption rose from 68.8 per cent in the 1950s to 73.8 per cent in the 1970s. This development was accompanied by a reduction in real interest rates and a growing income tax burden (Table 1.27 on page 59) which probably encourage private consumption contrary to what happened during the gold standard.

Table 1.10 contains the composition of the stock of net real private wealth, which has three components: the stock of physical capital, including housing, central government debt outstanding, and net foreign assets.[25] The most important component is the stock of real capital which on average was 98.0 per cent of the total during the gold standard and 95.3 per cent from 1920 to 1939 and from 1950 to 1979. This share was quite stable over the century with the exception of the war years and the hyperinflation period. The destruction of physical capital and the growth of the government debt explain the fall in the ratio during the wars. Government debt reached 14.1 per cent during the period 1914–19 and an estimated 29.3 per cent from 1940 to 1944. This share was relatively low during peace-time years with the highest levels reached during the 1930s and the 1970s. Net foreign assets of the private sector, corrected for exchange rate changes, were a minor component of total wealth, with the exception of the hyperinflation

*Table 1.10* The composition of net private wealth (averages by decade; in percent of net private wealth), 1880–1979

| | *Physical capital* | *Central government debt* | *Net foreign assets*[a] |
|---|---|---|---|
| 1880–89 | 98.7 | 0.7 | 0.6 |
| 1890–99 | 97.7 | 1.8 | 0.5 |
| 1900–09 | 97.7 | 2.2 | 0.1 |
| 1910–13 | 97.7 | 2.1 | 0.2 |
| 1914–19 | 85.8 | 14.1 | −0.1 |
| 1920–24 | 93.4 | 0.8 | 5.8 |
| 1925–29 | 98.1 | 2.1 | −0.2 |
| 1930–39 | 95.0 | 4.9 | 0.1 |
| 1950–59 | 95.5 | 3.8 | 0.7 |
| 1960–69 | 95.6 | 3.5 | 0.9 |
| 1970–79 | 94.8 | 4.1 | 1.1 |

[a] Including capital gains and losses due to exchange rate changes but excluding reparation commitments. (See note 25).
*Source*: Own estimates.

period when the large real depreciation of the mark induced substantial valuation changes, which more than compensated the effect on wealth of the large current account deficits.

**Investment**

The behaviour of real net private investment is analysed in this section as a component of aggregate demand rather than an increase in the supply of factors of production. According to neoclassical theory the main determinants of investment are the marginal productivity of capital and the user cost of capital. Neglecting tax factors and expected capital gains and losses, the latter can be proxied by the real financial interest rate. Table 1.11 contains the averages of the real interest rate and of the average product of capital by decade along with the ratio of net private investment to NNP. During the gold standard, real private investment increased as a ratio to NNP from 11.5 per cent in the first decade to 15.5 per cent in the years from 1910 to 1913. This development was mostly due to the decline in real interest rates. The ratio of NNP to the stock of capital, which is proportional to the marginal product of capital if one assumes a Cobb–Douglas production function, remained relatively stable during this period. During the hyperinflation period, investment was low

*Table 1.11* Net private investment and its determinants (averages by decade), 1880–1979

| | $-\frac{\Delta K}{\text{NNP}}.100$ | $\frac{NNP}{K}$ | $r-\pi$ |
|---|---|---|---|
| 1880–89 | 11.5 | 0.22 | 2.8 |
| 1890–99 | 14.2 | 0.23 | 2.6 |
| 1900–09 | 14.4 | 0.22 | 1.8 |
| 1910–13 | 15.5 | 0.21 | 1.5 |
| 1920–24 | (8.5) | (0.17) | — |
| 1925–33 | 6.7 | 0.19 | 7.1 |
| 1934–39 | 14.2 | 0.24 | 2.0 |
| 1950–59 | 16.2 | 0.28 | 4.1 |
| 1960–69 | 17.7 | 0.29 | 1.3 |
| 1970–79 | 16.7 | 0.26 | 0.7 |

*Legend*: $\Delta K$ = first difference of the net stock of capital
$r$ = nominal interest rate on government bonds
$\pi$ = rate of inflation measured by the consumer price index.

*Source*: Hoffmann (1965), Statistisches Bundesamt, *Statistisches Jahrbuch für die Bundesrepublik Deutschland*, various issues, and Deutsche Bundesbank (1976).

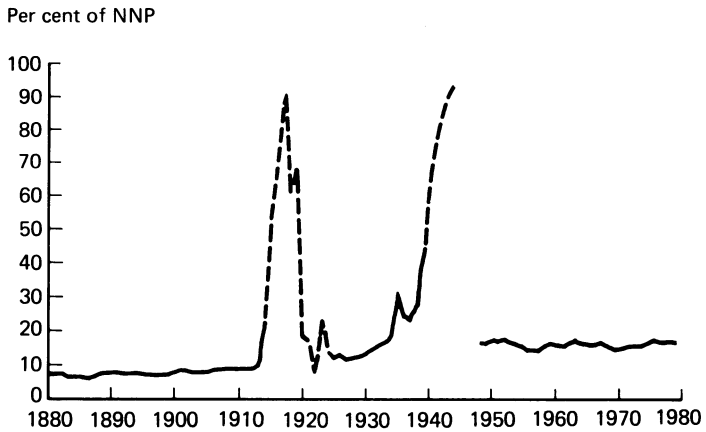
by historical standards partly because of the low productivity of capital and the greater uncertainty, which outweighed the effect of the negative real interest rate. Investment declined even further in the years from 1925 to 1933 because of the sharp increase in the real interest rate, particularly during the great depression of the early 1930s and the sharp fall in profit margins (Table 1.16 on page 44). It then rose sharply during the Nazi period, fostered by the expenditure policy of the government, the large drop in the real interest rate and the increase in the average product of capital. After the Second World War, the high rate of investment was related to the high productivity of capital and declining real financial interest rates. The high level of the average product of capital was in large part a consequence of the wartime destructions and the loss of territory. The reduction in the real net stock of capital from 1938 to 1950 was much larger than the reduction in civilian employment and population,[26] thus raising the average product of capital.[27] During the 1960s the average product of capital was even higher than in the 1950s owing to the inflows of refugees and foreign workers. Furthermore, the sharply lower real financial interest rate favored a higher investment activity. In the 1970s the average product of capital fell

when the effect of the war destruction came to an end (see Chapter 5) and because of the smaller importance of the opening of trade effect and of the worsening of the terms of trade. As a result, investment fell as a ratio to NNP with respect to the 1960s, despite the further reduction in the real interest rate.

## Government expenditure

Government expenditure represented one of the major influences to which the German private sector was subjected to during the period under analysis. Figure 1.7 shows the development of government expenditure on goods and services[28] as a ratio to NNP. During the gold standard, this ratio fluctuated slightly around an upward trend and remained always below 10 per cent of NNP. A major disturbance occurred during the First World War when the ratio increased from 20.7 per cent of NNP in 1914 to a peak of about 89.9 per cent in 1917. The share of government expenditure in NNP fell to about 9.0 per cent in 1922. The acceleration of inflation in 1922 and 1923 occurred, therefore, when the extent of the original exogenous shock to the goods and money markets was already being reduced. However, in

*Figure 1.7* Real government expenditure[a], 1880–1979




[a] National accounts definition of government expenditures.
Data from 1914–24 and from 1939–43 are very rough estimates made by the authors.

mid-1923, following the Ruhr occupation by the French and Belgian armies, a rise in nominal government expenditure and in the budget deficit was a determinant factor in the final acceleration of inflation and the ultimate collapse of the German monetary system.[29] From 1924 to 1929 the share of government expenditure in NNP fluctuated between 12 and 14 per cent. In 1931 a restrictive fiscal policy was initiated, following the banking crisis and the end of capital inflows from abroad, which had played a large part in financing the government deficit. This aggravated the fall in income already under way as a consequence of the fall in the international business cycle and the reduced competitiveness of German exports. Following the advent of Nazism and the German rearmament, the share of government expenditures in NNP rose steadily to 42.0 per cent in 1939. During the Second World War the second major shock stemming from government expenditure occurred when the share increased to a peak of over 90 per cent of NNP.[30] From 1949 onwards, the share fluctuated around narrow margins (between 14 per cent and 18 per cent). Total government expenditure on a budgetary definition, including transfers, showed a much stronger upward trend in the course of the century, from 10.5 per cent in 1881 to 53.6 per cent of NNP in 1979.[31]

The previous analysis suggests that the private components retained a certain degree of stability and responded to changes in their determinants according to predictions of economic theory, while the major shocks to the German economy originated from actions of the government sector, or from abroad.

## 1.3 THE BALANCE OF PAYMENTS

### The overall balance of payments

This section reviews balance-of-payments developments in relation to economic growth. Thus only the long-term trends will be dealt with here, while the mechanism of adjustment of the balance of payments will be dealt with later in some of the chapters referring to each main subperiod. Tables 1.12 and 1.13 contain an overview of the developments of the German balance of payments and its major components in the different stages of the country's economic development. The trade balance showed consistent and large deficits during the gold standard years (Table 1.13), partly as a reflection of the rapid industrialisation of the German economy. Figure 1.8 shows

the trade deficits and the share of industry in NNP in each decade of the period 1880–1979. The chart indicates that during the period of rapid industrialisation between 1880 and 1930, the trade balance showed in general large deficits. In the years 1950–79, in which the share of industry increased slightly or was declining, the trade balance moved into a surplus.[32]

Although the trade account registered a deficit in every decade of the gold standard, there were marked differences in the various decades. During the 1880s, the trade balance was on average almost balanced despite the rapid industrialisation of this period. This development was largely the result of long cyclical factors. German domestic demand, as a ratio to NNP, and particularly investment, were low and foreign demand was high relative to the following decades. Furthermore, the deterioration of the trade account in the 1890s and

*Table 1.12* The balance of payments (in per cent of NNP; period averages), 1880–1979

| | *Trade and service balance* (1) | *Unrequited transfers* (2) | *Current account balance* (1)+(2) (3) | *Long-term capital flows* (4) | *Changes in international reserves* (5) |
|---|---|---|---|---|---|
| 1880–89 | 2.4[a] | — | 2.4 | –2.5 | 0.2[c] |
| 1890–99 | 1.6[a] | — | 1.6 | –1.5 | 0.0[c] |
| 1900–09 | 1.0[a] | — | 1.0 | –0.9 | 0.1[c] |
| 1910–13 | 1.5[a] | — | 1.5 | –0.9 | 0.2[c] |
| 1925–33 | 0.0 | –1.7 | –1.7 | 1.1 | –0.3 |
| 1950–59 | 2.3[b] | –0.2 | 2.1 | –0.3 | –1.6 |
| 1960–69 | 2.3[b] | –1.5 | 0.8 | –0.8 | –0.3 |
| 1970–79 | 2.7[b] | –1.8 | 0.9 | 1.1 | 2.3[d] |

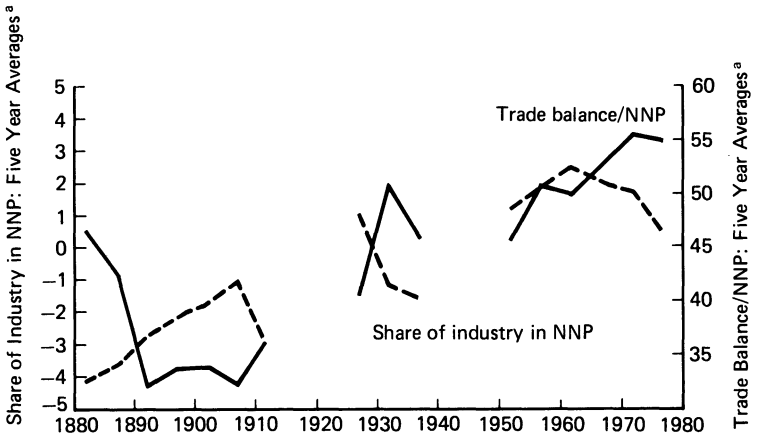
[a] Includes unrequited transfers.
[b] Imports of goods are valued fob; therefore, the trade balance in this table differs from the trade balance in Table 1.13 for the postwar period.
[c] Changes in international reserves of the Reichsbank and the private sector, since during the gold standard there were gold coins in circulation.
[d] Average inflow of international reserves net of valuation changes, obtained by adding the current account and long- and short-term capital flows.
*Source*: Hoffman (1965), Deutsche Bundesbank (1976) and Statistisches Bundesamt, *Statistisches Jahrbuch für die Bundesrepublik Deutschland*, various issues.

*Table 1.13* Foreign trade and the current account balance by decade (in per cent of NNP)[a], 1880–1979

| | *Exports of goods* (1) | *Imports of goods*[b] (2) | *Trade balance* (3) (1)−(2) | *Service balance* (4) | *Current account balance* (3)+(4) |
|---|---|---|---|---|---|
| 1880–89 | 17.0 | 17.1 | –0.1 | 2.5[c] | 2.4 |
| 1890–99 | 13.6 | 17.6 | –4.0 | 5.6[c] | 1.6 |
| 1900–09 | 15.2 | 19.2 | –4.0 | 5.0[c] | 1.0 |
| 1910–13 | 17.8 | 20.5 | –2.7 | 4.2[c] | 1.5 |
| 1914–19 | (7.1) | (13.5) | (–6.4) | — | — |
| 1920–24 | 24.7 | 30.4 | –5.7 | — | — |
| 1925–33 | 14.5 | 14.2 | 0.3 | –0.3 | –1.7 |
| 1934–39 | 6.2 | 6.1 | 0.1 | — | — |
| 1940–49 | (4.2) | (5.8) | (–1.6) | — | — |
| 1950–59 | 15.5 | 14.4 | 1.1 | 0.0 | 2.1[d] |
| 1960–69 | 18.1 | 16.0 | 2.1 | –0.9 | 0.8[d] |
| 1970–79 | 23.4 | 20.0 | 3.4 | –1.5 | 0.9[d] |

[a] Numbers in parenthesis are estimated.
[b] Valued cif.
[c] Including unrequited transfers.
[d] Imports valued fob, as in Table 1.12.
*Source*: See Table 1.12.

*Figure 1.8* The trade balance and the stages of German industrialisation, 1880–1979




[a] In per cent.
For the years 1914 to 1924 and 1939 to 1949 official data are not available.

the first decade of the century was aggravated by the loss of competitiveness, which was especially large with respect to the United States and Italy (Table 1.18 on page 46). Finally, the terms of trade worsened by 1.8 per cent per year on averge from 1890 to 1913, as opposed to only 1.0 per cent from 1880 to 1890.

The early 1920s were characterised by large trade deficits. In the first years after the war and up to 1924, this was due to the need for reconstruction, the worsening of the terms of trade, and excess domestic demand, as the latter influenced negatively not only the exchange rate but also the trade balance. From 1925 to 1928, the wage rate policy and the demand management policy pursued by the government led to a worsening of competitiveness and to large deficits of the trade balance which averaged 1.9 per cent of NNP.[33] From 1930 to 1933 the trade account moved into substantial surpluses, despite the sharp fall in foreign demand because of the very restrictive fiscal and monetary policy pursued by the German authorities during this period.

In the post-Second World War period the positive trade balance was due to the moderate growth in domestic demand compared to potential output, to the favourable development of the terms of trade and to changes in the structure of production and aggregate demand in Germany (see Chart 1.8). During the first decade, the trade balance registered a surplus of 1.1 per cent of NNP on average which increased to 2.1 per cent and 3.4 per cent of NNP in the two following decades. The development of the trade balance during the 1950s was uneven: from 1950 to 1956 it showed an average surplus of 0.2 per cent of NNP because of the high level of imports needed for reconstruction. After 1956, the trade balance moved into large surpluses which continued in the 1960s. In the 1970s, the trade balance surplus increased further despite the two oil price shocks of 1973/74 and of 1979/80, mainly because of a restrictive demand management policy in Germany in relation to other countries, particularly after the first oil shock. The worsening of the terms of trade in the 1970s was mitigated by a shift in asset preferences away from the dollar and the pound towards the Deutschmark which tended to appreciate more than was justified by inflation differentials.

The balance of services and transfers moved from large surpluses during the gold standard to large deficits in the interwar period and after the Second World War. During the gold standard net interest payments and dividends on capital owned abroad contributed about one fourth of the service surplus. After the First World War, Ger-

many became a net importer of capital and this contributed strongly to the deterioration of the service balance. Unrequited transfers also became negative after the First World War, because of the large reparation payments. After the Second World War, the service and transfer balance became increasingly negative mainly in connection with the spreading of travel by Germans abroad and because of aid to developing countries and contributions to international organisations, in particular to the European Community.

Turning to long-term capital flows, Germany was always a net exporter of capital during the hundred years under analysis, with the exception of the interwar period and the 1970s (Table 1.12). The fact that Germany was a net exporter of capital already in 1880 indicates that the economy was even then in an advanced stage of development with sufficient domestic saving to finance the new stage of industrialisation. During the gold standard, long-term capital outflows almost matched the current account surplus and changes in the ratio of international reserves to NNP were generally small. As a ratio to NNP, net capital outflows were greater under the gold standard than after the Second World War. In the 1960s, long-term capital outflows exactly matched the current account surplus and there were yearly inflows of short term capital of 0.3 per cent of NNP on average. This could indicate that already in the 1960s there was some currency substitution towards the Deutschmark. In the 1970s long-term capital inflows averaged 1.1 per cent of NNP. This reflected strong capital inflows in the early 1970s and in 1979, while after the first oil crisis there were large outflows. In the early 1970s the large net inflows were mostly a result of expansionary United States monetary policy and the weakness of the United States dollar, while in 1979 direct investment in Germany became more attractive to foreign investors, thanks to the undervaluation of the Deutschmark.

In the economic literature there exist two theories explaining movements in the current account and long-term capital flows. One theory maintains that the level of capital flows is determined by the current account balance, the other that the direction of causation is the other way around.[34] From the data reported in Table 1.12 it is not possible to disentangle the direction of causation between these two variables. There is a third hypothesis based on general equilibrium theory which attributes great importance to the excess of domestic saving over domestic investment in the movements of both the current account[35] and net capital flows. No data are available to check the validity of this hypothesis for periods prior to 1950. How-

*Table 1.14* Domestic savings and investment and the current account balance by decade (in per cent of NNP), 1950–79

| | *Household saving (1)* | *Gross enterprise saving (2)* | *Overall budget surplus (3)* | *Gross private investment (4)* | *Excess saving (1)+(2) +(3)−(4)* | *Current account surplus*[a] |
|---|---|---|---|---|---|---|
| 1950–59 | 4.6 | 16.5 | 4.1 | 23.6 | 1.6 | 2.1 |
| 1960–69 | 7.7 | 16.9 | 1.0 | 24.7 | 0.9 | 0.8 |
| 1970–79 | 10.9 | 15.6 | −1.9 | 22.4 | 2.2 | 0.9 |

[a] The current account figures do not match exactly with the excess saving figures because the former are computed on the basis of trade statistics and the latter are based on national accounts statistics. For the 1970s adverse terms of trade movements have particularly weakened the relationship.

*Source*: Deutsche Bundesbank (1976) and Statistisches Bundesamt, *Statistisches Jahrbuch für die Bundesrepublik Deutschland*, various issues.

ever, for the period 1950–79 there seem to exist a high correlation between the current account and the difference between saving and investment, as shown in Table 1.14. There is reason to believe that the same correlation held also during the gold standard and during the 1920s.[36]

**Foreign trade**

During the gold standard, German imports of goods at current prices as a ratio to nominal NNP grew on average by 0.7 per cent, while real imports as a ratio to real NNP grew at an average rate of 1.4 per cent. This difference was due to a decline in the ratio of import prices to the GDP deflator. The decline in this ratio was largely a result of the behaviour of raw material prices, which had a large weight in import prices, and which fell by 0.6 per cent per year on average from their peak in 1872 to 1913, while German wholesale prices fell only by 0.3 per cent per year during the same period. However, during the gold standard there was a period of falling and a period of rising raw material prices. From 1872 to 1897 these fell on average by 2.7 per cent per year as a result of low world demand, caused largely by insufficient gold production. During the same period, wholesale prices in Germany fell only by 1.6 per cent per year. New gold discoveries and the discovery of the cyanide process for gold extraction initiated a raw material prices boom. These prices increased by 2.7 per cent per year on average from 1897 to 1913. At the same time

*Table 1.15* Ratio of tariff revenues to total imports of goods in selected years (in per cent), 1880–1979

| | |
|---|---|
| 1880 | 5.8 |
| 1890 | 8.6 |
| 1900 | 7.7 |
| 1910 | 6.8 |
| 1920 | 2.2 |
| 1930 | 10.2 |
| 1940 | 33.7 |
| 1950 | 5.4 |
| 1960 | 6.5 |
| 1970 | 2.7 |
| 1979 | 1.4 |

*Source*: Caasen (1953) and Statistisches Bundesamt, *Statistisches Jahrbuch für die Bundesrepublik Deutschland*, various issues.

the wholesale price index in Germany increased only by 1.7 per cent per year. Thus, even during the gold standard, raw material prices fluctuated more sharply in relation to world demand than prices of manufactures. The fall in relative import prices occurred despite the tariff policy pursued by the German government which led to a rise in the ratio of tariff revenues to imports from 5.8 per cent in 1880 to a maximum of 9.5 per cent in 1896 (Table 1.15).

Real imports increased on average by 3 percentage points more than real NNP from 1925 to 1929, despite increasing tariff protection. The ratio of tariff revenues to imports grew from 4.9 per cent in 1925 to 8.0 per cent in 1929 in part also as a result of the change in the composition of imports. During this period, the increased tariff protection was not sufficient to counteract the effect on imports of the growth in German domestic demand relative to foreign demand and to prevent a loss in competitiveness of German goods in the domestic market. The ratio of import prices to the NNP deflator declined by 3.8 percentage points per year on average from 1925 to 1929.

During the 1930s, the ratio of nominal imports to NNP fell steadily from 14.8 per cent in 1930 to 5.0 per cent in 1939, due to an increase in tariff revenues which increased from 10.2 per cent of imports in 1930 to 31.6 per cent in 1939, to the compression of private consumption and to the policy of autarky. In the post-Second World War period, nominal imports grew by 2.2 per cent on average more than nominal NNP, while import prices fell by 2.1 percentage points on average with respect to the NNP deflator. The cause of this fall in import prices was the relative stability of raw material prices until

1971 accompanied by the fall in tariff revenues which declined from 5.4 per cent of imports in 1950 to 1.4 per cent in 1979.

During the gold standard, the ratio of German nominal exports of goods to NNP showed on average much wider fluctuations than the corresponding ratio for imports. The ratio of exports to NNP fell from 17 per cent on average in the 1880s to 13.6 per cent in the following decade. This was a consequence of the weakness of foreign demand, in turn caused by the insufficient world gold production. The ratio reached a maximum of 18.8 per cent in 1882 and declined steadily thereafter until 1894, when it reached an absolute minimum of 12.5 per cent. The ratio of real exports to NNP fell only marginally from 11.8 per cent in the 1880s to 11.4 per cent in the 1890s. These developments reflected a substantial fall in export prices in relation to the NNP deflator, indicating that between 1880 and 1894 German producers adopted a flexible export price policy in the face of sluggish world demand. In the first decade of this century, the ratio of nominal exports to NNP increased at a much slower rate than the ratio of real exports to NNP, because of a further sharp fall of the ratio of export prices to the NNP deflator.

During the whole gold standard, unit export values declined on average by 0.8 per cent per year, while the NNP deflator increased by 0.6 per cent per year. Unit labour costs in industry fell on average by 0.1 per cent per year, suggesting a decline or a smaller rise in profits on exports with respect to profits on goods sold domestically (Table 1.16).[37] There is a marked difference in the price setting behaviour of German export industries before and after the upturn in world gold production in the mid-1890s. During the first period of sluggish world demand, German industry reduced unit export values in order to maintain the level of real exports. Successively, they reduced unit export values to increase market shares (Table 1.17). The struggle for export markets in this period and the aggressiveness of German export industries has been looked at by some authors as one of the causes of the First World War.[38]

After the disruption of world trade caused by the First World War, in 1925 German nominal exports as a per cent of NNP returned to the levels of the last years of the gold standard, and they fluctuated around this level until 1929. The same ratio of exports to NNP implied a lower degree of openness because of the smaller territory of Germany after the war. The ratio of nominal exports as a per cent of NNP declined sharply in 1932 because of the downturn of the international business cycle and continued to decline thereafter because of

*Table 1.16* Indicators of changes in profit margins in German export industry by major sub-periods (average geometric growth rates), 1880–1979

| | *1880–1913* | *1925–33*[b] | *1950–70* | *1970–79* |
|---|---|---|---|---|
| (1) Unit export values | –0.8 | –4.7 | 2.5 | 4.7 |
| (2) NNP deflator | 0.6[a] | –3.0 | 3.2 | 5.1 |
| (3) Ratio (1)/(2) | –1.4 | –1.7 | –0.7 | –0.4 |
| (4) Average product of labour in industry | 2.0 | 1.6 | 6.0 | 3.8 |
| (5) Real Wages in industry | 1.9 | –0.7 | 7.3 | 7.2 |
| (6) Unit labour cost in industry: (5)/(4) | –0.1 | –2.3 | 1.2 | 3.3 |
| (7) Ratio of (1)/(6) | –0.7 | –2.5 | 1.3 | 1.4 |
| (8) Ratio of (2)/(6) | 0.5 | –0.7 | 2.0 | 1.8 |

[a] A price index of industrial products which, however, excludes machines, also increased by 0.6 per cent per year (Jacobs and Richter, 1935). A price index of machines and instruments for agriculture increased by 0.7 per cent (Hoffmann, 1965).

[b] If the calculations are performed from 1925 to 1930, no major changes emerge in the picture.

*Sources*: Hoffmann (1965), Mitchell (1975), Jacobs and Richter (1935), International Monetary Fund, *IFS* (1982) Yearbook and Statistisches Bundesamt, *Statistisches Jahrbuch für die Bundesrepublik Deutschland* (1982).

sluggish world demand and the policy of autarky. After the Second World War, the ratio of nominal exports to NNP increased from 9.1 per cent in 1950 to a maximum of 26.2 per cent in 1974 and declined marginally thereafter. Unit export values increased during the post-Second World War period less than the NNP deflator, as during the gold standard. Contrary to what happened in the gold standard period, however, the ratio of unit export values to unit labour costs increased (Table 1.16).

Table 1.17 shows the development of German exports of goods in relation to total exports of goods of a group of industrial countries. German exports were 18 per cent of total exports of the group in 1880 and increased to 22.3 per cent in 1910. Most of the increase occurred in the last twenty years of the gold standard. The slump in world demand up to the mid-1890s prevented gains in market shares be-

*Table 1.17* Export shares of selected countries[a] (in per cent), 1880–1979

| | *Germany* | *United States* | *United Kingdom* | *France* | *Italy* |
|---|---|---|---|---|---|
| 1880 | 18.0 | 23.9 | 35.9 | 17.2 | 5.0 |
| 1890 | 18.9 | 21.8 | 38.0 | 17.2 | 4.1 |
| 1900 | 20.0 | 29.6 | 31.5 | 14.5 | 4.4 |
| 1910 | 22.3 | 25.0 | 32.6 | 15.1 | 5.0 |
| 1925 | 15.1 | 34.3 | 30.6 | 15.0 | 5.0 |
| 1930 | 23.3 | 31.9 | 26.0 | 13.6 | 5.2 |
| 1937 | 23.1 | 33.5 | 28.7 | 9.4 | 5.3 |
| 1950 | 8.7 | 44.7 | 27.8 | 13.5 | 5.3 |
| 1960 | 22.0 | 37.5 | 20.3 | 13.2 | 7.0 |
| 1970 | 27.0 | 33.0 | 15.4 | 14.3 | 10.3 |
| 1979 | 27.3 | 28.9 | 16.3 | 16.0 | 11.5 |

[a] Exports of goods of each country divided by the sum of exports of goods of Germany, the United States, the United Kingdom, Italy and France.
*Source*: Mitchell (1975), International Monetary Fund, *IFS*, various issues and US Department of Commerce (1979).

tween 1880 and 1893. In the 1880s, German unit labour costs increased at about the same rate as in the United Kingdom and Italy, while from 1899 to 1913 they increased at a much lower rate than in the United States, the United Kingdom and Italy (Table 1.18).

Starting from a much lower level, the German export share grew in the second half of the 1920s, despite a sharp deterioration in competitiveness as measured by unit labour costs. During this period German industry was able to retain market shares at the cost of a large squeeze in profit margins (Table 1.16). In 1930, the German export share was higher than in 1910 and it was at about the same level in 1937, despite the policy of autarky. This was possible as both world trade and German exports collapsed together. After the Second World War, the German export share grew very rapidly until 1970 and remained stable thereafter. The growth in the German export share from 1960 to 1970 occurred despite unfavourable developments of unit labour costs in German industry compared to other industrial countries (Table 1.18). Over the one hundred years the German export market share increased from 18 per cent to over 27 per cent. This is remarkable, particularly in the light of the large losses in territory. During the same period, the United States export share increased from 23.9 per cent to 28.9 per cent; the United Kingdom's declined from 35.3 per cent to 16.3 per cent; the French share declined from 17.2 per cent to 16 per cent, while Italy's remained

*Table 1.18* Developments of unit labour costs in industry[a] by major subperiods, International comparisons (average geometric growth rates), 1880–1979

| | *Germany*[b] | *United States*[c] | *United Kingdom*[g] | *Italy*[j] |
|---|---|---|---|---|
| 1880–90 | 0.52 | — | 0.73 | 0.84 |
| 1890–99 | –1.00 | –2.25 | 0.49[h] | –1.54 |
| 1899–1913 | –0.09 | 1.25[d] | 1.16 | 0.62[d] |
| 1925–30 | 2.61 | –1.97[e] | –6.89[i] | 5.22 |
| 1950–60 | 0.11 | 1.82 | 3.17 | –2.07 |
| 1960–70 | 2.62 | –0.81 | –0.71 | 1.08 |
| 1970–79 | 3.41 | –3.06 | 4.33 | 4.48 |
| 1880–1913 | –0.15 | –0.06[f] | 0.83 | 0.12[k] |
| 1950–79 | 2.00 | –0.60 | 2.20 | 1.05 |

[a] Wages in industry are expressed in Marks for all countries and are divided by the average productivity of labour in industry.
[b] Wages are from Mitchell (1975) until 1913, and after 1913 from Statistisches Bundesamt, *Statistisches Jahrbuch für die Bundesrepublik Deutschland* (1982).
[c] Manufacturing only. *Source*: US Department of Commerce, (1979).
[d] 1899–1914.
[e] 1925–29.
[f] 1890–1914.
[g] Including construction. *Source*: Mitchell (1962, 1975).
[h] 1890–1900.
[i] 1921–31.
[j] *Source*: Mitchell (1975) and ISTAT, *100 anni di sviluppo economico e sociale dell'Italia 1861–1961* (1962). For the gold standard, hourly wages instead of annual earnings have been used.
[k] 1880–1914.

remarkably stable at about 5 per cent until 1950 and more than doubled in the post-Second World War period to about 12 per cent in 1979.

German export penetration in individual markets over 100 years is summarised in Table 1.19. Among the five countries considered in the table, German export penetration was highest in Russia during the gold standard and the interwar years. It returned again to high levels during the 1970s. During the gold standard and especially after the Second World War, German export penetration increased in all five markets considered in Table 1.19. In the former period, the increased export penetration was mostly a reflection of the increased competitiveness of German products (Table 1.18), and it was during this period that Germany became a major exporter of capital goods,

*Table 1.19* German export penetration in major industrial countries,[a] in selected years (in per cent), 1880–1979

| | *Russia* | *United States* | *United Kingdom* | *Italy* | *France* | *Total*[c] |
|---|---|---|---|---|---|---|
| 1880 | 13.7 | 6.1[b] | 5.2 | 5.6 | 7.0 | 7.4 |
| 1890 | 21.6 | 11.5 | 8.0 | 8.8 | 6.4 | 9.2 |
| 1900 | 24.1 | 12.1 | 8.1 | 9.5 | 7.2 | 9.7 |
| 1910 | 23.4 | 9.4 | 7.9 | 12.4 | 9.3 | 10.0 |
| 1925 | 20.1 | 3.4 | 3.5 | 9.7 | 5.5 | 4.6 |
| 1930 | 24.1 | 5.3 | 5.7 | 12.7 | 13.3 | 8.2 |
| 1937 | 23.6 | 2.6 | 3.4 | 17.0 | 7.3 | 5.1 |
| 1950 | 0.0 | 1.1 | 1.2 | 7.8 | 4.8 | 2.1 |
| 1960 | 3.8 | 6.1 | 4.0 | 14.4 | 15.9 | 7.5 |
| 1970 | 9.2 | 7.8 | 5.5 | 20.5 | 22.0 | 12.0 |
| 1979 | 14.1 | 5.6 | 9.9 | 17.2 | 20.4 | 11.7 |

[a] German exports of goods to each country over total imports of goods of country.
[b] 1882.
[c] German exports of goods to the five countries over sum of imports of five countries.
*Source*: Mitchell (1975) International Monetary Fund, *Direction of Trade* and *International Financial Statistics*, various issues, and US Department of Commerce (1979).

partly displacing United Kingdom products in world markets. Exports of higher technology products and capital goods of countries like the United States and Italy were at that time less important. Thus the fact that the export competitiveness of the United States and Italy did not worsen much with respect to Germany's competitiveness, did not constitute a major impediment for the gain in market shares by Germany. German exports of higher technology products defined as the sum of metal, engineering, mechanical and chemical products, increased during the gold standard from 28.9 per cent of German exports of finished products in 1880 to 50.2 per cent in 1910.

In the 1950s and 1960s most of the observed increase in German export penetration was a reflection of the abnormal circumstances of the early postwar period. Two additional factors can explain the continued good performance of German exports in the 1960s despite the worsening of relative unit labour costs. First, the alleged strong improvement in the quality of German products. Second, the price elasticity of demand of higher technology products and capital goods is generally thought to be 'relatively' small in the long run and even smaller in the short run. In the 1970s, there was a virtual halt in the

gain of market shares and a partial reversal of export penetration, particularly in the United States, France and Italy.[39]

The structure of German exports by commodity groups changed substantially in the course of the period under analysis. Agricultural exports which represented 22.4 per cent of total German exports of goods in 1880 fell to 10.2 per cent already in 1910 (Table 1.20). They declined further to 5.5 per cent in 1930 also because of changes in territory. During the Nazi period, agricultural exports declined even further to 1.2 per cent in 1938 in connection with the policy of autarky, but after the Second World War they returned slowly to 5 per cent in 1979. Exports of raw materials were 14.5 per cent of total exports of goods in 1880 and fluctuated around that level until 1930. After the Second World War, exports of raw materials declined drastically mostly in connection with the substitution of coal with oil in world industrial uses. The share of exports of manufactured goods experienced an upward trend until 1970 and showed a high positive correlation with the share of industrial output in total output (Figure 1.9). Within the category of manufactured products, exports of machinery showed a very marked upward trend during the whole period up to 1970 while exports of textiles showed a very strong downward trend.

Table 1.21 shows the structure of German imports of goods by major commodity groups. From 1880 to 1938, Germany was a major importer of raw materials and unfinished products, while the share of imports of finished products in total imports of goods showed a declining trend. This suggests a strategy of industrial growth of the import substitution type. After the Second World War, the share of agricultural products and of raw materials and unfinished products declined sharply with a corresponding increase in the share of finished products, suggesting an opening of the German domestic market to foreign producers and thus a deeper integration of Germany in the world economy. The share of imports of agricultural and food products in total imports fell drastically in the period after the Second World War. However, this fall did not prevent an increased integration of the German agricultural sector with the rest of the world, as the share of imports of agricultural products in final consumption of these products increased from 13.3 per cent in 1950 to 20.2 per cent in 1979. The ratio was 11.9 per cent in 1880 and 6.4 per cent in 1938.

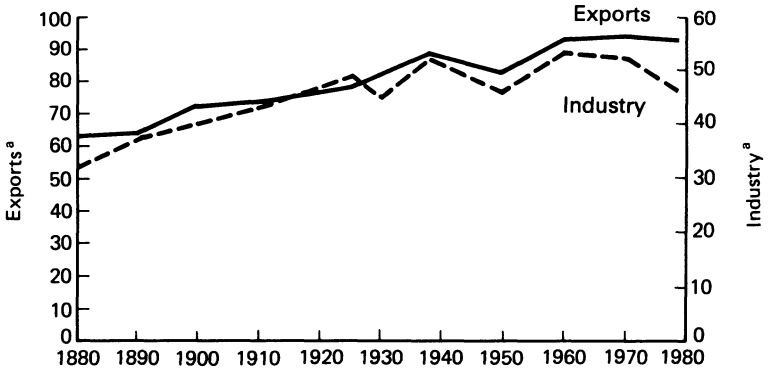
*Table 1.20* German exports of goods by major community groups[a] in selected years (in per cent of total exports of goods), 1880–1979.

| | *Agricultural products and food* | *Raw materials* | *Manufactured products[b]* *Total* | *of which: Machines & electrical equipment* | *textiles* |
|---|---|---|---|---|---|
| 1880 | 22.4 | 14.5 | 63.1 | 1.5 | 27.3 |
| 1890 | 14.2 | 16.0 | 69.9 | 2.3 | 25.4 |
| 1900 | 11.2 | 16.1 | 72.7 | 6.8 | 19.4 |
| 1910 | 10.2 | 15.8 | 74.0 | 10.8 | 15.4 |
| 1925 | 7.2 | 14.7 | 78.1 | 11.2 | 14.5 |
| 1930 | 5.5 | 12.9 | 81.7 | 16.1 | 12.3 |
| 1938 | 1.2 | 9.8 | 88.9 | 27.6 | 8.3 |
| 1950 | 2.3 | 14.7 | 83.0 | 23.2 | 4.9 |
| 1960[c] | 2.3 | 4.6 | 93.1 | 43.7 | 4.3 |
| 1970[c] | 3.5 | 2.6 | 93.9 | 46.5 | 5.6 |
| 1979[c] | 5.0 | 2.1 | 92.9 | 44.8 | 5.0 |

[a] Excluding precious metals.
[b] Finished and unfinished products, excluding food products.
[c] *Source*: Statistisches Bundesamt.

*Source*: Hoffmann (1965) and Statistisches Bundesamt, *Fachserie Aussenhandel*, various issues.

*Figure 1.9* Share of exports of manufactured goods in total exports of goods and share of industry in NNP in selected years, 1880–1979




[a] In per cent.

*Table 1.21* German imports of goods[a] by major commodity groups in selected years (in per cent of total imports), 1880–1979

| | *Agricultural products and food* | *Raw materials and unfinished products* | *Finished products* |
|---|---|---|---|
| 1880 | 33.0 | 48.7 | 18.3 |
| 1890 | 33.7 | 42.5 | 23.7 |
| 1900 | 30.6 | 48.6 | 20.8 |
| 1910 | 27.8 | 58.6 | 13.6 |
| 1925 | 42.3 | 48.0 | 9.8 |
| 1930 | 40.7 | 45.7 | 13.6 |
| 1938 | 39.6 | 51.7 | 7.9 |
| 1950 | 44.1 | 43.4 | 12.5 |
| 1960[b] | 26.6 | 40.9 | 32.5 |
| 1970[b] | 19.4 | 30.0 | 50.6 |
| 1979[b] | 13.9 | 32.2 | 53.9 |

[a] Excluding precious metals.
[b] *Source*: Statistisches Bundesamt, *Fachserie Aussenhandel.*
*Source*: Deutsche Bundesbank (1976), Hoffmann (1965), and Statistisches Bundesamt, *Fachserie Aussenhandel*, various issues.

## The international monetary system and the exchange rate regime

Germany experienced two long periods of fixed exchange rates which also coincided with periods of great prosperity in the country and abroad and with stable international relations: the gold standard period starting in about 1875 and ending at the beginning of the First World War, and the post-Second World War period until the breakdown of the Bretton Woods system in August 1971. The fixity of exchange rates was guaranteed in the first period by the convertibility of German banknotes into gold and hence by gold shipments by the private sector which kept the exchange rates betwen the so-called 'gold points'.[40] During the second period of fixed exchange rates the fixity was guaranteed by central bank interventions in the foreign exchange market according to the rules laid down at Bretton Woods in 1944. Exchange rates could fluctuate within a band of plus and minus 1.25 per cent from the central parity with the United States dollar. The central parity could be changed in case of 'fundamental disequilibrium' of the balance of payments. The central parity of the Deutschmark with respect to the United States dollar was changed in 1949 (devaluation of 20.7 per cent), in 1961 (appreciation of 5 per

cent) and in 1969 (appreciation of 9.3 per cent). Fixed exchange rates prevailed also from 1924 to 1931 when most large industrial countries attempted to return to the prewar gold standard parities. However, it is misleading to compare the international monetary system of this period with the prewar gold standard because of the lack of international monetary cooperation, low gold production, maldistribution of available gold reserves, the difficulties created by the German reparation payments and increasing protectionism among industrial countries particularly from 1930 onwards.

Flexible exchange rates prevailed in Germany during the hyperinflation period from 1919 to 1923 and after March 1973. Exchange rates were floating virtually without central bank interventions during the hyperinflation period,[41] while in the 1970s the value of the Deutschmark was influenced in the short run by interventions of the Bundesbank and by exchange rate agreements with members of the European Community (EC), although the latter did not exist on a continuous basis. The German interest in stabilising the Deutschmark *vis-à-vis* other European currencies in the 1970s was caused by the importance of these countries in Germany's foreign trade. In 1982, European countries accounted for about 67 per cent of total German exports of goods while EC countries accounted for about 48 per cent. A summary overview of the different exchange rate regimes is contained in Table 1.22.

The dollar price of the Mark/Reichsmark/Deutschmark deflated by the relative consumer price indices in the United States and Germany is shown in Figure 1.10. The figure shows that there is a long-run tendency of the exchange rate to fluctuate around the level predicted by the purchasing power parity theory. It also suggests that deviations from purchasing power parity were relatively narrow during the gold standard period compared to the large deviations which occurred thereafter. The major fluctuations of the real exchange rate occurred during the hyperinflation. The nominal exchange rate depreciated much more than was justified by the relative price differential in the period 1919 to 1922 and rebounded in 1923, when domestic inflation in Germany outpaced the depreciation of the nominal exchange rate, particularly in the last months of the hyperinflation period. In the period from 1919 to 1923, the very expansionary monetary policy exerted its impact first on the exchange rate and later on prices. The deviations of the real exchange rate from purchasing power parity during the gold standard and in the 1950s and 1960s are explained largely by real rather than monetary factors,

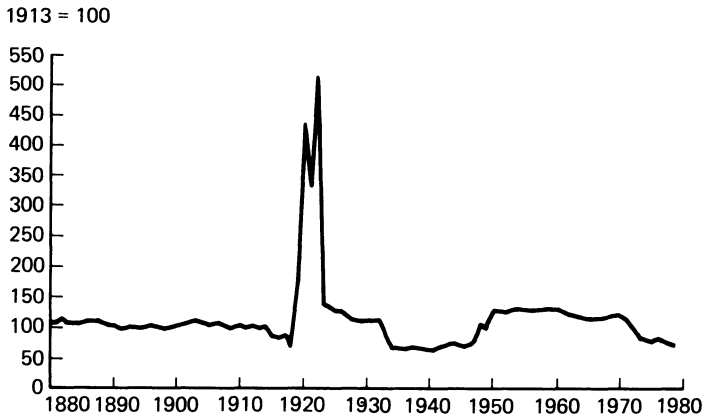
*Table 1.22* Overview of Germany's exchange rate regimes, 1875–1983

| | *Description of exchange rate regime* | *Convertibility of domestic into foreign currencies* |
|---|---|---|
| 1875–Aug. 1914 | fixed central parities with exchange rates fluctuating within narrow gold points | free |
| Aug. 1914–18 | controlled and changing exchange rates | restricted |
| 1919–Dec. 1923 | flexible exchange rates | free |
| Jan. 1924–Summer 1931 | fixed exchange rates | relatively free |
| Summer 1931–June 1948 | fixed and controlled exchange rates | heavily restricted |
| June 1948–Aug. 1971 | fixed, but adjustable exchange rates | free after 1958 |
| Dec. 1971–March 1973 | rates fixed according to Smithsonian agreement of December 1971 | free |
| March 1971–March 1979 | flexible exchange rate with the US dollar, with interventions by German monetary authorities | free |
| March 1979– | flexible exchange rate with the US dollar, fixed and adjustable central rates with EC currencies, excluding the pound (European Monetary System) | free |

mainly differential productivity growth.[42] During the 1950s and the 1960s the exchange rate was substantially undervalued in real terms. This undervaluation had probably significant effects on trade developments and economic growth in Germany. Starting from 1970 the exchange rate appreciated in real terms up to 1979. However, after 1979, the Deutschmark depreciated strongly in relation to the United States dollar, thus reversing the previous appreciation.

During the gold standard, gold and other metals (largely silver) were by far the most important items in the international reserves of the Reichsbank. Foreign currencies represented on average barely 5.4 per cent of her international reserves in the period 1880–89. The

*Figure 1.10* Real exchange rate[a], 1880–1979




[a] Marks per US dollar corrected by ratio of consumer price indices.

ratio grew to 18.4 per cent in the period 1910–13 as a result of the relative scarcity of gold, and exhibited a tendency to increase in the course of the century under analysis (Table 1.23). The secular increase was interrupted in the 1960s due to the large acquisition of gold by Germany up to 1965. On the contrary, in the 1970s foreign currency reserves expressed in dollars increased by a factor of about 9 from 1969 to 1973 and by a factor of almost 2 from 1973 to 1979, while the gold stock declined by almost 20 per cent (in volume).

## 1.4 THE GROWTH OF THE GOVERNMENT SECTOR

The long-run growth of government expenditure, excluding transfers has already been discussed in Section 1.2 with the major items of aggregate demand. Figure 1.7 and Table 1.24 show that the ratio of government expenditure on goods and services more than doubled in the course of the period. If transfers are included, government expenditure as a ratio to NNP increased by a factor of about 5. The effects of the growth in the size of government on the economy can be analysed from at least three points of view. First, the long-run effect of the rising trend of the ratio of government expenditure to NNP on investment, savings, the incentive to work and economic growth. Second, the consequences of large departures of the ratio from its trend persisting for several years, as it happened in the interwar

*Table 1.23* Foreign exchange of German Reich/Bundesbank as a proportion of total German international reserves (period averages), 1880–1979

| | |
|---|---|
| 1880–89 | 5.4 |
| 1890–99 | 2.9 |
| 1900–09 | 11.9 |
| 1910–13 | 18.4 |
| 1925–32 | 26.0 |
| 1933–38 | 32.3 |
| 1950–59 | 61.8 |
| 1960–69 | 33.9 |
| 1970–79 | 69.4[a] |

[a] With gold at national valuation.
*Source*: Deutsche Bundesbank (1976) and for the post-Second World War period, International Monetary Fund, *IFS*, various issues.

period and especially during the Nazi period. Large and sudden departures can be financed by taxation only with difficulty and hence they pose financing problems which have to be taken into account. Third, there is the question of whether it is better to keep year-to-year fluctuations of the ratio and of the budget deficits to a minimum, or whether fiscal policy should be used actively to try to stabilise economic activity. In addressing these questions it is important to keep in mind that the relevant measure of the size of government may not always be the same.

Concerning the first issue, economic theory does not provide conclusive answers and in addition the debate has very strong political and ideological connotations. The effects on economic growth of a rising trend in the size of the government depend significantly on the type of expenditures and taxation policies pursued and the distortions which ensue. The expenditures on goods and services can be for productive investment or current consumption. Transfers can be made to cover current deficits of non-viable state enterprises or to finance private investment in technology intensive sectors of the economy in which the country has already a comparative advantage or will gain a comparative advantage. Furthermore, current government expenditure can provide the population with services, which it values highly or services which have no value to it. How workers value public services can affect the savings ratio of households and the net wages demanded by the workers and hence economic growth and employment in the private sector.

*Table 1.24* Ratio of government expenditure to NNP in selected years (in per cent), 1881–1979

| | *Total government expenditure*[a] | *Government expenditure, national accounts definition*[b] |
|---|---|---|
| 1881 | 10.5 | 7.3 |
| 1891 | 13.6 | 7.6 |
| 1901 | 15.3 | 8.4 |
| 1907 | 16.6 | 8.7 |
| 1913 | 18.5 | 9.8 |
| 1925 | 23.4 | 12.4 |
| 1930 | 34.1 | 13.5 |
| 1938 | 37.9 | 27.9 |
| 1950 | 37.5 | 17.4 |
| 1960 | 35.2[c] | 15.5 |
| 1970 | 43.0[c] | 14.7 |
| 1979 | 53.6[c] | 16.3 |

[a] Central, state and local government, including transfers; ratio calculated on figures in current prices.
[b] Ratio calculated on figures in 1913 prices.
[c] *Source*: OECD, *Historical Statistics, 1960–81* (1983).
*Sources*: Andic and Veverka (1964), Statistisches Bundesamt, *Statistisches Jahrbuch für die Bundesrepublik Deutschland*, various issues and OECD, *Historical Statistics, 1960–81* (1983).

If workers value highly the services provided by the government, they will substitute them for private consumption and increase their savings out of a given disposable income. Furthermore, they will accept a reduction or less growth of their net-of-tax wage rate when the size of government grows. But if they value government expenditure lowly, they will demand higher net-of-tax real wages to compensate for the higher rate of taxation, including the inflation tax and indirect taxes. Thus, as the wedge between net wages and labour costs to firms goes up, real labour costs increase and private employment goes down, and the rate of growth of the economy is adversely affected. In addition, higher labour costs are likely to reduce profits and hence the rate of investment of the private sector.

Government expenditure on education and investment was 4.4 per cent of NNP in 1880 and grew to only 10 per cent in 1979. Table 1.25 shows the behaviour of public expenditure on education as a proxy for public investment in human capital and of public investment from 1880 to 1979. Expenditures on education grew from 1.7 per cent of

*Table 1.25* Public expenditure on education and public investment in selected years (as per cent of nominal NNP), 1880–1979

| | *Expenditure on education* *(1)* | *Public investment*[a] *(2)* | *Total* *(1)+(2)* |
|---|---|---|---|
| 1880 | 1.7 | 2.7 | 4.4 |
| 1890 | 1.6 | 2.0 | 3.6 |
| 1900 | 2.0 | 2.5 | 4.5 |
| 1910 | 2.4 | 2.7 | 5.1 |
| 1925 | 3.0 | 1.7 | 4.7 |
| 1930 | 3.7 | 2.0 | 5.7 |
| 1937 | 2.6 | 3.1 | 5.7 |
| 1950 | 2.3 | 2.3 | 4.6 |
| 1960 | 2.8 | 3.4 | 6.2 |
| 1970 | 4.6 | 4.8 | 9.4 |
| 1979 | 6.1 | 3.9 | 10.0 |

[a] From 1880 to 1937 includes public investment in buildings, railways and public works (source: Hoffmann (1965)). From 1950 to 1979, investment in new buildings and equipment, national accounts statistics (source: Statistisches Bundesamt).

*Source*: Hoffmann (1965), p. 260, and Statistisches Bundesamt, *Statistisches Jahrbuch für die Bundesrepublik Deutschland*, various issues.

NNP in 1880 to 3.7 per cent in 1930; they fell to 2.3 per cent in 1950 and reached 6.1 per cent in 1979. Public investment which was 2.7 per cent of NNP in 1880 did not show a clear rising trend during the gold standard, but increased substantially from 1930 to 1937, and then again from 1950 to 1970. Over the century, it seems on the basis of Table 1.25 that the government followed an active investment policy particularly in the 1950s and 1960s.

Turning to the composition of government expenditure by function, Table 1.26 indicates that expenditures for administration showed a clear declining trend from 1880 to 1930. Expenditures for defence declined slightly during the gold standard from 33.1 per cent in 1881 to 24.2 per cent in 1911; they were much lower in the 1920s, but increased to 42.7 per cent in 1938, as a result of the German rearmament. In the post-Second World War period, they showed a declining trend, as during the gold standard, but they were by then a much smaller fraction of the total. Social services were a minor item of the budget in 1881 (0.8 per cent), and increased to 22.6 per cent in 1911. In 1930, expenditures on social services represented already 63.5 per cent of total government expenditures. They increased again

*Table 1.26* Nominal government[a] expenditure by function in selected years (in per cent of total nominal expenditures), 1881–1978

| | *Administration*[b] | *Defence*[c] | *Social services* | *Debt service* | *Other*[d] |
|---|---|---|---|---|---|
| 1881 | 40.6 | 33.1 | 0.8 | 0.5 | 25.0 |
| 1891 | 29.1 | 28.6 | 13.3 | 4.7 | 24.3 |
| 1906 | 26.9 | 24.9 | 21.4 | 6.1 | 20.7 |
| 1910 | 25.5 | 24.2 | 22.6 | 6.0 | 21.7 |
| 1925 | 17.2 | 14.7 | 57.0 | 0.6 | 10.5 |
| 1930 | 13.0 | 11.7 | 63.5 | 2.3 | 9.5 |
| 1938 | — | 42.7 | — | — | — |
| 1950 | 11.3[e] | 16.7 | 59.5 | 1.9 | 11.4 |
| 1961 | 13.9[e] | 13.8 | 55.8 | 2.7 | 13.8 |
| 1970 | 18.1[e] | 10.1 | 52.0 | 3.5 | 16.3 |
| 1978 | 14.4[e] | 6.0 | 68.6 | 3.6 | 7.4 |

[a] Before 1913 figures refer to central government and state expenditures. After 1913, local authorities expenditures are included.
[b] Including law and order.
[c] Including reparations and war damage compensations.
[d] Economic and environmental services.
[e] Includes education and research.
*Source*: Andic and Veverka (1964), and Statistisches Bundesamt, *Statistisches Jahrbuch für die Bundesrepublik Deutschland* (1977 and 1981).

from 52.0 per cent in 1970 to 68.6 per cent in 1978. Thus social services were mostly responsible for the large increase in the size of the government sector in the 1920s and in the 1970s. During the gold standard, there was a rapid process of urbanisation of the population which required government intervention and there was also the need to supply the basic social security which the new ideologies required. In the 1920s the government had to support the people whose lives had been damaged by the war and the families of war casualties.

The weight of the debt service in total expenditures followed to some degree the behaviour of total government debt (cf. Table 1.30). The importance of the debt service reached the highest levels in the years immediately before the First World War, when the share of total government debt to NNP exceeded 50 per cent. In 1925, after the destruction of the real value of the debt during the period of hyperinflation, the weight of the debt service in total expenditures was 0.6 per cent and grew to 2.3 per cent in 1930, after local authorities had borrowed heavily also in foreign capital markets. After the Second World War the weight grew from 1.9 per cent in

1950 to 3.6 in 1978 as the share of the total government debt rose from 22.9 per cent of NNP to 33.4 per cent.

Taxation affects economic growth first through the tax wedge as discussed previously. Second it has effects on the allocation of resources, and on consumption, savings and investment. Income taxes may on the one hand be shifted forward onto higher labour costs more than indirect taxes, on the other hand they represent a double taxation of saving.

On the revenue side statistics are available only for tax revenues of the central government on a more or less homogenous basis for the whole period, and the analysis will therefore be limited to the tax revenues of the central government. The Reich was a minor tax collector and spender in relation to the states and local governments up to about the First World War. This was the result of the highly federalist structure of the German state, as set up upon unification in 1870. The Reich accounted for 29.3 per cent of total government expenditures in 1881 and 34.9 per cent in 1907. Tax revenues of the Reich were only 1.7 per cent of NNP in 1880 and 3.2 per cent in 1910 (Table 1.27). In addition to accounting for less than one-third of total government expenditure, the Reich was not allowed to collect income taxes until after the reforms introduced during the First World War and in the 1920s. As a result of the above tax reforms, the Reich's tax revenues increased to 22.6 per cent of NNP in 1920. However NNP was much below the full employment level in that year and an attempt was made to balance the budget in the presence of a high level of expenditures. By 1930, therefore, the ratio of tax revenues of the Reich to NNP was only 12.5 per cent. The increase in government expenditures during the Nazi period, the further centralisation of the German state and the Second World War caused the ratio to return in 1940 to about the level of 1920. The period after the Second World War showed an increasing trend of the ratio, particularly in the 1970s. Custom duties were over 50 per cent of total tax revenues of the Reich during the gold standard and became a negligible item thereafter. The second most important item during the gold standard was the tax on consumption (around 40 per cent of total tax revenues). The income tax of the Reich was first introduced in 1917 and by 1930 it became the most important source of revenue.

The second issue, concerning the consequences of large departures of the ratio of government expenditure to NNP from trend, arises particularly in connection with the period 1934–39 and the two world wars. Table 1.28 shows the ratio of government expenditure on goods

*Table 1.27* Total tax revenues of the Central government[a] in selected years (calendar years), 1872–1979

| | *Total tax revenues as per cent of NNP* | *Custom* | *Tax on exchanges* | *Tax on consumption* | *Income tax* | *Property tax* | *Other* |
|---|---|---|---|---|---|---|---|
| | | *as per cent of total tax revenues* | | | | | |
| 1872 | 1.0 | 55.8 | 2.9 | 41.3 | — | — | — |
| 1880 | 1.7 | 55.6 | 2.6 | 41.8 | — | — | — |
| 1890 | 2.8 | 55.8 | 5.4 | 38.8 | — | — | — |
| 1900 | 2.7 | 52.4 | 9.0 | 38.6 | — | — | — |
| 1910 | 3.2 | 43.7 | 17.1 | 39.2 | — | — | — |
| 1920 | 22.6 | 2.7 | 47.9 | 7.1 | 22.5[b] | 19.1[c] | — |
| 1930 | 12.5 | 12.1 | 20.7 | 21.9 | 35.7 | 9.6 | — |
| 1940 | 23.1 | 7.2 | 20.1 | 15.7 | 48.7 | 3.4 | 4.9 |
| 1950 | 17.6 | 4.2 | 32.7 | 24.5 | 38.6 | — | — |
| 1960 | 18.9 | 5.3 | 32.0 | 15.9 | 46.8 | — | — |
| 1970 | 20.7 | 2.3 | 31.7 | 17.3 | 48.7 | — | — |
| 1979 | 26.8 | 1.4 | 29.8 | 13.2 | 55.6 | — | — |

[a] Excluding capital receipts.
[b] First introduced in 1917.
[c] First introduced in 1916; after the Second World War receipts accrue to Länder.
*Source*: Caasen (1953) and Mitchell (1975).

and services for major subperiods, including estimates for the wars. The behaviour of government expenditures, during these periods, introduced very large disturbances into the German economy which were made even more severe by the methods chosen to finance them, relying mainly on creation of money and sales of bonds. The large increase in government debt which they entailed would have put a tremendous burden on public finances for many years if these episodes of expansionary fiscal policy had not culminated in the hyperinflation of 1923 and the monetary reform of 1948. The real value of the debt was simply wiped out with losses being imposed on those who had bought government bonds or held monetary assets.

On the active use of fiscal policy as a means to stabilise output in the short run, it seems that during the gold standard and in the postwar period, the behaviour of the government was not very different. In both periods, year-to-year fluctuations of the share of government expenditure on goods and services to NNP were very limited. The standard deviation of the share of government expendi-

*Table 1.28* Average ratio of government expenditure[a] to NNP during major subperiods and standard deviation, 1880–1979

| | *Average ratio* | *Standard deviation* |
|---|---|---|
| 1880–1913 | 7.8 | 0.8 |
| 1921–39 | 18.7 | 8.1 |
| 1950–79 | 16.0 | 0.9 |
| *War periods:*[b] | | |
| 1914–18 | (57.2) | (22.3) |
| 1940–44 | (83.4) | (11.9) |
| 1924–29 | 12.8 | 0.7 |
| 1930–33 | 14.8 | 1.0 |
| 1934–39 | 27.6 | 7.6 |

[a] National accounts definition.
[b] The ratios for the war periods have to be considered as very rough estimates, due to the difficulties of reconstructing the national accounts.

ture in NNP was 0.8 during the gold standard and 0.9 in the postwar period (Table 1.28). Similarly, the ratio of the budget deficits of the central government to NNP fluctuated between narrow margins in both periods. The standard deviation of this ratio was 0.7 during the gold standard and 1.2 in the post war period (Table 1.29 on page 61). On the other hand, the standard deviations of the ratio of the deficit and of government expenditure to NNP were high during the Nazi period.

If one considers the major subperiods, the budget of the central government was on average always in deficit (Table 1.29). During the gold standard, it was in deficit in every single year, with a minimum of 0.7 per cent of NNP in 1884 and a maximum of 3.4 per cent in 1913. The average deficit from 1880 to 1913 was 1.9 per cent and there was a clear upward trend during the period, the deficit averaging 1.1 per cent during the 1880s, 1.6 per cent during the 1890s and 2.6 per cent from 1900 to 1909. During the post-Second World War period, the average deficit was 1.1 per cent of NNP with surpluses recorded in the years 1954 to 1956 and 1969, while the largest deficits occurred in 1953 and in 1975. The deficit averaged 0.9 per cent in the 1950's, 0.7 per cent in the 1960s and 1.5 per cent in the 1970s. However, there was a marked difference between the first half and the second half of the latter decade: the deficit averaged 0.5 per cent from 1970 to 1974 and 2.6 per cent from 1975 to 1979.

The effects of deficit spending on the debt of the central govern-

*Table 1.29* Average central government surplus as per cent of NNP by major periods, 1880–1979

| | *Average surplus* | *Standard deviation* |
|---|---|---|
| 1880–1913 | −1.9 | 0.7 |
| 1925–28 | −1.5 | 0.8 |
| 1929–33 | −4.9 | 0.8 |
| 1934–38 | −7.3 | 2.3 |
| 1950–79[a] | −1.1 | 1.2 |

[a] *Source*: International Monetary Fund, IFS.
*Source*: Andic and Veverka (1964), Caasen (1953) and International Monetary Fund, *IFS*, various issues.

ment are shown in Table 1.30. The ratio of the debt of the central government to NNP increased from 1.8 per cent in 1881 to 10.3 per cent in 1908. In 1938, after several years of substantial deficit spending, it reached 19.5 per cent. This figure underestimates the debt of the Reich, however, because of hidden means to finance the deficit used by the German government during this period. The ratio stayed at around 8 per cent from 1950 to 1970, but increased to 16.3 per cent in 1979 owing to the larger deficits and the slowdown in the growth of NNP.

The share of total government debt, which includes the debt of state and local governments, is reported in the first column of Table 1.30. The comparison with the second column shows the secular increase in the importance of the central government within the German public sector. The indebtedness of the whole government sector was much larger during the gold standard than after the Second World War. Despite large increases in the 1970s, the ratio of the total government debt to NNP in 1979 was below the level of 1881. The dynamics of this ratio suggests that the periods during which the overall public sector must have had high deficits were the 1880s, the last years of the 1920s and the 1970s. Thus state and local governments were big deficit spenders in the first two periods at a time when the Reich was relatively more restrained, while in the 1970s the government was a big deficit spender at all levels.

It is difficult to understand the effects of the increase of government expenditure, the deficit and the debt on growth only on the basis of the previous analysis. The hypothesis that higher ratios of government spending to aggregate income should be associated with higher

*Table 1.30* Government debt as per cent of NNP in selected years[a], 1881–1979

| | *Total government debt* | *Debt of central government* |
|---|---|---|
| 1881 | 36.5 | 1.8 |
| 1891 | 53.0 | 5.8 |
| 1901 | 51.9 | 7.9 |
| 1908 | 54.1 | 10.3 |
| 1928 | 17.4 | 8.5 |
| 1930 | 29.7 | 13.4 |
| 1938 | 30.9 | 19.5 |
| 1950 | 22.9 | 7.9 |
| 1960 | 18.9 | 8.3 |
| 1970 | 20.6 | 8.1 |
| 1979 | 33.4 | 16.3 |

[a] From 1881 to 1938 the debt refers to the end of March, afterwards to the end of December.
*Source*: Deutsche Bundesbank (1976).

rates of economic growth is tested empirically in the appendix to this chapter by regressing five-year arithmetic average growth rates of real NNP per capita on a number of variables including the ratio of government expenditures to NNP. No support was found in the data for the hypothesis that government spending is associated with higher growth rates. However, the evidence presented so far in this chapter as well as the wage demands of German workers in the 1970s could indicate that in the 1970s the general attitude towards paying for increased government expenditure has changed with respect to previous decades.[43] If this hypothesis is correct, the growth of the ratio of government expenditure to NNP could have affected the average growth rate of real NNP per capita negatively in the 1970s and the early 1980s. The channels through which this could have occurred have been described above in this section. The estimates indicate instead that the ratio of government debt to NNP had a significant negative effect on economic growth in the medium term because of financial crowding out.

*Table 1.31* Notes issued by the Reichsbank in selected years, 1876–1944

| | *In proportion to total currency in circulation*[a] | *In proportion to total notes in circulation*[b] |
|---|---|---|
| 1876 | 24.4 | 69.0 |
| 1880 | 27.4 | 72.3 |
| 1890 | 36.0 | 79.1 |
| 1900 | 33.8 | 82.9 |
| 1910 | 34.3 | 90.9 |
| 1913 | 39.3 | 89.7 |
| 1918 | 67.0 | 67.4 |
| 1922 | 98.9 | 98.9 |
| 1924 | 45.4 | 49.9 |
| 1929 | 73.9 | 89.7 |
| 1932 | 62.8 | 85.6 |
| 1939 | 81.3 | 92.5 |
| 1944 | 94.3 | 97.8 |

[a] Currency includes gold during the gold standard period.
[b] Including Reichskassenscheine, Darlehenkassenscheine and Rentenbankscheine.
*Source*: Deutsche Bundesbank (1976), p. 14.

## 1.5 FINANCIAL POLICY AND INFLATION

### The supply of money and the development of the banking system

The analysis of German monetary developments for the period up to the second monetary reform of 1948 is complicated by the fact that the Reichsbank, which started operations in 1876, was not the only bank of issue. In addition, the weight of the Reichsbank as measured by the proportion of notes issued by it, changed substantially during this period, as shown in Table 1.31. The ratio of notes issued by the Reichsbank to the currency in circulation was 24.4 per cent in 1876 and it increased to 39.3 in 1913. A major concentration of note issues at the Reichsbank occurred during the First World War and during the hyperinflation period. At the end of 1922, 98.9 per cent of currency outstanding was issued by the Reichsbank. This process of concentration was abruptly reversed in the immediate post-hyperinflation period, when the ratio fell to 45.4 per cent in 1924, but resumed in the remaining part of the 1920s and in the 1930s.

*Table 1.32* Composition of assets of the central bank in selected years[a] 1880–1979

| | *IR* | *MF* | *A* | *(MF/GD). 100* |
|---|---|---|---|---|
| 1880 | 27.5 | 7.7 | 64.8 | 19.8 |
| 1890 | 36.7 | 4.1 | 59.2 | 4.1 |
| 1900 | 30.1 | 5.3 | 64.6 | 4.1 |
| 1910 | 32.1 | 7.4 | 60.5 | 4.3 |
| 1913 | 40.2 | 13.1 | 46.7 | 8.7 |
| 1925 | 49.3 | 8.0 | 42.7 | 5.1 |
| 1930 | 50.3 | 5.4 | 44.3 | 2.8 |
| 1939 | 5.7 | 29.2 | 65.1 | 8.4 |
| 1950 | 6.5 | 59.1 | 34.4 | 68.8 |
| 1960 | 74.9 | 20.5 | 4.6 | 39.4 |
| 1970 | 63.6 | 14.0 | 22.4 | 23.9 |
| 1979 | 69.1 | 7.5 | 23.4 | 5.7 |

[a] As per cent of sum of *IR*, *MF* and *A*.

*Legend*: *IR* = international reserves; gold, and foreign currency holdings, excluding other metals
*MF* = monetary financing of the government
*A* = central bank advances to banks and private sector
*GD* = stock of central government debt.

*Source*: Deutsche Bundesbank (1976) and *Monatsberichte*, various issues (see also Appendix 1 and 2).

The composition of the assets of the Central Bank in selected years is given in table 1.32. During the gold standard period up to the last years before the war, no clear-cut trend is discernible in the share of the three sources of creation of the Reichsbank's monetary base. The Reichsbank kept the share of international reserves in its portfolio relatively stable,[44] because it had to keep at all times at least one third of its note issues in legal tender German coins,[45] in notes of the Reich's Treasury or in gold (the so-called Dritteldeckung). In fact, it held much higher reserves than legally required. For instance, at the end of 1880, gold reserves alone were 23.8 per cent of banknotes issued by the Reichsbank. They were 53.3 per cent at the end of 1891, 35.5 at the end of 1900 and 31.9 per cent at the end of 1910.[46] The Reichsbank probably considered its other short-term liabilities, mainly deposits of banks and of the private non-banking sector, as equivalent to note issues and it felt the need to keep reserves also against them.

According to the monetary approach to the balance of payments, under fixed exchange rates, if the central bank of a country wants to

keep the share of international reserves in its portfolio constant, it should not increase the share of its domestic assets. Otherwise the banknotes created in excess of the needs of trade will sooner or later lead to a gold outflow from the country via a deficit in the balance of payments, because domestic prices are not allowed to deviate in the long run from foreign prices by the fixed exchange rate constraint, unless productivity is assumed to grow at differential rates in the traded and non-traded goods sectors. Under the gold standard, the reduction of the gold in the portfolio of the central bank could have been somewhat retarded by the fact that gold coins held by the public could be initially used to pay for the excess of payments to foreigners over receipts, but sooner or later also the gold stock of the central bank would have been affected. The monetary approach thus provides an explanation of why legal requirements, or the desire of keeping the ratio of international reserves to assets from rising or falling in the long run implied keeping the ratio of domestic assets to total assets also relatively stable.

The long-run stability of the ratio of domestic assets in the portfolio of the Reichsbank during the gold standard was favoured by the relatively low levels of the government budget deficits and by a level of interest rates which was high enough to finance a large fraction of the government deficits outside the Reichsbank. The last column of Table 1.32 and Table 1.33 contain the ratio of monetary financing by the Reichsbank to central government debt. In the 1880s this ratio fell rapidly despite the large increase in the debt and it remained at very low levels until the outbreak of the First World War. In the period between 1934 and the outbreak of the Second World War, the large increase in the government budget deficits and their monetary financing by the Reichsbank contributed to an increase in the claims of the Reichsbank on the government both as a proportion of central government debt and of the assets of the Reichsbank.

In the post-Second World War period, some clear trends in the share of the various assets in the portfolio of the central bank are discernible: modest budget deficits in the presence of a high rate of real economic growth enabled the German central bank to reduce drastically the ratio of its claims on the government to its total assets from 59.1 per cent in 1950 to 7.5 per cent in 1979. As a result, Germany accumulated international reserves by means of surpluses in the balance of payments, as predicted by the monetary approach. The ratio of international reserves in the portfolio of the German central bank increased from 6.5 per cent in 1950 to 63.6 per cent in

*Table 1.33* Monetary financing of the government in percent of central government debt by major sub-periods[a], 1880–1979

| | |
|---|---|
| 1880–89 | 11.5 |
| 1890–99 | 1.9 |
| 1900–09 | 6.1 |
| 1910–13 | 4.8 |
| 1914–18 | 21.4 |
| 1919–23 | 31.6 |
| 1924–29 | 4.9 |
| 1930–33 | 3.6 |
| 1934–39 | 5.1 |
| 1940–45 | 17.2 |
| 1950–59 | 51.4 |
| 1960–69 | 37.6 |
| 1970–79 | 13.5 |
| 1880–1913 | 6.3 |
| 1914–23 | 26.5 |
| 1924–39 | 4.7 |
| 1940–45 | 17.2 |
| 1950–79 | 34.2 |

[a] The numerator refers to the end of the year, while the denominator refers to the end of March of the succeeding year until 1945.
*Source*: Deutsche Bundesbank (1975) and *Monatsberichte*, various issues.

1970. In the 1970s the revaluation of the stock of gold played a major role in the further increase in the ratio of international reserves to assets and the prediction of the monetary approach are complicated by these changes and by the changes in the exchange rate. Also as a ratio to central government debt the central bank's claims on the government fell drastically in the post-Second World War period.

More insights into the financing of government budget deficits by the Reichsbank/Bundesbank can be obtained from Table 1.34. The comparison of the first two columns of the table shows that claims of the Reichsbank on the government grew more than central bank notes only during the wars and during the great depression. During the wars, large public sector deficits put a heavy constraint on the behaviour of the central bank, while in 1932 and 1933 the Reichbank tried to counteract the effect of the restrictive fiscal policy pursued by the government by monetising more of the latter's debt. In those two years its claims on the government increased both as a ratio to the central government debt and in absolute value, while in 1930 and 1931 they were falling both in absolute and relative terms. The claims

*Table 1.34* Rates of growth of claims of the central bank on the government and of notes in circulation[a] by major subperiods, 1880–1979

| | *Claims of central bank on government* | *Notes in circulation issued by central bank* | *Total currency in circulation outside banks* |
|---|---|---|---|
| 1880–89 | –3.4 | 4.1 | 0.5 |
| 1890–99 | –2.0 | 2.3 | 3.0 |
| 1900–12 | 1.6 | 4.8 | 3.7 |
| 1913–18 | 85.6 | 42.9 | 33.5 |
| 1919–22 | 110.0 | 119.3 | 110.6 |
| 1924–28 | –0.2 | 23.3 | 10.8 |
| 1929–33 | 11.9 | –8.1 | –2.8 |
| 1934–38 | 6.8 | 18.6 | 13.5 |
| 1939–44 | 54.9 | 28.9 | 25.9[c] |
| 1950–59 | –0.7 | 9.7[b] | 9.7 |
| 1960–69 | 3.4 | 5.7[b] | 5.7 |
| 1970–79 | –0.3 | 8.6[b] | 8.6 |
| 1880–1912 | 2.2 | 3.6 | 2.4 |
| 1950–79 | 0.6 | 7.9[b] | 7.9 |

[a] Average geometric growth rates.
[b] Total currency in circulation outside banks.
[c] Total currency in circulation.
*Source*: Deutsche Bundesbank (1976) and *Monatsberichte*, various issues.

on the government grew less than notes issued, even from 1934 to 1938, despite the large budget deficits, but the figures are probably distorted by the fact that a substantial part of government expenditure was financed by commercial banks who were buying certificates issued by agencies which were formally outside the government sector but were actually operating on behalf of it. In addition, the Reich was issuing coupons which could be used by firms to pay taxes at some future date.

During the hyperinflation period, claims on the government grew also less than central bank notes. This resulted particularly from the developments of 1922, when the central government budget deficit shrinked to 6.2 per cent of NNP and no major pressure on financial markets originated from the public sector. Instead, the policy of low nominal interest rates in the face of accelerating inflation stimulated a huge demand for central bank loans by the private sector.[47]

The standard deviation of the growth rate of the sum of the assets

*Table 1.35* Standard deviation of the growth rate of the total assets of the central bank by major subperiods[a], 1880–1979

| | *Standard deviation* | *Average arithmetic growth rate* |
|---|---|---|
| 1880–1913 | 6.2 | 4.7 |
| 1925–38 | 12.7 | 6.9 |
| 1950–79 | 4.6 | 8.3 |

[a] The assets have been defined as in Table 1.32.

of the central bank as defined in Table 1.32 was calculated for the major subperiods (Table 1.35). It was 6.2 during the gold standard, 4.6 in the post-Second World War period and 12.7 in the period 1925–38. Thus monetary authorities were stabilising the rate of growth of the sum of their assets more during the post-Second World War period than during the gold standard. However, there were significant differences during the gold standard period. The variability of the rate of growth of the sum of assets was much higher in the early gold standard period than in the last decade and a half before the First World War: the standard deviation was 8.1 from 1880 to 1897 and only 2.1 from 1898 to 1913. In the interwar period, even excluding the hyperinflation episode, the variability of monetary policy was substantially higher, but the difference with the other two periods is less striking than for the fiscal variables considered in the previous section (cf. Tables 1.28 and 1.29).

The rates of growth of 'narrow' money by major subperiods are reported in Table 1.36 along with those of its determinants: the rate of growth of the sum of central bank assets and the rate of growth of the monetary base multiplier. The last column reports the rate of change of the ratio of currency in circulation outside banks to demand deposits which is in turn a determinant of the multiplier. Narrow money grew at moderate rates during the gold standard accelerating from 1.9 per cent on average in the period 1883–89 to 3.7 per cent in the 1880s and 5.7 per cent in the period 1900–13.[48] In the interwar period a much higher instability in the growth of monetary aggregates is observed. Excluding the hyperinflation period, narrow money grew on average by 8.8 per cent from 1925 to 1928 and fell by 7.8 per cent during the great depression (1929–33). From 1934 to 1938 there was an acceleration to an average growth rate of 11.4 per cent. During the post-Second World War period the average growth

*Table 1.36* Money supply and its determinants (average geometric growth rates during major subperiods), 1883–1979

| | *M1* | *B* | *m* | *cd* |
|---|---|---|---|---|
| 1883–89 | 1.9 | 8.1 | –6.2 | –6.3 |
| 1890–99 | 3.7 | 3.4 | 0.3 | –2.8 |
| 1900–13 | 5.7 | 4.4 | 1.3 | –6.6 |
| 1925–28 | 8.8 | 10.9 | –2.1 | –1.6 |
| 1929–33 | –7.8 | –7.1 | –0.7 | 6.9 |
| 1934–38 | 11.4 | 15.0 | –3.6 | 3.1 |
| 1950–59 | 11.8 | 8.6 | 3.2 | –3.5 |
| 1960–69 | 9.3 | 3.8 | 5.5 | –5.2 |
| 1970–79 | 9.9 | 6.7 | 3.2 | –1.7 |
| 1883–1913 | 4.1 | 4.6 | –0.5 | –5.5 |
| 1925–38 | 3.8 | 6.0 | –2.2 | 2.1 |
| 1950–79 | 10.2 | 7.7 | 2.5 | –3.4 |

*Legend*: *M1* = currency in circulation excluding notes and coins held by commercial banks plus demand deposits at commercial banks
*B* = sum of *IR*, *A* and *MF* from Table 1.32, central bank only
*m* = *M1* divided by *B*
*cd* = ratio of currency to demand deposits.
*Source*: Deutsche Bundesbank (1976) and International Monetary Fund, *IFS*, various issues.

rate of narrow money was substantially higher than during the gold standard, averaging 10.2 per cent.

Narrow money has generally grown less rapidly than total assets of the central bank in periods characterised by lower economic and political stability, because of the shift in the public's preferences towards currency. Thus in each of the interwar periods considered in the table, narrow money grew less or fell more than the sum of the assets of the central bank. This occurred also but for another reason from 1880 to 1889, when gold in circulation, which is included in narrow money, fell by 25.2 per cent and gold holdings of the Reichsbank more than doubled.

During the great depression assets of the central bank fell substantially and the monetary base multiplier changed relatively little, despite the large increase in the currency/deposit ratio of the public. Commercial banks accepted a drop in the reserve/deposit ratio and thereby managed to keep the fall in the narrow money within reasonable proportions. In the United States instead the monetary base did

*Table 1.37* Development of bank intermediation (in per cent), 1883–1979

| | *BU/M2* | *DD/M2* | *TD/M2* | *M1/M2* |
|---|---|---|---|---|
| 1883 | 42.6 | 7.0 | 50.4 | 49.6 |
| 1890 | 32.5 | 8.1 | 59.4 | 40.6 |
| 1900 | 27.0 | 9.9 | 63.1 | 36.9 |
| 1910 | 20.5 | 14.7 | 64.8 | 35.2 |
| 1913 | 19.1 | 16.4 | 64.5 | 35.5 |
| 1925 | 22.9 | 61.2 | 15.9 | 84.1 |
| 1930 | 14.6 | 40.4 | 45.0 | 55.0 |
| 1938 | 17.6 | 35.9 | 46.5 | 53.5 |
| 1950 | 34.9 | 47.0 | 18.1 | 81.9 |
| 1960 | 18.1 | 33.6 | 48.3 | 51.7 |
| 1970 | 9.9 | 31.0 | 59.1 | 40.9 |
| 1979 | 8.5 | 30.9 | 60.6 | 39.4 |

*Legend:* *BU* = total currency in circulation excluding notes and coins held by commercial banks
*DD* = demand deposits at commercial banks
*TD* = time and saving deposits at commercial banks
*M2* = *BU* + *DD* + *TD*.
*Source*: Deutsche Bundesbank (1976) and International Monetary Fund, *IFS*, various issues.

not fall during the great depression.[49] This fact is often cited by the opponents of the theory that monetary factors were a major cause of the worsening of economic conditions after 1929. If the monetary base increased, so the argument goes, how could monetary factors be a major cause of the great depression? However, what really matters to be able to judge whether monetary developments were important or not is the supply of money and not the monetary base. In the United States the multiplier fell sharply as banks aggravated the effect of the increase in the public's currency-deposit ratio on money by increasing precautionary reserves, especially after mid-1930.[50]

The secular shift of the public's preferences towards bank deposits away from currency was interrupted in the course of the century only during wars, the great depression and the Nazi regime. A synthesis of the shift in the public's preference towards bank deposits and of the growth of banks as financial intermediaries is given in Table 1.37, where the ratio of currency, of demand deposit and of time and savings deposits to broad money (M2) is reported. While in 1883 currency was 42.6 per cent of broad money, in 1979 it was only 8.5 per cent. The fall in this ratio gives an idea of the increased role of

banks as financial intermediaries in Germany. The process of growth of bank intermediation came to a halt from 1913 to 1925 as a result of the disturbances which intervened during the period. It experienced another setback from 1930 to 1938 and particularly from 1938 to 1950, when the ratio of currency to broad money almost doubled from 17.6 to 34.9 per cent as a result of the uncertainties caused by the war. The two world wars and the hyperinflation period greatly reduced the holdings of time and savings deposits, which fell from 64.5 per cent of broad money in 1913 to 15.9 per cent in 1925, and from 46.5 per cent in 1938 to 18.1 per cent in 1950. The last column of Table 1.37, which reports the ratio of narrow money to 'broad' money, shows more clearly that in periods of uncertainty the public chooses to hold its monetary assets in more liquid forms, while during periods of greater economic stability the public moves in the opposite direction.

**The demand for money and inflation**

Table 1.38 summarises the long-run development of the ratio of various monetary aggregates to NNP, i.e. the reciprocal of velocity of money with respect to income. The table shows that currency holdings fell during the hundred years from an average of 15.9 per cent of NNP in the period 1883–89 to an average of 9.5 per cent in the 1970s. The secular decline was interrupted by the wars and by the hyperinflation period; in the period from 1919 to 1923 average currency holdings were 24.7 per cent of NNP, a very high level judging by previous historical standards. This indicates that the German public was very slow in adjusting real currency holdings to normal prewar levels, either because prices were sticky or because they expected prices to return to the prewar level.[51] Only towards the end of the hyperinflation period did the public reduce considerably its real currency holdings, which fell to 5.1 per cent of NNP in 1923 from 21.1 per cent in 1922 and 24.8 per cent in 1921.

The ratios of narrow and broad money to NNP show instead a strong secular increase. Narrow money grew from an average of 18.9 per cent of NNP in the 1883–89 period to an average of 42.5 per cent in the 1970s, while broad money grew from an average of 42.1 per cent of NNP in the first period to an average of 107.1 per cent in the 1970s. The increase in the broad money to NNP ratio was particularly strong in the last two decades of the gold standard period and after The Second World War. The increase in the narrow money to NNP

*Table 1.38* Money to nominal NNP ratios[a] (in per cent-period averages), 1883–1979

| | $\frac{BU}{NNP}$ | $\frac{M1}{NNP}$ | $\frac{M2}{NNP}$ |
|---|---|---|---|
| 1883–89 | 15.9 | 18.9 | 42.1 |
| 1890–99 | 13.3 | 16.8 | 44.8 |
| 1900–09 | 13.1 | 19.4 | 54.4 |
| 1910–13 | 11.6 | 20.9 | 58.3 |
| 1914–18[b] | 21.8 | 40.7 | 78.8 |
| 1919–23[b] | 24.7 | 36.7 | 47.9 |
| 1924–28 | 7.0 | 22.5 | 30.1 |
| 1929–33 | 8.6 | 28.7 | 53.8 |
| 1934–39 | 8.7 | 27.6 | 47.6 |
| 1950–59 | 10.3 | 26.4 | 41.4 |
| 1960–69 | 10.3 | 33.0 | 72.9 |
| 1970–79 | 9.5 | 42.5 | 107.1 |

[a] The denominator is real NNP multiplied by the consumer price index.
[b] NNP has been estimated by the authors for these periods.
*Source*: Deutsche Bundesbank (1976) and International Monetary Fund, *IFS*, various issues.

ratio was a marked one only after The Second World War. As for currency holdings, wars and the hyperinflation period caused large departures of the ratios from their trend levels. During the hyperinflation period, the average holdings of narrow money were substantially above the trend level, while the holdings of broad money were substantially below. Hence, during the hyperinflation period, the public shifted its portfolio of monetary assets towards more liquid forms in a significant way, a result already found in the analysis of Table 1.37. The desired holdings of broad money seem to have been affected negatively by hyperinflation for many decades, since the ratio returned to the 1910–13 average only in the early 1960s.

Table 1.38 suggests that the habits of the public as regards the holdings of monetary assets in relation to NNP change quite slowly, at least when no major disturbances occur. The large departures of the ratios from trends observed in some periods are the result of large money supply disturbances introduced into the economy and slow adjustment of the public. The hypothesis that at least the demand for currency is quite stable is confirmed by the econometric work presented in this book. In Chapter 5, a well-behaved demand function for currency is estimated on annual data from 1880 to 1979, and in

*Table 1.39* Average annual inflation rate[a] by major subperiod, 1880–1979

| | |
|---|---|
| 1880–89 | –0.4 |
| 1890–99 | 0.1 |
| 1900–13 | 2.0 |
| 1914–18 | 28.3 |
| 1919–23 | 662.6 |
| 1925–29 | 2.3 |
| 1929–33 | –6.7 |
| 1934–39 | 0.8 |
| 1950–59 | 1.9 |
| 1960–69 | 2.4 |
| 1970–79 | 4.8 |
| 1880–1913 | 0.8 |
| 1950–79 | 3.0 |

[a] Geometric average.

Chapter 3, a demand function is estimated on monthly data from April 1920 to July 1923. For the latter period, stability tests of the parameters of the demand function for currency are also presented, which show that they do not shift between the initial period of more moderate inflation and the final period of hyperinflation.

Economic theory predicts that if the public's demand function for currency or money is stable, an increase in the nominal supply of currency or money beyond the real demand for it, will in the medium or long run generate inflation. This quantity theory prediction has been subjected to empirical test both within the structural macroeconomic model of the German economy estimated over one hundred years (Chapter 5), as suggested by Lucas (1980) and within the three-equation monthly model of inflation and exchange rate determination estimated for the hyperinflation (Chapter 3).

The average inflation rate in Germany is given for major subperiods in Table 1.39. Inflation was negative in the 1880s, averaging minus 0.4 per cent. It increased to 2.0 per cent in the period 1900 to 1913, and for the whole gold standard it averaged a mere 0.8 per cent. Also in the post-Second World War period a rising trend of inflation is observable. It increased from 1.9 per cent in the 1950s to 2.4 per cent in the 1960s and 4.8 per cent in the 1970s, averaging 3.0 per cent from 1950 to 1979, a much higher rate than during the gold standard period. From 1914 to 1949, inflation was very variable. Inflation averaged 28.3 per cent from 1914 to 1918, 662,6 per cent

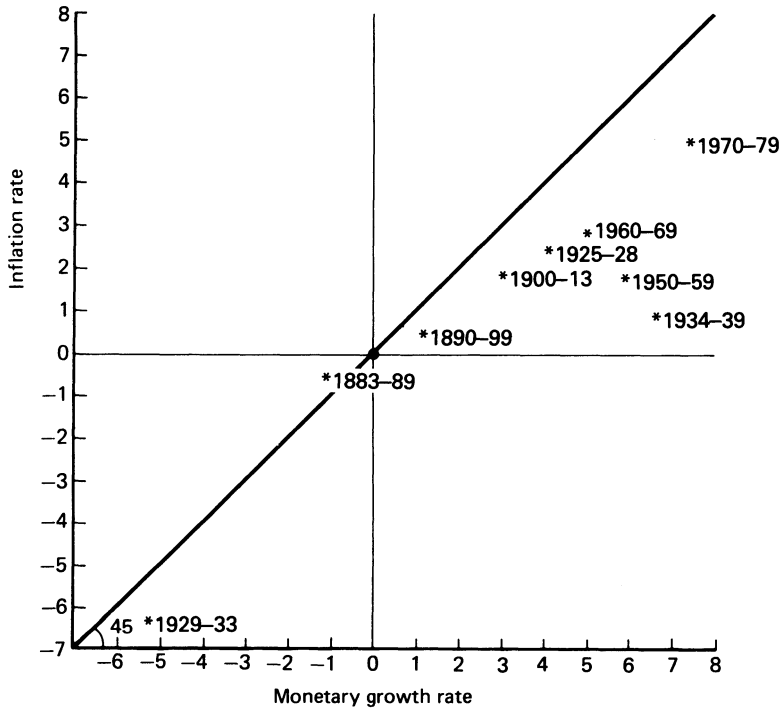
during the hyperinflation period (1919–23) and it was minus 7.6 per cent per year from 1930 to 1933. From 1924 to 1929 and from 1934 to 1939 it was slightly positive averaging 2.3 and 0.8 per cent respectively. No figures are reported in Table 1.39 for the Second World War because the system of price controls was not lifted until after the monetary reform of June 1948 and hence the measured price indices have little economic significance.

A non-rigorous preliminary test of the quantity theory and of the importance of monetary policy for the determination of the price level in Germany is given in Figure 1.11, where the average geometric rate of inflation by major peace-time periods is reported on the vertical axis and the difference between the rate of growth of narrow money and real NNP is reported on the horizontal axis. The correlation between inflation rates and money growth rates corrected for real NNP growth for the various subperiods is quite high, although the points do not tend to be located around the 45 degree line, but slightly below it. This reflects the secular increase in the narrow money to NNP ratio (the fall in velocity of narrow money) discussed in connection with Table 1.38. The observation relating to the period 1934–39 lies well below the 45 degree line, mostly reflecting the existence of price controls set up during this period.

The causality between money and prices is affected by the exchange rate regime. Under flexible exchange rates, the monetary authorities of a country can set the growth rate of money at the level they desire independently of the rest of the world, provided they are willing to accept the consequences of their actions in terms of exchange rate depreciations and inflation. If the government wishes to maintain fixed exchange rates, however, the necessary changes in international reserves require the money supply to be endogenous. The long-run endogeneity of the money supply does not make the quantity theory invalid under fixed exchange rates. The domestic assets of the central bank have to grow under fixed exchange rates consistently with the required rate of growth of money and the desired growth in international reserves. In this sense, the quantity theory maintains a normative value also under perfectly fixed exchange rates.

Money is endogenous under fixed exchange rates only in the long run. In the short run, monetary authorities can generally affect the stock of money, unless capital mobility is perfect, and cause increases in the price level above the level consistent with the maintenance of fixed exchange rates in the long run. To what extent the monetary authorities can affect the stock of money under fixed exchange rates,

*Figure 1.11* Monetary growth and inflation[b], 1883–1979
Average geometric growth rates




[b] Excluding the war periods and the hyperinflation period.
The inflation rate is measured by the consumer price index. The money stock is defined as narrow money; its rate of growth has been corrected for changes in real NNP.

and for how long and to what extent money can affect the price level depends on institutional factors like the degree of capital mobility, the short-run stickiness of prices and the degree of commodity arbitrage between the country and the rest of the world.

**Appendix**: Effects of the growth of government on the rate of growth of real NNP

This appendix investigates the effect of the growth of the government sector on the long-run growth rate of the economy by means of simple regressions. The role of government in the growth process has been discussed in Sections

1.1 and 1.4. The empirical tests presented in this appendix are meant to shed more light on, and support some of the conclusions drawn from, the historical analysis.

Several channels through which government policy can affect economic growth are investigated in this regression. The first one concerns the effects of deficit spending on economic growth. In the economic literature there are three competing hypotheses concerning the effects of deficit spending on economic growth. The first one is the Pre-Ricardian equivalence proposition, which maintains that the private sector perceives and fully discounts future taxes implied by government debt. Under such hypothesis, bond financing is equivalent to taxation and deficit spending has no effects on economic growth. The second one is the simple Keynesian multiplier theory which assumes that deficit spending has a positive impact on economic growth and private sector investment. The positive effect is more or less strong depending on the way the deficit is financed. The third hypothesis is the more popular one and it assumes that deficit spending crowds out private sector investment and hence reduces economic growth. To test these alternative hypotheses, the central government deficit as a ratio to NNP was introduced separately in the regression.

The degree of crowding out which can occur is not independent of the way the deficit is financed: the higher the amount of bond financing with respect to monetary financing the larger the effect on real financial interest rates and hence the greater the scope for crowding out of private expenditure. To test for the effect of bond versus monetary financing on economic growth the average ratio of general government debt to NNP and the five-year average growth rate of the monetary base have been introduced as additional explanatory variables in the regression.

In order to investigate whether the growth in the size of government itself has affected economic growth positively or negatively in Germany, the five-year average of total government expenditure to NNP has been introduced as an additional explanatory variable in the regression. The effects of these variables on the long-run rate of growth probably operate more via the supply side rather than the demand side. First, productive government expenditure whether on physical or on human capital, is an addition to the productive potential of the country. Second, government expenditures have to be mostly financed through taxation or inflation in which case they increase the wedge between gross and net wages. This is also a supply effect. Third, taxes and transfers have effects on the allocation of resources. The first effect on economic growth is positive, the second negative, the third is generally believed to be negative.

A further hypothesis tested in the regression is whether monetary fluctuations affect economic growth. Monetary changes which are unexpected by the private sector make the real rate of return on investment projects more uncertain, with a consequent negative effect on investment and hence economic growth. The standard deviation of monetary base growth within five-year periods has been used here to measure variability in monetary growth. Finally, the hypothesis was tested that there exists a positive relationship between economic growth and the growth of the ratio of exports to income, as predicted by theories of export-led growth.

The equation tested is therefore of the type:

$$\overline{\frac{\dot{\mathrm{NNP}}}{\mathrm{PO}}} = a_0 + a_1 \frac{\overline{GD}}{\mathrm{NNP}} + a_2 \overline{\dot{B}} + a_3 \mathrm{SB} +$$

$$a_4 \frac{\overline{G-T}}{\mathrm{NNP}} + a_5 \frac{\overline{G}}{\mathrm{NNP}} + a_6 \frac{\overline{X}}{\mathrm{NNP}} \qquad (1.1)$$

where NNP is real or nominal net national product, depending on whether the variable in the numerator is real or nominal, PO is population, $GD$ is government debt, $B$ is the monetary base of the central bank, $SB$ is the standard deviation of the rate of growth of the monetary base, $G$–$T$ is the central government deficit, $G$ is total government expenditure, and $X$ are nominal exports of goods and services. A dot above a variable indicates a rate of change and a bar a five-year average. The central government deficit was used in the regression because of lack of data for the gold standard period on the overall government deficit. Total government debt and total government expenditure for the gold standard years were estimated by linear interpolation using as a benchmark the corresponding variables relating to the central government. The war years and the hyperinflation years were eliminated from the sample because of excessive disturbances in those periods, which could bias the regression results. 16 observations are used in the regression two of which are based on four year averages (1910 to 1913 and 1925 to 1929) in order to gain two degrees of freedom.

Table 1.40 presents the estimates of equation (1.1) for one hundred years. The first three regressions contain neither the budget deficit nor government expenditure. The specification explains about three-quarters of the variation in measured per capita NNP growth. The residuals appear serially uncorrelated. The coefficient of the ratio of government debt to NNP turns out to be negative and significant. The coefficient varies between –0.05 and –0.09 indicating that a 10 percentage point higher average ratio in a five-year period reduced the average five-year growth rate of NNP per capita from about half a percentage point to about 1 percentage point. The significance of this coefficient is increased when two dummy variables for the periods 1929–33 and 1934–38 are introduced. These two dummy variables were added to the regression because the two periods presented special features which might bias the estimated coefficients. The average rate of growth of the monetary base has a significantly positive coefficient in the first equation but the significance of the coefficient is highly reduced when the two dummy variables are introduced. The evidence thus seems to indicate that in general the growth of the monetary base had no effect on economic growth, with the exception of the monetary contraction in 1929–33 and the monetary expansion of 1934–38. The severity of the 1929–33 recession, the very large pool of unemployed resources at the beginning of 1934 and, later, the introduction of price and wage controls explain why the monetary expansion of 1934–38 was only partly reflected in prices and mostly on the growth rate of the economy.

The standard deviation of the monetary base has a negative but significant

*Table 1.40* Effect of government debt, expenditure and deficits on growth rates of real NNP per capita[a]; five-year averages, 1880–1979

| *No. of observations* | *Intercept* | $\frac{\overline{GD}}{NNP}$ | $\bar{\dot{B}}$ | *SB* | $\frac{\overline{G-T}}{NNP}$ | $\frac{\bar{G}}{NNP}$ | *D29* | *D34* | $R^2Adj$ | *DW* |
|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 2.90 | –0.05 | 0.47 | –0.18 | — | — | — | — | 0.66 | 1.69 |
| | (1.50) | (1.41) | (4.56) | (1.30) | | | | | | |
| 16 | 4.85 | –0.07 | 0.33 | –0.26 | — | — | — | 4.89 | 0.80 | 1.76 |
| | (2.97) | (2.62) | (3.58) | (2.27) | | | | (2.99) | | |
| 16 | 5.84 | –0.09 | 0.20 | –0.20 | — | — | –2.21 | 5.73 | 0.79 | 1.60 |
| | (2.90) | (2.69) | (1.16) | (1.47) | | | (0.86) | (2.98) | | |
| 16 | 3.17 | –0.07 | 0.46 | –0.24 | 0.44 | — | — | — | 0.73 | 1.75 |
| | (1.82) | (2.13) | (4.89) | (1.81) | (1.95) | | | | | |
| 16 | 5.62 | –0.07 | 0.27 | –0.25 | –0.33 | — | — | 7.35 | 0.79 | 1.73 |
| | (2.91) | (2.40) | (2.26) | (2.19) | (0.79) | | | (2.08) | | |
| 16 | 5.87 | –0.08 | 0.22 | –0.21 | –0.14 | — | –1.58 | 6.49 | 0.77 | 1.63 |
| | (2.76) | (1.90) | (1.11) | (1.31) | (0.20) | | (0.37) | (1.49) | | |
| 16 | 2.83 | — | 0.39 | –0.31 | –0.89 | 0.03 | 2.98 | 9.76 | 0.70 | 2.06 |
| | (1.50) | | (2.03) | (1.75) | (1.42) | (0.72) | (0.79) | (2.10) | | |

*Note*: Numbers in parenthesis are *t*-statistics.

[a] The periods 1914–24 and 1939–49 are excluded. Two observations are four-year rather than five-year averages: 1910–13 and 1925–28.

*Legend*: *GD* = total government debt; NNP = net national product; *G* = total government expenditure, including transfers;
*B* = monetary base created by the Central Bank = *IR* + *A* + *MF*; see Chapter 5 and Table 1.32 for definition of *IR*, *A*, *MF*;
*SB* = standard deviation of *B*; *G* – *T* = central government deficit; *D*29 = Dummy variable equal to 1 from 1929 to 1933 and zero otherwise: *D*34 = Dummy variable equal to 1 from 1934 to 1938 and zero otherwise.
A dot indicates a rate of change and a bar a five year average.

coefficient in the three equations. This variable can be considered as a measure of uncertainty and reached its highest levels in the years 1885–89, 1929–33, 1934–38 and in the 1970s, particularly the early 1970s. The empirical evidence supports the hypothesis that the variability in monetary growth negatively affects investment and growth. A negative effect of the standard deviation of monetary growth on economic growth has also been found for a pooled group of 47 and 35 countries by Kormendi and Meguirie (1983) and Kormendi (1984). The coefficients of the ratio of exports to NNP turned out to be not significantly different from zero in all three regressions contrary to what is predicted by theories of export-led growth.

The last four equations in Table 1.40 introduce alternatively the ratio of the central government deficit to NNP and of total government expenditure to NNP. The coefficient of the ratio of central government deficit to NNP turns out positive and significantly different from zero, when the two dummy variables are excluded from the regression. However, the inclusion of the two dummy variables for the years 1929–33 and 1934–38 makes the coefficient negative and not significantly different from zero. Finally, with the inclusion of government expenditure in the last regression the coefficient of the government deficit becomes significantly negative.

The empirical evidence presented here seems to suggest that the Pre-Ricardian equivalence proposition and the simple Keynesian hypothesis about deficit spending are not verified for Germany during the sample period. The empirical evidence supports instead the crowding-out hypothesis and to some extent the hypothesis that unexpected monetary variation slows down growth. As far as supply side effects arising from the secular growth of the ratio of overall government expenditure to NNP, no significant effect was detected in either direction. It is possible, however, as was argued in Section 1.4, that the size of government might have reached, in the 1970s and early 1980s, a level of saturation or surpassed it, given the development of the structure of government expenditures and taxation in the last ten or twenty years.

The results reported in Table 1.40 must be treated with some caution. First, one of the important problems faced in this study is the measurement of the deficit which is restricted to the central government. The use of the narrower definition of the deficit may bias the coefficient of the deficit towards zero, and hence the results towards the Pre-Ricardian hypothesis away from the crowding-out hypothesis. Second, the use of five-year averages might not have removed completely the reverse causation between fiscal and monetary policy variables and NNP growth, although business cycles in Germany have not been very long, with the exception of the 1930s.

**Notes**

1. Cost of living index.
2. Average geometric growth rate.

3. The ratio of the number of students attending universities to total civilian employment increased from 1.1 per thousand in 1880 to 1.9 in 1900, 2.4 in 1910; the ratio was 4.2 per thousand in 1930, 8.3 in 1960 and increased to 37.8 in 1979 (see Table 1.4).
4. The production function would be modified as follows:

$$\mathrm{NNP} = AK^{\alpha}L^{1-\alpha}\, e^{\lambda' t + \beta \Delta \ln(p_v/p_i)}$$

where $\lambda'$ is the growth rate of total factor productivity of labour and capital (see Bruno (1981)).
5. Assuming $\beta$ to be equal to 0.30 the value of $\lambda'$ is 1.11 for the gold standard and 2.05 for the period 1950–79.
6. See Knoester (1983).
7. The latter can be considered as a proxy of the participation rate.
8. The major changes occurred in 1919, 1923, 1925, 1938/39 and 1945. Furthermore, in 1960 West Berlin and the Saarland were included in the official statistics.
9. See Table 1.7.
10. Dividing the standard deviation of NNP per capita by the arithmetic mean of the absolute values of its rate of change, the standard deviation drops from 1.55 in the gold standard to 0.68 in the post-Second World War period.
11. See Tables 1.27 and 1.29 in Section 1.4, and Table 1.35 in Section 1.5.
12. See Chapter 4.
13. Consideration of other factors besides the variability of economic policy would reinforce this point. Probably the most important other factor is the much more intense use of the labour force from 1925 to 1929 and during the Nazi period. In 1939, civilian employment was 49.9 per cent of the population, while it was 42.6 per cent in 1968.
14. Undiscriminating fiscal policy refers here to a policy not explicitly aimed at increasing productive investment.
15. See Lindbeck (1983) for an analysis of the causes of the slowdown of productivity growth in the OECD area.
16. The ratio of students enrolled in universities to civilian employment increased at an average geometric rate of 10.4 per cent from 1970 to 1979.
17. The ratio of real private consumption to NNP, used here as a proxy for the welfare of the population, declined steadily from 88.8 per cent in 1931 to 58.6 per cent in 1938. The decline in this ratio is partly due to the recovery itself and cannot therefore be attributed fully to explicit policies to reduce private consumption.
18. For an international comparison of long-term economic growth see also Maddison (1977).
19. The growth of German output was higher with respect to the growth of foreign output in the early part of the period (see also Chapter 2).
20. See Fratianni and Spinelli (1984).
21. The rearmament played a major role in this context; for example, Germany started to increase military expenditures already in 1934.
22. This conclusion is also confirmed by the empirical estimates of the consumption and investment functions presented in Chapter 5.

23. Real private wealth is defined as the sum of physical capital, central government debt deflated by the consumer price index and net foreign assets corrected for capital gains and losses due to exchange rate changes and deflated by the consumer price index (see Table 1.10 and footnote 25).
24. For a private consumption function in which government expenditure appears as an argument, see Bailey (1972).
25. The real stock of net foreign assets has been obtained by cumulating current account surpluses from 1876 as follows:

$$\left[\sum_{i=1876}^{t}\left(\frac{CA_i}{S_i}\right)\right]\frac{S_t}{p_t}$$

where $t$ is equal to 1876–1979, $\Sigma$ indicates the cumulation operation, $CA$ is the current account in current marks obtained from balance of payments statistics, and $S$ and $p$ are the dollar-mark exchange rate and the price level respectively (see also Chapter 5).
26. Between those two years the real stock of capital fell by 41.4 per cent, while civilian employment and population fell by 34.8 per cent and 31.6 per cent respectively.
27. For a given production technology, and assuming a Cobb-Douglas production function, the average product of capital is given by:

$$\frac{\text{NNP}}{K} = A\left(\frac{L}{K}\right)^{1-\alpha}$$

and the marginal product of capital (MPK) is equal to:

$$MPK = \alpha\frac{NNP}{K}$$

If the ratio of $L/K$ increases the marginal and average products of capital also increase (see Table 1.1 for description of symbols).
28. Government expenditure on goods and services is defined on a national account basis; thus it excludes transfers. This choice is also due to the greater difficulties in reconstructing government expenditure according to a budgetary definition for the whole period. Even on this narrower definition, estimates of government expenditure have to be interpreted with very great caution for the war years and the hyperinflation period. For the behaviour of government expenditure including transfers, see Section 1.4.
29. A description of the monetary disturbances generated by the strong increase of the government deficit during the war and the hyperinflation period is given in Chapter 3.
30. As far as the war periods are concerned, these ratios have to be interpreted with extreme caution owing to difficulties of reconstructing the national accounts during war periods. Ratios of expenditure to NNP as high as 90 per cent are possible when net investment and the current account are strongly negative or when part of government expenditures are financed by taxing residents of occupied territories.
31. For a more detailed discussion of the growth of total government expenditures, see Section 1.4.

32. This relationship is not satisfied in the war periods and in the 1930s probably because of exchange and trade controls.
33. If one excludes the surplus of 1926, caused by a recession, the average deficit was 2.96 per cent of NNP.
34. See Machlup (1966).
35. See Kindleberger (1976).
36. During the 1930s and the war periods, the presence of trade barriers, exchange controls and rationing must have disrupted the relationship because part of the excess saving was hoarded in the form of money.
37. This conclusion has to be interpreted with caution because unit export values include indirect taxes and because of the less than full coverage of unit export values prior to 1906. In addition, the NNP deflator includes non-traded goods where technical progress is generally thought to be slower. Quality improvements of German exports which may not be fully captured in unit exports values, are a factor working in the opposite direction.
38. See de Cecco (1973).
39. For the sake of completeness it should be added that German competitiveness improved considerably after 1979 in connection with the weakness of the Deutschmark.
40. Exchange rates fluctuated within a band of less than 1 per cent because of low transportation and insurance costs of gold. The Reichsbank could change the transportation costs by changing the location where it would buy and sell gold (see Morgenstern (1959)).
41. Some minor direct intervention took place in 1923.
42. See Chapter 2 for a test of the hypothesis that differential productivity growth was an important determinant of the deviations of the real exchange rate from purchasing power parity during the gold standard.
43. In the sense that workers may have become more reluctant to pay.
44. International reserves of the Reichsbank as defined here, whose ratio to total assets is reported in the first column of Table 1.32, include only gold and foreign exchange holdings and exclude German coins (largely silver coins) held by the Reichsbank.
45. Up to 1910 the banknotes issued by the Reichsbank were not legal tender.
46. The other major item excluded from reserves as defined in Table 1.32 were German coins; they were 40.9 per cent of issued banknotes in 1880 but fell gradually to 10 per cent in 1913.
47. For a more detailed analysis of economic and monetary developments during the hyperinflation, see Chapter 3.
48. The rate of inflation accelerated during the gold standard period from –0.4 in the 1880s to 0.1 in the 1890s and 2.0 per cent in the period 1900–13 (cf. Table 1.39).
49. See Friedman and Schwartz (1963).
50. See Bernanke (1983).
51. The dynamics of hyperinflation will be analysed in Chapter 3 with the help of an econometric model.

# 2 Monetary Policy and the Determinants of Gold-Flows in Gold Standard Germany: 1876–1913

## INTRODUCTION

This chapter focuses on the discount rate policy of the Reichsbank during the gold standard. It analyses by means of econometric techniques the economic factors which influenced the Reichsbank's decisions to change the official discount rate. It also tries to answer the question of whether the Reichsbank followed the so-called 'rules of the game'. At the risk of some oversimplification, the 'rules of the game' have been interpreted in the gold standard literature in three different ways:

1. A narrow interpretation, implying that a central bank followed the 'rules of the game' if its main concern was the covertibility of the currency and if it changed the discount rate in response to changes in its liquidity ratios. This interpretation seems to have been adopted by Goodhart (1972) in analysing the behaviour of the Bank of England.
2. A second interpretation, implying that a central bank followed 'the rules of the game' if it changed its domestic assets in the same direction as its foreign assets in a given time interval, thus speeding up the balance-of-payments adjustment process. This interpretation was adopted by Bloomfield (1959);
3. A third interpretation, implying that a central bank followed the 'rules of the game' if the discount rate was changed so as to lead to an anti-cyclical behaviour of its assets and liabilities. This interpretation was adopted by McGouldrick (1984) in his analysis of the behaviour of the Reichsbank.

The behaviour of the Reichsbank is analysed by estimating reaction functions which use the discount rate as the dependent variable both on annual data and on data relating to each discount rate change. Changes in the discount rate in Germany were rather frequent during the gold standard period, amounting to 136 from 1876 to 1913. There

were 38 changes in the twenty years from 1876 to 1895 corresponding to 1.9 changes per year on average, as opposed to 98 changes in the eighteen years from 1896 to 1913, corresponding to 5.4 changes per year on average. Fluctuations in the liquidity ratios within the year were also extremely high.[1] Therefore annual averages hide a substantial amount of information. In addition, regressing discount rate changes on the cyclical position of the economy using annual data probably entails problems of reverse causation. For these reasons, whenever data were available, regressions using annual data have been supplemented by regressions using data for each discount rate change. These draw upon two statements of the Reichsbank; the first one dated two to four days prior to the discount rate change, and the second one generally preceding it by two weeks to two months. The choice of the lags was made by the compilers of a table contained in one volume published by the German Imperial Printing Office in 1925 (Vergleichende Notenbankstatistik, 1925). Presumably the choice of the lags was based on the knowledge of the statements which the Reichsbank actually used in deciding changes in the discount rate. The table also contains information about the short term market interest rates and exchange rates on the day just preceding the discount rate change. The same table is available for other gold standard countries, suggesting that the comparisons of statements by the officials of the Reichsbank was a usual practice among gold standard central bankers.

The tests were performed separately for the periods 1876 or 1878 to 1895 and 1896 to 1913. The degree of commercial and financial integration with the other gold standard countries increased substantially since 1876 justifying a split into subperiods. 1895 has been chosen as the end of the first period because the phase of declining prices in Germany and abroad ended in that year after the discoveries of new gold mines and of new processes to extract gold.

The analysis presented in this chapter shows that during the gold standard the dominant explanatory variables of discount rate changes in Germany were the liquidity ratios of the Reichsbank, its gold or metal cover of notes and short term liabilities outstanding. It shows also that the business cycle affected the discount rate policy of the Reichsbank, predominantly through its effects on its liquidity ratios. It follows that the state of the balance of payments or the business cycle were most likely not a direct concern of the Reichsbank. The narrow objective of keeping the convertibility of the currency into gold and the practice of changing the discount rate as a result of

changes in the liquidity ratios would ensure both an anticyclical monetary policy and the adjustment of the balance of payments. Finally a key variable in the automatic transmission of foreign interest rates and domestic cyclical impulses to the Reichsbank's liquidity ratios and to discount rate changes was the difference between the private short-term market interest rate in Berlin and the official discount rate of the Reichbank.

A second closely related issue which will be investigated in this chapter by means of econometric techniques are the determinants of Germany's international gold flows. In Bloomfield's criteria to judge whether a central bank followed the 'rules of the game' of the classical gold standard, implicitly the direction of causation runs from exogenous changes in foreign assets to endogenous changes in domestic assets. He found from a sample of gold standard central banks that domestic and foreign assets moved in the opposite direction in 60 per cent of the observations, while they moved in the same direction in 34 per cent of the observations and concluded that central banks did not follow the 'rules of the game' at all times.

But the observed negative correlation is also consistent with the direction of causation running mainly from changes in domestic assets to endogenously determined changes in foreign assets, as suggested by the monetary approach to the balance of payments as reformulated by Harry Johnson[2] to explain the balance of payments fluctuations in industrialised countries during the 1950s and 1960s. A stylised model of the German monetary system during the gold standard is therefore presented from which an equation explaining international gold flows is derived and tested.

The main conclusions derived from the testing of this equation are, first, that the direction of causation was mainly from domestic assets to international gold flows. If one defines the balance of payments as international gold flows this is in accordance with the monetary approach to the balance of payments.[3] Second, gold flowed in during expansions and out during depressions, which is also in accordance with the monetary approach to the balance of payments. Furthermore the study of the discount rate policy and of the determinants of net international gold flows suggests that it is incorrect to attribute to central banks of the gold standard years objectives of today's central banks, like the stabilisation of economic activity or full employment. Their objectives were much narrower and more clearly defined. One important reason for this behaviour is that accurate statistics about business cycles and the balance of payments were not promptly

available as they are today, although during the gold standard central banks had probably some knowledge of the state of the business cycle and the balance of payments.

The degree of financial market integration of Germany and the degree of correlation of domestic and foreign prices and output is very important for the analysis of the discount rate policy of the Reichsbank as well as for the tests of the monetary approach to the balance of payments. Section 2.1 is therefore devoted to the study of the synchronisation of German and foreign variables and their changes from 1876 to 1913.

Financial market integration was very high while the year-to-year correlation of inflation was substantial but far from perfect. Long-term movements of prices, especially consumer prices, were quite different in Germany and abroad, with the movement more exacerbated in Germany. A similar development was observed in Japan in the post-1945 period. It is shown that this phenomenon can be explained by the more rapid economic growth in Germany than abroad during the period, thus supporting Balassa's hypothesis[4] of a productivity bias.

The remaining part of this introduction gives a brief overview of the developments of the major items of the Reichsbank balance sheet and of currency in circulation. Table 2.1 gives a summary overview of the role of gold and other metals in the German circulation and in the balance sheet of the Reichsbank from 1876 to 1913. The table reports five-year averages of the ratio of gold coins in circulation to total circulation and of the ratio of gold reserves of the Reichsbank to its total assets. Gold coins in circulation represented 32.2 per cent of total circulation at the end of 1876 and 42 per cent at the end of 1913. In terms of five-year averages gold fell in importance from 39.5 per cent in the period 1876 to 1880 to a minimum of 30.6 per cent in the period 1886 to 1890. It increased steadily to a maximum of 49.0 per cent in the period from 1906 to 1910. The initial fall in this ratio was the result of insufficient world gold production in the early gold standard years. The subsequent rise was caused by the end of the world gold shortage, as well as by the large acquisitions of gold by the Reichsbank. Gold holdings of the Reichsbank also increased during the gold standard period from 28.1 per cent of total assets in 1876 to 39.2 per cent in 1913. The increase in the importance of gold in the circulation and in the balance sheet of the Reichsbank constituted in part a compensation for the reduced importance of other metals, mainly silver which remained relatively stable in absolute terms. Notes in

*Table 2.1* Summary statistics on the role of gold in the German monetary system 1876–1913 (in per cent)

| | *Composition of currency in circulation*[a] | | | | *Composition of Reichsbank assets*[c] | | |
|---|---|---|---|---|---|---|---|
| | *Gold coins*[b] | *Other metal coins*[b] | *Notes*[b] | *of which: Bank notes issued by*[b] *Reichsbank* | *Gold reserves* | *Other metal* | *Foreign exchange* |
| 1876 | 32.2 | 32.4 | 35.4 | 24.4 | 28.1 | 22.0 | 0.1 |
| 1876–80 | 39.5 | 24.2 | 36.3 | 25.4 | 23.3 | 29.5 | 1.0 |
| 1881–85 | 38.2 | 21.5 | 40.3 | 29.1 | 23.6 | 30.7 | 1.2 |
| 1886–90 | 30.6 | 22.9 | 46.5 | 36.2 | 37.1 | 21.3 | 1.0 |
| 1891–95 | 34.6 | 20.1 | 45.3 | 36.3 | 37.9 | 19.4 | 0.7 |
| 1896–1900 | 39.4 | 18.2 | 42.4 | 34.8 | 34.0 | 15.6 | 1.8 |
| 1901–05 | 44.9 | 16.0 | 39.1 | 33.7 | 35.1 | 12.5 | 3.8 |
| 1906–10 | 49.0 | 13.7 | 37.3 | 33.8 | 31.9 | 10.4 | 6.7 |
| 1911–13 | 44.7 | 13.7 | 41.6 | 37.6 | 35.7 | 11.7 | 4.9 |
| 1913 | 42.0 | 14.2 | 43.8 | 39.3 | 39.2 | 10.4 | 5.8 |

[a] Currency in circulation includes notes held by banks.
[b] End-of-year figures or five-year averages of end-of-year figures.
[c] Yearly averages or five-year averages of yearly averages.
*Sources*: Deutsche Bundesbank (1976), pp. 14 and 36 and Vergleichende Notenbankstatistik (1925) pp. 26–27.

circulation increased in importance from 36.3 per cent in the period from 1876 to 1880 to 46.5 per cent from 1886 to 1890, just before the gold discoveries, and fell back to 41.6 per cent in the last three years of the gold standard. Table 2.1 shows also that the gold standard in Germany started with gold as an item of similar importance as other metals both in circulation and in the balance sheet of the Reichsbank, and ended with gold being by far the most important metal both in circulation and in the balance sheet of the Reichsbank.

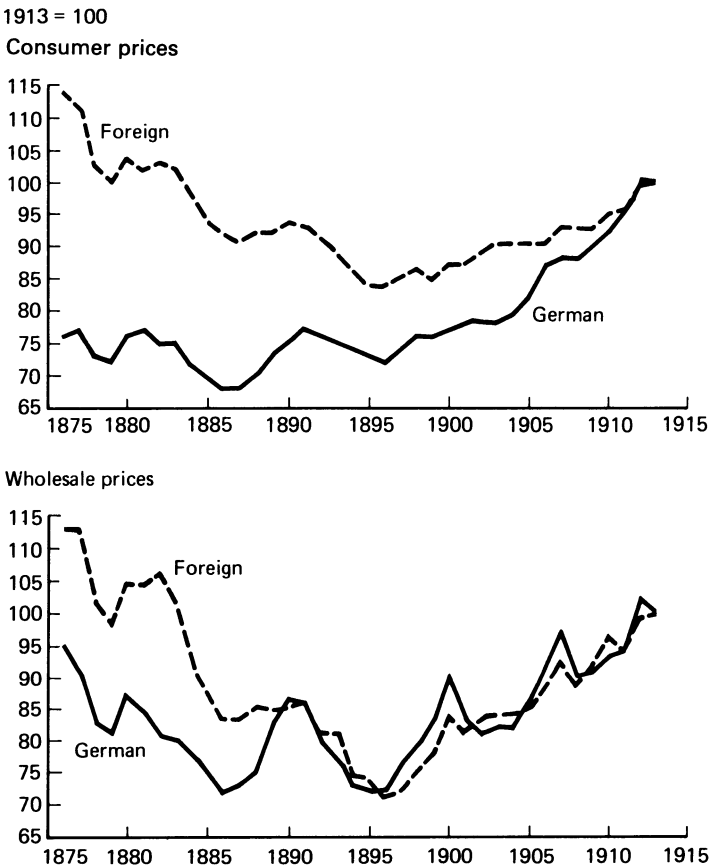
The structure of the chapter is as follows: Section 2.1 deals with the degree of correlation of German and foreign output (national product and industrial production), prices (consumer and wholesale prices) and interest rates (official discount rates and private short term interest rates). The results reported in Section 2.1 confirm the results reached by other authors about the degree of harmonisation of domestic and foreign interest rates (Morgenstern, 1959). However they do not confirm those regarding the degree of harmonisation of business cycles (Morgenstern, 1959) and prices (McCloskey and Zecher, 1976 and 1984). Section 2.2 analyses the behaviour of the Reichsbank by estimating reaction functions of the discount rate, both on annual and non-annual data. In Section 2.3 net gold flows between Germany and the rest of the world will be explained in terms of the monetary approach to the balance of payments.

## 2.1 INTERNATIONAL LINKAGES

### Prices: the law of one price and differential productivity growth

Figure 2.1 shows the development of German and foreign consumer and wholesale price indices from 1876 to 1913. The foreign price variable has been calculated as a weighted average of price indices of the three countries other than Germany considered by Morgenstern (1959). These were the United Kingdom, the United States and France, and the weights used are equal to the share of 1890 German imports of goods from each of those countries in total imports from those countries. Figure 2.1 shows that both German and foreign wholesale price indices and the foreign consumer price index exhibit a strong declining trend until 1895, while no clear trend is discernible for German consumer prices. From 1896 onwards all indices exhibit a strong positive trend. This chart, coupled with empirical evidence about the degree of commercial integration of Germany with the rest

*Figure 2.1* German and foreign price indices[a], 1876–1913




[a] The foreign indices are a weighted average of UK, US and French indices (see Table 2.2).

of the world reported in Chapter 1,[5] suggests a division of the gold standard into two subperiods for the purpose of econometric analysis of the behaviour of the Reichsbank and of the balance-of-payments (1880–95 and 1896–1913).

The trends of the four indices are reported in Table 2.2. During the first period, German consumer prices declined much less than the average of foreign consumer prices, while they rose much more

*Table 2.2* Trends of German and foreign price and output indices (Annual data)[a]

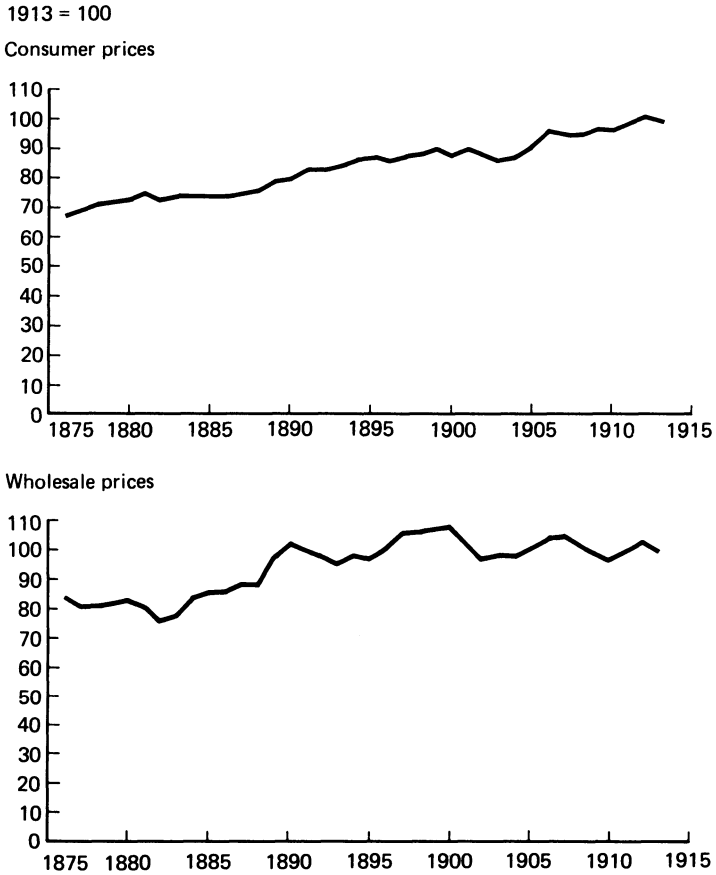
| | *Prices* | | | | | |
|---|---|---|---|---|---|---|
| | *1876–1895* | | | *1896–1913* | | |
| | *a* | *b* | $R^2adj$ | *a* | *b* | $R^2adj$ |
| German wholesale prices | 87.6 | –0.66 | 0.33 | 74.2 | 1.39 | 0.79 |
| | (35.6) | (3.2) | | (39.5) | (8.0) | |
| Foreign wholesale prices | 112.6 | –1.94 | 0.87 | 70.9 | 1.59 | 0.95 |
| | (54.8) | (11.3) | | (72.9) | (17.7) | |
| German consumer prices | 74.3 | –0.06 | –0.04 | 68.6 | 1.61 | 0.93 |
| | (55.0) | (0.6) | | (61.5) | (15.6) | |
| Foreign consumer prices | 109.9 | –1.24 | 0.86 | 82.6 | 0.85 | 0.94 |
| | (79.1) | (10.7) | | (140.9) | (15.7) | |
| | *Output* | | | | | |
| | *c* | *d* | $R^2adj$ | *c* | *d* | $R^2adj$ |
| German industrial production | 22.7 | 1.49 | 0.66 | 56.6 | 2.45 | 0.98 |
| | (7.8) | (6.2) | | (64.0) | (29.9) | |
| Foreign industrial production | 32.8 | 1.10 | 0.92 | 54.9 | 2.17 | 0.91 |
| | (37.4) | (15.0) | | (30.8) | (13.2) | |
| German real NNP | 33.6 | 1.22 | 0.92 | 17.2 | 2.16 | 0.96 |
| | (35.7) | (15.6) | | (5.7) | (21.4) | |
| Foreign real GDP | 36.1 | 1.13 | 0.97 | 32.0 | 1.54 | 0.98 |
| | (77.2) | (29.0) | | (37.6) | (40.6) | |

*Note*: Numbers in parentheses are *t*-statistics.

[a] The foreign price indices are calculated as weighted averages of the UK, the US and the French indices, with weights equal 0.43, 0.39 and 0.18 respectively. The weights are the shares of German 1890 imports from the above countries in total imports from the three countries. The regressions are of the form $p = a + bt$ where $p$ is the price level (1913 = 100) and $t$ is the time trend. The foreign output indices (1913 = 100) are weighted averages of the UK, US and French indices with the same weights as for prices. The regressions are of the form $Ip = c + dt$ where $Ip$ is the industrial production or output index.

during the second period. German wholesale prices fell much less than foreign wholesale prices in the first period but exhibited a similar trend in the second period. As a result, large changes in the ratio of German to foreign prices occurred during the gold standard.[6] This is particularly evident for consumer prices, whose ratio in-

*Figure 2.2* Ratio of German to foreign price indices[a], 1876–1913




[a] Based on the same data as Figure 2.1.

creased from 0.67 in 1876 to 1 in 1913.[7]

The positive trends in the price ratios can be explained mainly by the higher rates of growth of German productivity with respect to other countries. According to an hypothesis advanced by Balassa (1964), different productivity growth in the traded and non-traded good sectors can explain deviations of domestic from foreign price levels under fixed exchange rates. The average geometric growth rate of German real NNP per capita was higher than those of the United States and France, and about double than that of the United King-

dom from 1880 to 1913. This difference was more marked in the early gold standard years,[8] when the tendency of German prices to rise more rapidly than foreign prices was also more marked. Industrial production also rose much faster in Germany than in the average of the other three countries especially in the earlier period.[9]

Table 2.3 presents econometric tests of the hypothesis advanced by Balassa. Deviations of relative price indices from their 1913 level are regressed on current and lagged deviations of the relative industrial production index from the 1913 level. These tests are relatively simple and their results should be taken with some caution, particularly because relative industrial production indices have been used as a proxy for relative productivity indices for lack of reliable employment figures. The upper part of the table shows the tests for relative consumer prices which contain a higher proportion of non traded goods, while the lower part of the table presents the same tests for relative wholesale prices which contain a higher proportion of traded goods.

Considering first the regressions involving consumer prices, the coefficient of relative industrial production is highly significant and has the correct sign in the period from 1880 to 1895. The contemporaneous relative industrial production index explains 81 per cent of the variance of the deviations of relative consumer prices from their 1913 level. For the second period the explanatory power of the regression is reduced, even if the lagged values of relative industrial production are added as explanatory variables. However, the regression still explains 44 per cent of the variance of the dependent variable. The fact that the coefficients of lagged relative industrial production are significant in the second period, but not in the first, is probably due to the smoother and more pronounced growth of German industrial production with respect to the foreign one in the first period, rather than a change in the underlying lag structure. The second regression for each period includes the deviations of German and foreign consumer price indices from their respective trends as explanatory variable in addition to relative industrial production. The deviations of relative prices from trend are included in order to eliminate the short-run or cyclical component from relative consumer prices. The cyclical component became more important in the second period, as relative industrial production became less significant.

The lower part of the table shows the same regressions for relative wholesale prices. The coefficients are equally significant for the first period. As for relative consumer prices, the explanatory power of the

regression is very small for the second period when the cyclical term dominates completely the variability of relatively wholesale prices. This is not surprising because during this period there was no systematic variation of relative wholesale prices.[10]

The previous analysis has ascertained the existence of large and systematic or long-run deviations of German prices from foreign prices and has advanced an explanation for them. As to the yearly synchronisation of German and foreign prices, Table 2.4 shows the simple correlation coefficients between German and foreign inflation rates and between deviations from the trend of German and foreign price levels. The highest correlation between inflation rates is observed for wholesale prices in the period 1896 to 1913. The correlation increased in the second period probably in connection with the higher integration of German industry in the world economy, while the correlation of consumer price inflation fell from 0.48 to 0.27. The growth of the service sector during the second part of the gold standard may explain in part the observed reduced correlation[11]. The correlation between deviations from trend of prices exhibit the same changes from the first to the second period. The correlation coefficients reported in Table 2.4 are not particularly high and suggest that the degree of synchronisation between year-to-year movements of prices was much lower than some authors previously suggested (McCloskey and Zecher, 1976, 1984). Costs of information, transportation costs, the existence of non traded goods and changes in tariffs were probably much more important than implied by these authors.

**The synchronisation of business cycles**

Time trends for German and foreign real NNP/GDP and industrial production have been calculated separately for the period 1876–95 and 1896–1913 and are reported in Table 2.2. They show that in both periods German output and industrial production grew faster than abroad. The average growth rates of all indices accelerated sharply in the second period as world gold production ceased to be a major constraint on world economic growth. Deviations from these trends have been used as a measure of the domestic and foreign business cycles in the analysis of this section.

The lower part of Table 2.4 shows correlation coefficients between the rates of change of German and foreign NNP/GDP indices and industrial production indices. It also shows the correlation coef-

*Table 2.3* Deviations of German consumer prices and wholesale prices from corresponding foreign prices and differential growth of industrial production[a] (annual data), 1880–1913

| | | | | *Consumer prices* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Period* | *Intercept* | $X1$ | $X1_{-1}$ | $X1_{-2}$ | $X1_{-3}$ | $X2$ | $X2_f$ | *RMSE* | $R^2$ | $\varrho$ |
| 1880–1895 | –0.17 | 0.28 | – | – | – | – | – | 0.02 | 0.81 | –0.40 |
| | (19.60) | (7.37) | | | | | | | | (1.77) |
| | 0.17 | 0.28 | – | – | – | 0.50 | –0.37 | 0.01 | 0.96 | 0.07 |
| | (41.79) | (15.11) | | | | (3.02) | (1.36) | | | (0.28) |
| 1896–1913 | –0.11 | 0.04 | 0.15 | 0.16 | 0.09 | – | – | 0.02 | 0.44 | –0.78 |
| | (6.08) | (0.53) | (2.05) | (2.23) | (1.29) | | | | | (6.63) |
| | –0.11 | 0.06 | 0.08 | 0.12 | 0.09 | 0.92 | –0.92 | 0.02 | 0.72 | –0.83 |
| | (6.91) | (1.19) | (1.67) | (2.36) | (1.79) | (4.81) | (3.63) | | | (7.93) |

*Sources*: Deutsche Bundesbank (1976), 00.14 and 36 and Vergleichende Notenbankstatistik (1925) p. 26–27.

| Period | Intercept | $X1$ | $X1_{-1}$ | $X1_{-2}$ | $X1_{-3}$ | $X2$ | $X2_f$ | RMSE | $R^2$ | $\varrho$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | *Wholesale prices* | | | | | | |
| 1880–95 | –0.04 | 0.41 | – | – | – | – | – | 0.03 | 0.62 | –0.57 |
| | (1.63) | (4.60) | | | | | | | | (2.76) |
| | –0.04 | 0.36 | – | – | – | 0.75 | –0.70 | 0.02 | 0.97 | –0.04 |
| | (5.89) | (12.96) | | | | (8.15) | (5.66) | | | (0.17) |
| 1896–1913 | –0.01 | 0.03 | 0.10 | 0.03 | 0.14 | – | – | 0.03 | 0.27 | –0.55 |
| | (0.46) | (0.23) | (0.86) | (0.30) | (1.24) | | | | | (3.52) |
| | –0.01 | 0.06 | 0.08 | 0.09 | 0.10 | 0.01 | –0.98 | 0.01 | 0.94 | –0.81 |
| | (1.47) | (1.97) | (2.85) | (2.94) | (3.61) | (16.17) | (9.79) | | | (7.34) |

*Note*: Numbers in parenthesis are *t*-statistics, $\varrho$ is the coefficient of auto-correlation. The Cochrane–Orcutt technique has been used to correct for auto-correlation, RMSE is the root mean square error of the regression.

[a] The dependent variable is $(p/p_f-1)$ where $p$ is the German price index (1913 = 100) and $p_f$ is a weighted average of the UK, US and French price indices calculated as in Table 2.2.

*Legend*: $X1$ = $(Ip/Ip_f)-1$ where $Ip$ is the German industrial production index and $Ip_f$ is a weighted average of the UK, and US and French indices. The weights are the same as those used for the construction of $p_f$.

$X1_{-1}$ = $X1$ lagged one year and $X1_{-2}$ is $X1$ lagged two years and so forth.

$X2$ = deviation from trend of German price index (see Table 2.2).

$X2_f$ = deviation from trend of foreign price index (see Table 2.2).

*Table 2.4* Correlation coefficients between German and corresponding foreign variables and between deviations from trend of German and foreign variables (annual data)[a]

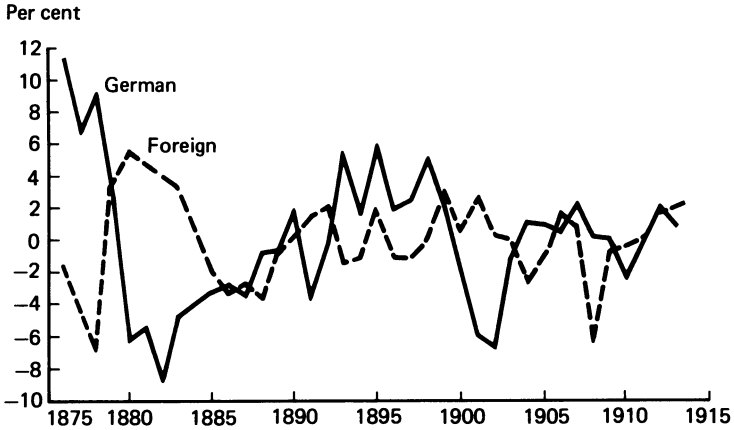
| | *1877–95* | *1896–1913* |
|---|---|---|
| Wholesale price inflation | 0.39 | 0.65 |
| Consumer price inflation | 0.48 | 0.27 |
| Deviation from trend of wholesale prices[b] | 0.44 | 0.55 |
| Deviation from trend of consumer prices[b] | 0.77 | 0.14 |
| | *1878–95* | *1896–1913* |
| Rates of changes of Industrial production | 0.04 | 0.09 |
| Rates of changes of NNP/GDP | –0.31 | 0.03 |
| Deviations from trend of industrial production[b] | 0.02 | –0.002 |
| Deviations from trend of NNP/GNP[b] | –0.66 | –0.42 |

[a] The coefficient of lagged foreign inflation never turns out to be significantly different from zero in regressions explaining German inflation. The effect of lagged foreign output on German output is always insignificant or significantly negative.
[b] Based on trends reported in Table 2.2.

ficients between German and foreign deviations of output and industrial production from their respective trends. Surprisingly, the correlation coefficients turn out not to be very high. The inclusion of lagged foreign variables do not change the previous results indicating a low degree of harmonisation of business cycles. The exclusion of the United States from the foreign production index improves the results somewhat. According to Morgenstern, the United States business cycle was less synchronised with cycles in the major European countries.[12] Figure 2.3 shows deviations from trend of German real NNP and of foreign real NNP/GDP.

The measure of business cycles constructed by Burns and Mitchell (1946) and used by Morgenstern (1959) and McGouldrick (1984) was not the same as that used in the present study. The drawback of their measure is that they isolate only the months in which the business

*Figure 2.3* Deviations from trend of German real NNP and foreign NNP/GDP[a], 1876–1913




[a] Foreign output is a weighted average of UK, US and French GDP indices, 1913 = 100, with the same weights as those used for foreign price indices. Trends are reported in Table 2.2.

cycle reached a peak and a trough and do not give quantitative information on the extent of the rise or fall in activity from one reference date to the other. Morgenstern measured the degree of harmonisation of cyclical fluctuations during the gold standard by computing the percentage of months during which the business cycles in Germany and abroad were in the same phase from September 1879 to August 1914, disregarding the correlation of the amplitude of the upswings and downswings. Thus he found that in that period the German and United Kingdom business cycles were in the same phase in 90.2 per cent of the months, while the German and French business cycles were in the same phase in 89.7 per cent of the months. The corresponding figures for the period June 1919 to July 1932 were 50.0 per cent and 61.1 per cent respectively.[13] Furthermore, Burns and Mitchell measured very long cycles. For the gold standard period the average duration of the cycles in the three European countries estimated by these two authors was just below 6 years, while the average duration of the United States cycle was about 3.6 years.

The small degree of harmonisation of business cycles which emerges from the correlation coefficients of Table 2.4 and the far from perfect long-run and short-run correlation of prices suggest that during the

*Table 2.5* Regressions of official German discount rate on foreign official discount rates 1876–1913

*Annual data*[a]

| *Foreign country* | *1876–95* | | | *1896–13* | | |
|---|---|---|---|---|---|---|
| | *a* | *b* | $R^2adj$ | *a* | *b* | $R^2adj$ |
| UK | 2.43 | 0.46 | 0.32 | 1.03 | 0.97 | 0.66 |
| | (5.24) | (3.17) | | (1.70) | (5.78) | |
| France | 2.87 | 0.35 | 0.06 | 1.42 | 1.03 | 0.40 |
| | (4.18) | (1.48) | | (1.58) | (3.48) | |

*Monthly data*[b]

| *Foreign country* | Feb. 1876–Dec. 1895 | | | | Jan. 1896–Dec. 1913 | | | |
|---|---|---|---|---|---|---|---|---|
| | *c* | *d* | *e* | $R^2adj$ | *c* | *d* | *e* | $R^2adj$ |
| UK | 2.61 | 0.35 | 0.05 | 0.34 | 1.33 | 0.66 | 0.23 | 0.62 |
| | (21.39) | (5.32) | (0.78) | | (7.69) | (7.10) | (2.44) | |
| France | 3.02 | 0.35 | –0.05 | 0.06 | 1.20 | 1.20 | –0.10 | 0.30 |
| | (13.28) | (2.72) | (0.41) | | (3.49) | (3.02) | (0.24) | |

*Note*: Numbers in parenthesis are *t*-statistics.

[a] $r_G = a + br_f$, where $r_G$ is the German official discount rate and $r_f$ is the official discount rate of the foreign country.

[b] $r_G = c + dr_f + er_{f,-1}$ where $r_G$ is the official rate in month $t$ and $r_f$ is the contemporaneous official discount rate of the foreign country and $r_{f,-1}$ is $r_f$ lagged one month. The regressions for the first period are based on 239 observations and for the second on 216.

*Source*: Deutsche Bundesbank (1976) and Vergleichende Notenbankstatistik (1925).

gold standard domestic demand and supply factors must have been very important in Germany in determining yearly business fluctuations. They also suggest that German monetary policy could have influenced to some extent the year-to-year fluctuations of the German price level, as implied by the estimates of the model presented in Chapter 5. Deviations from trend of German wholesale prices, lagged one year, seem to have had a significant effect on deviations of industrial production from trend. Thus lagged deviations from trend of German wholesale prices explain a much higher fraction of the variance of deviations from trend of industrial production in Germany than the cycles of industrial production in other countries.[14]

**Correlation of short-term interest rates in Berlin, London and Paris**

The extent to which foreign short-term private interest rates influenced those in Germany is important for the determination of the differential between the private short-term interest rate in Berlin and the official discount rate of the Reichsbank, which in turn was the major determinant of changes in the liquidity ratios of the Reichsbank and in its discount rate. It will be shown that the harmonisation of interest rates both on annual and monthly basis, although substantial, was not perfect. This left enough room for significant independent effects of the domestic cycles of real NNP and prices on German interest rates and on the differential between private short-term interest rates in Berlin and the discount rate. This section analyses the influence of foreign interests rates on German interest rates, while the analysis of the effect of the domestic cycles of real NNP and prices on German interest rates and on the differential will be taken up in Section 2.2.

Contrary to the empirical results presented in the previous section indicating a low correlation of business cycles among industrial countries during the gold standard, the regressions presented in Tables 2.5 and 2.6 seem to confirm Morgenstern's findings.[15] The top part of Table 2.5 shows regressions of the average annual German official discount rate on the United Kingdom and the French official rates for the two periods. The bottom part shows the same regressions on monthly data using the current and lagged foreign discount rates. The tests presented in these tables indicate that the degree of financial market integration was substantially higher in the second period. Moreover, the degree of financial market integration of Germany with France increased relatively more than the one with the United Kingdom. The lags with which the German official discount rate reacted to the foreign official discount rates were very short, generally the adjustment occurred within one month. The tests indicate also that the German official discount rate was systematically higher than the ones in the United Kingdom and in France, but the 'mark-up' fell substantially in the second period. This can be seen also from Figure 2.4 which shows the development of the differential between the official discount rates in Berlin and London.

Table 2.6 also shows the same regressions for the private short-term interest rates. They confirm the high degree of financial integra-

*Table 2.6* Regressions of private short-term interest rate in Berlin on private foreign short-term interest rates

| *Foreign country* | *Annual data*[a] *1876–95* | | | *1896–1913* | | |
|---|---|---|---|---|---|---|
| | *a* | *b* | $R^2adj$ | *a* | *b* | $R^2adj$ |
| UK | 1.03 | 0.97 | 0.66 | 1.41 | 0.71 | 0.50 |
| | (1.70) | (5.78) | | (2.65) | (4.24) | |
| France | 1.11 | 0.71 | 0.33 | 0.65 | 1.15 | 0.65 |
| | (2.08) | (3.20) | | (1.23) | (5.70) | |

| *Foreign country* | *Monthly data*[b] *1876–95* | | | | *1896–1913* | | | |
|---|---|---|---|---|---|---|---|---|
| | *c* | *d* | *e* | $R^2adj$ | *c* | *d* | *e* | $R^2adj$ |
| UK | 1.52 | 0.41 | 0.13 | 0.40 | 1.42 | 0.60 | 0.11 | 0.54 |
| | (13.77) | (5.71) | (1.88) | | (9.72) | (6.72) | (1.22) | |
| France | 1.19 | 0.93 | –0.26 | 0.25 | 0.66 | 1.11 | 0.03 | 0.56 |
| | (5.96) | (5.78) | (1.63) | | (3.55) | (7.46) | (0.24) | |

*Note*: Numbers in parentheses are *t*-statistics.

[a] $r_G = a + br_f$, where $r_G$ is the private short-term interest rate in Berlin, and $r_f$ is the private short-term rate in London or Paris.

[b] $r_G = c + dr_f + er_{f,-1}$ where $r_G$ is the private short-term interest rate in Berlin in month $t$, $r_f$ is the private short-term interest rate in London or Paris in month $t$ and $r_{f,-1}$ is $r_f$ lagged one month.

*Source*: Deutsche Bundesbank (1976) and Vergleichende Notenbankstatistik (1925).

tion of Germany with other industrial countries. In addition, they show that the mark-up of the German private short-term interest rate over the London and Paris rates was smaller than for the official rates. Moreover, the correlation of private short term rates was higher than for the official discount rates, as shown by the fact that both the regression coefficients and $R^2$ are generally higher. German private short-term interest rates were more synchronised with French private interest rates than United Kingdom interest rates in the period from 1896 to 1913. This explains why in Section 2.2 the private short-term interest rate in Paris has been substituted for the London rate in the regressions estimated for the latter period.

*Figure 2.4* Official discount rate differential between Berlin and London, 1876–1913

*Source*: Deutsche Bundesbank (1976) and Vergleichende Notenbankstatistik (1925)

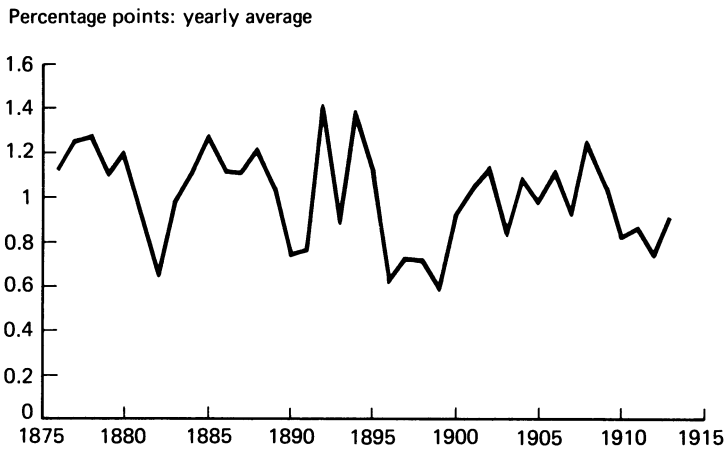
## 2.2 THE BEHAVIOUR OF THE REICHSBANK

This section contains the central analysis of this chapter, namely the study of the factors determining the discount rate changes of the Reichsbank.

The chain of interactions between, on the one hand, foreign interest rates and the German business cycle and, on the other hand, the discount rate of the Reichsbank are summarised in Table 2.7. For the purpose of analysing the short-term discount rate policy of the Reichsbank, foreign interest rates and the position of the real economy in the cycle can be considered as exogenously given or determined by past policies. These variables influenced the differential between private and official interest rates in Berlin (Channel 1 in Table 2.7). Changes in this differential influenced in turn the liquidity ratios of the Reichsbank and other asset items by changing the incentives of the private sector and commercial banks to re-discount bills at the Reichsbank (Channel 2). Liquidity ratios in turn were the major determinant of discount rate changes (Channel 3).

These three channels in the transmission of the effects of foreign interest rates and the domestic cycle to the discount rate will be investigated econometrically using annual data and, whenever poss-

*Figure 2.5* Differential between the official discount rate and the private short-term interest rate in Berlin, 1876–1913




*Source*: Deutsche Bundesbank (1976) and Vergleichende Notenbankstatistik (1925).

ible, data collected for each discount rate change. The first channel is analysed by means of regressions of the differential on the foreign interest rates and the position of the real economy in the cycle. The results are presented in Table 2.8. The tests are performed using annual data because the measure of the cycle are available only on an annual basis. The second channel will be investigated by regressing the relevant balance sheet ratios of the Reichsbank on the interest rate differential using both annual data (Table 2.9) and data relating to each discount rate change (Table 2.10). The third channel linking changes in the discount rate to changes in the liquidity ratio of the Reichsbank is analysed in Table 2.11 using data relating to each discount change, and in Table 2.12 using annual data. Finally, Channel 4 is analysed in Table 2.12 using annual data.

Several liquidity ratios were used. In regressions using annual data the ratios of gold and of all metal holdings to notes outstanding were used. Annual regressions shown in Table 2.9 and 2.12 include only the former ratio, because it yielded better results. In the regressions using data relating to each discount rate change, the ratios of all metals to bank notes outstanding and of all metals to total short-term liabilities outstanding (bank notes and sight deposits) were used because they are the only ones available.

*Table 2.7* The short-run behaviour of the Reichsbank: Summary overview of major factors and channels affecting discount rate changes 1876–1913

| *Exogenous variables*: | | | | | | |
|---|---|---|---|---|---|---|
| Foreign interest rates<br>Domestic business cycle and deviations of domestic price level from trend | (1) → | Differential between private short-term interest rate in Berlin and official discount rate | (2) → | Relevant ratios[a] in balance sheet of Reichsbank and other items in balance sheet | (3) → | Changes in discount rate |

(4) →

*Notes*: Channel (1) is studies in Table 2.8.
Channel (2) is studied in Tables 2.9 and 2.10.
Channel (3) is studied in Tables 2.11 and 2.12.
Channel (4) is studied in Tables 2.12.

[a] The most significant ratios were: the ratio of gold holdings to bank notes outstanding, the ratio of metal holdings to bank notes outstanding and to total short run liabilities outstanding.

These regressions show that the differential had a greater influence on discount rate changes in the second period, because of the better knowledge on the part of the Reichsbank about the working of the system, of the stronger links between the Berlin and the foreign money markets, and of the more frequent changes in the discount rate.

*Channel 1: The effects of the German business cycle and of foreign interest rates on the differential between the private and the official interest rate in Berlin*

Figure 2.5 shows the behaviour of the differential between the official discount rate of the Reichsbank and the private short-term interest rate in Berlin. The differential between the private and the official interest rate underwent large fluctuations during the gold standard period.[16] These fluctuations were of major importance in explaining discount rate changes, as it will be subsequently shown. The regressions of the differential on the exogenous variables are contained in Table 2.8 for the period 1876–1895 and 1896–1913. Notice that in the regressions the differential is defined as the private minus the official rate, while in Chart 2.5 the sign is reversed.

The exogenous variables explain 68 per cent of the variance of the differential in the first period and 39 per cent in the second period. The cycles of real NNP and/or prices exerted a positive effect on the differential, as already found by McGouldrick using the reference cycles of Burns and Mitchell.[17] The loss of significance of the short-term interest rate in Paris in the second period occurs partly because of the more frequent changes in the discount rate which shortened the lags between changes in the private short-term rate in Paris and the official discount rate in Berlin. As a result the effects of the Paris interest rate on the Berlin differential does not show up in the annual averages. Separate regressions of the private short-term interest rate and of the German official discount rate on the 'exogenous' variables, are presented in the lower part of the same table. The results confirm that in the first period the level of both interest rates was more affected by the deviations from trend of consumer prices, while in the second period it was more influenced by deviations from trend of real NNP. The private short-term rate was always more responsive than the official discount rate. The estimated coefficients imply that in the second period the private short-term interest rate in Berlin rose, other things being equal, by about 9.63 basis points for every 1 per cent rise of real NNP above trend.[18] The corresponding figure for the

official rate was 6.96 basis points. This pro-cyclical movement of the private short-term interest rate confirms Morgenstern's results, that the specific interest rate cycle and the reference cycle were in the same phase in 81.9 per cent of the months from February 1878 to August 1913.[19]

*Channel 2: The effects of the differential on the liquidity ratios of the Reichsbank.*

Regressions explaining changes in the liquidity ratios of the Reichsbank in terms of the differential are shown in Tables 2.9 and 2.10. Table 2.9 uses annual data and Table 2.10 data relating to each discount rate change. Table 2.9 also shows regressions of the liquidity ratios on the cyclical variables and the foreign interest rate.

The regressions using annual data are less satisfactory than those of Table 2.10 because annual averages hide relevant information. In the first period, the non-adjusted $R^2$ in the regression explaining annual changes in the gold cover of notes outstanding is 0.28, while the adjusted $R^2$ varies from 0.37 to 0.38 in the regressions using data relating to each discount rate change. In the second period, the results obtained using data relating to each discount rate change are again superior to those of Table 2.9. The regressions show that the explanatory power of the differential increased substantially during the second period, suggesting a more important function of the differential in the second period than in the first one. During the first period there seem to have been forces other than the differential affecting the liquidity ratios as direct effects of the business cycle on the demand for gold by the public and the banks. This is suggested by the fact that the explanatory power of the cyclical variables in Table 2.9 is higher than the explanatory power of the differential in the first period, while this is no longer true in the second period. As to the quantitative effect of the differential on the liquidity ratios, in the first period a 100 basis-points higher differential implied a fall of 12 percentage points of the ratio of metal holdings to notes outstanding and of 7 percentage points of the ratio of metal holdings to total short-term liabilities. During the second period, a 100 basis-point higher differential implied a fall of 18 and 10 percentage points respectively. These fluctuations were quite sharp and occurred within a relatively short period of time or less than two months on average. Finally, Table 2.10 shows that the differential was also highly significant in also explaining absolute gold holdings and earning assets of the Reichsbank. Both are expressed in millions of Marks. During the

*Table 2.8* Domestic and foreign factors affecting the differential between the private short-term interest rate in Berlin and the official discount rate (annual data) 1878–1913

| *Period* | *Intercept* | *X2* | *X3* | *X4* | *RMSE* | $R^2$ | $\varrho$ |
|---|---|---|---|---|---|---|---|
| 1878–95[a] | –1.48 | 1.69 | — | 0.18 | 0.15 | 0.68 | 0.44 |
| | (15.56) | (2.52) | | (4.54) | | | (2.12) |
| 1896–1913[a] | –0.91 | 3.10 | 1.88 | 0.003[d] | 0.16 | 0.39 | –0.07 |
| | (4.76) | (1.71) | (1.18) | (0.04) | | | (0.28) |
| *Period* | *Intercept* | *X2* | *X3* | *X4* | *RMSE* | $R^2$ | $\varrho$ |
| 1878–95[b] | 1.24 | 4.84 | — | 0.65 | 0.35 | 0.76 | 0.06 |
| | (4.60) | (2.30) | | (5.94) | | | (0.24) |
| 1896–1913[b] | 0.55 | 2.69 | 9.63 | 1.18[d] | 0.30 | 0.87 | –0.44 |
| | (1.44) | (0.66) | (2.88) | (8.24) | | | (2.08) |

| *Period* | *Intercept* | *X2* | *X3* | *X4* | *RMSE* | $R^2$ | $\varrho$ |
|---|---|---|---|---|---|---|---|
| 1878–95[c] | 2.61<br>(10.36) | 2.86<br>(1.25) | — | 0.52<br>(5.28) | 0.28 | 0.70 | –0.32<br>(1.45) |
| 1896–1913[c] | 1.61<br>(3.42) | 1.04<br>(0.21) | 6.96<br>(1.72) | 1.12[d]<br>(6.46) | 0.36 | 0.79 | –0.44<br>(2.12) |

*Note*: Numbers in parentheses are *t*-statistics. $\varrho$ is the coefficient of auto-correlation. Correction for auto-correlation has been performed by using the Cochrane–Orcutt technique.

[a] The dependent variable is the differential between the private short-term interest rate in Berlin and the official German discount rate.

[b] The dependent variable is the level of private short-term interest rate in Berlin.

[c] The dependent variable is the level of the official German discount rate.

[d] Private short-term interest in Paris.

*Legend*: *X2* = deviation from trend of German consumer price index
*X3* = deviation from trend of German NNP
*X4* = private short-term interest rate in London or Paris.

*Table 2.9* Effect of differential between private short-term rate in Berlin and official discount rate ($X8$) on changes in the ratio of gold held by the Reichsbank to Reichsbank notes outstanding, (annual data)[a] 1878–1913

| *Period* | *Intercept* | $\Delta X8$ | $X2$ | $X3$ | $\Delta X4$ | *RMSE* | $R^2$ | $\varrho$ |
|---|---|---|---|---|---|---|---|---|
| 1878–95 | 0.02 | −0.11 | — | — | — | 0.05 | 0.28 | −0.02 |
| | (1.46) | (2.44) | | | | | | (0.08) |
| | 0.01 | — | −0.61 | −0.25 | −0.03 | 0.05 | 0.41 | 0.26 |
| | (0.93) | | (2.22) | (1.00) | (2.00) | | | (1.15) |
| 1896–1913 | −0.00 | −0.14 | — | — | — | 0.04 | 0.43 | 0.11 |
| | (0.49) | (3.40) | | | | | | (0.49) |
| | 0.06 | — | — | −0.35 | −0.05[b] | 0.04 | 0.40 | −0.03 |
| | (0.06) | | | (0.96) | (2.51) | | | (0.15) |

*Note*: Numbers in parentheses are $t$-statistics.
[a] The dependent variable is $\Delta X_5$, where $X_5$ is the ratio of gold holdings to bank notes outstanding, annual averages.
[b] $X_4$ = private short-term interest rate in Paris.
*Legend*: $X2$ = deviation from trend of consumer prices index
$X3$ = deviation from trend of NNP
$X4$ = private short-term interest rate in London
$X8$ = difference between private short-term rate in Berlin and official discount rate of the Reichsbank.
*Source*: Vergleichende Notenbankstatistik (1925).

*Table 2.10* Effect of differential between private short-term rate in Berlin and official discount rate ($X8$) before each discount rate change on changes in major balance sheet items of Reichsbank, 1876–1913.

| *Period* | *No. of observations* | *Dependent variable* | *Intercept* | *X8* | $R^2$ *adj* | *DW* |
|---|---|---|---|---|---|---|
| 1876–95 | 38 | $\Delta X5A$ | −0.14 | −0.12 | 0.37 | 2.15 |
| | | | (3.96) | (4.41) | | |
| | | $\Delta X5B$ | −0.07 | −0.07 | 0.38 | 2.10 |
| | | | (3.91) | (4.50) | | |
| | | $\Delta X6$ | −44.50 | −29.78 | 0.21 | 2.23 |
| | | | (3.55) | (3.09) | | |
| | | $\Delta X7$ | 96.34 | 87.16 | 0.42 | 1.98 |
| | | | (4.19) | (4.93) | | |
| 1896–1913 | 98 | $\Delta X5A$ | −0.18 | −0.18 | 0.55 | 1.70 |
| | | | (7.26) | (10.32) | | |
| | | $\Delta X5B$ | −0.10 | −0.10 | 0.57 | 1.80 |
| | | | (7.38) | (10.71) | | |
| | | $\Delta X6$ | −96.13 | −88.22 | 0.51 | 1.47 |
| | | | (7.23) | (9.50) | | |
| | | $\Delta X7$ | 240.32 | 277.33 | 0.45 | 1.95 |
| | | | (5.09) | (8.41) | | |

*Note*: Number in parentheses are $t$-statistics.
*Legend*: $X5A$ = metal coverage of Reichsbank notes outstanding
$X5B$ = metal coverage of notes and other short-term liabilities
$X6$ = gold stock of Reichsbank, in millions of Marks
$X7$ = earning assets of Reichsbank, in millions of Marks
$\Delta$ = first difference of a variable between two statements of Reichsbank preceeding discount rate change

first period a 100 basis-point higher differential on the day prior to the discount rate change implied a 29.8 million Mark fall in the gold stock. The corresponding figure in the second period was 88.2 million. The effect of the differential on the level of earning assets was even more pronounced in both periods. The threefold increase in these coefficients reflects in part the growth of the German economy and the rise in the price level between the two periods, and in part a genuine greater responsiveness of the balance sheet items to the differential. Changes in the differential must have influenced the liquidity ratios mainly via larger discounts of bills at the Reichsbank coupled with an initial phase of passive behaviour of the Reichsbank during which the profit motive prevailed. The increase in earning assets of the Reichsbank must have led initially to a one-to-one

increase in the sum of Reichsbank notes and short-term liabilities outstanding. The effects on the liquidity ratios must have been reinforced if some of the proceeds from the re-discounting were converted by the private sector into gold.

*Channel 3: The effects of changes in the liquidity ratios on changes in the discount rate of the Reichsbank*

Table 2.11 presents regressions of changes in the discount rate on changes in the liquidity ratios. The data used relate to each discount rate change. Table 2.12 presents the same regressions using annual data. Changes in the liquidity ratios between the two Reichsbank statements explain 60 to 70 per cent of the variability of the changes in the discount rate. The coefficients of the liquidity ratios have the expected negative sign and are very significantly different from zero.[20] They indicate that a fall of 1 percentage point in the ratio of metal to notes outstanding led to the decision to raise the discount rate by 6 basis points in the first period and 3 basis points in the second. The Reichsbank was more responsive to changes in the ratio of metal holdings to all short-term liabilities: a 1 percentage point fall in the latter led to a 10 basis-point increase in the discount rate in the first period, and 6 basis points in the second. By multiplying the coefficients of the differential in the equations explaining the liquidity ratios (Table 2.10) by the coefficients of the liquidity ratios in the equations explaining discount rate changes (Table 2.11), it is shown that a 100 basis-point increase in the differential led in the first period to 63.7–65.2 basis points increase in the official discount rate, depending on the liquidity ratio used for the calculation.[21] In the second period, the response of the Reichsbank was also less than full, being in the order of 61.2 to 62.0 basis points for every 100 basis-point increase in the differential.

The same regressions using annual data are shown in Table 2.12. They support the empirical results of Table 2.11. In the second period the ratio of gold to notes explains less of the annual variance of changes in the discount rates due to the greater variability of liquidity ratios and of the discount rate within the year. The $R^2$ of the regression using annual data is 0.49 for the second period as opposed to $R^2$ of 0.70 and 0.69 of the corresponding regressions in Table 2.11.

*Table 2.11* Reaction function of the Reichsbank; determinants of changes in the discount rate (data referring to each discount rate change)

| *Period* | *No. of observations* | *Intercept* | *ΔX5A* | *ΔX5B* | *RMSE* | $R^2$ | $\varrho$ |
|---|---|---|---|---|---|---|---|
| 1876–95 | 38 | 0.01 | −0.06 | — | 0.45 | 0.63 | 0.29 |
| | | (0.14) | (7.77) | | | | (1.87) |
| | 38 | 0.01 | — | −0.10 | 0.49 | 0.57 | 0.19 |
| | | (0.19) | | (6.82) | | | (1.21) |
| 1896–1913 | 98 | 0.04 | −0.03 | — | 0.44 | 0.70 | 0.20 |
| | | (1.16) | (15.02) | | | | (2.06) |
| | 98 | 0.06 | — | −0.06 | 0.46 | 0.69 | 0.19 |
| | | (1.56) | | (14.41) | | | (1.89) |

*Source*: Vergleichende Notenbankstatistik (1925) Table 133, p. 240–45.
*Legend*: *X5A* = metal coverage of Reichsbank notes outstanding
*X5B* = metal coverage of notes and other short-term liabilities outstanding
*Δ* = first difference between latest available statement, usually relating to two to four days before the discount rate change and a statement relating to two weeks to two months prior to the former.

*Table 2.12* Reaction function of Reichsbank; determinants of changes in the official discount rate (annual data)[a] 1876 – 1913

| *Period* | *Intercept* | *X2* | *X3* | *ΔX4* | *ΔX5* | *RMSE* | $R^2$ | $\varrho$ |
|---|---|---|---|---|---|---|---|---|
| 1878–95 | 0.05 | — | — | — | –0.06 | 0.36 | 0.57 | 0.18 |
| | (0.59) | | | | (4.45) | | | (0.79) |
| | −0.02 | — | — | 0.52 | — | 0.35 | 0.58 | 0.24 |
| | (0.33) | | | (4.53) | | | | (1.06) |
| | −0.01 | 1.84 | | 0.50 | — | 0.33 | 0.66 | 0.36 |
| | (0.15) | (1.84) | | (4.73) | | | | (1.62) |
| 1896–1913 | 0.11 | — | — | — | –0.11 | 0.57 | 0.49 | –0.24 |
| | (0.63) | | | | (3.79) | | | (1.07) |
| | 0.00 | — | — | 1.17[b] | — | 0.43 | 0.72 | 0.02 |
| | (0.04) | | | (6.19) | | | | (0.07) |
| | 0.02 | – | 7.87 | 1.05[b] | — | 0.36 | 0.83 | 0.20 |
| | (0.21) | | (2.80) | (6.47) | | | | (0.88) |

[a] The dependent variable is the first difference of the official discount rate, with respect to the previous year.
[b] private short term interest rate in Paris
*Legend*: *X2* = deviations from trend of wholesale price index
*X3* = deviation from trend of German real NNP
*X4* = private short-term rate in London or Paris
*X5* = ratio of Reichsbank's gold holdings to notes outstanding.

*Channel 4: The effects of the 'exogenous' variables on discount rate changes*

Table 2.12 shows also regressions of the changes in the discount rate on the exogenous variables. The coefficient of the deviation of consumer prices from trend is positive and significant at the 10 per cent level in the first period, and the deviation of real NNP from trend is positive and significantly different from zero at the 5 per cent level in the second period. The changes in the foreign private short-term interest rate are very significantly different from zero in both periods, with coefficients which are twice as large in the second one. The fraction of the variance explained by the regressions is 66 per cent in the first period and 83 per cent in the second one.

The last regressions for each period in Table 2.12 have to be interpreted with caution: they do not imply that the Reichsbank was directly reacting to the position of the economy in the cycle, to deviations of inflation from its trend and to foreign interest rates. Rather these variables were influencing the liquidity ratios through the widening and narrowing of the differential, and the Reichsbank was reacting to changes in the liquidity ratios.[22] In this sense the liquidity ratios were an automatic signalling device for a central bank principally interested in keeping the notes in circulation convertible into gold and in making profits. The perfection of the working of the system lay in an automatic and prompt transmission of information about the position of the economy in the cycle and the inflation outlook through the behaviour of the liquidity ratios without needing data on the cyclical position of the economy and/or prices. Thus the evidence presented here supports the narrow interpretation of the 'rules of the game' of the classical gold standard along the lines suggested by Goodhart rather than broader interpretations. The evidence reported here also seems to indicate that the working of the system was more automatic on average in the second part of the gold standard. As a result, the role of the discount rate changes and of German monetary policy as a tool for stabilisation of economic activity and of the price level must have increased in the latter period.

There is a similarity between the stabilisation of the liquidity ratios in Germany during the gold standard and the policy by the German Bundesbank of keeping the growth of the monetary base within predetermined margins during the second half of the 1970s. These two intermediate targets of monetary policy were intended to play the same role, and in large part they did.[23]

## 2.3 THE DETERMINANTS OF GOLD-FLOWS BETWEEN GERMANY AND ABROAD

This section presents a stylized model of the German monetary system during the gold standard. An equation to explain Germany's gold flows in the spirit of the monetary approach to the balance of payments is derived and tested. Bloomfield's interpretation of 'the rules of the game' of gold standard Central Banks is then assessed in the light of the empirical findings. It is shown that, at least for Germany, the direction of causation was mostly from domestic assets to international gold flows as predicted by the monetary approach to the balance-of-payments and not the other way around and that gold flowed in during expansions and out during depressions.

Equation (2.1a) in Table 2.13 is a demand function for currency and sight deposits at the Reichsbank by the German private sector. This function is assumed to depend on the price level, real NNP and the private short-term interest rate in Berlin. Equation (2.1b) defines currency in circulation as the sum of coins other than gold coins ($S^P$), gold coins ($G^P$), Reichsbank notes outstanding ($N$) and notes issued by private issuing banks and by the Treasury (NP). Substituting equation (2.1b) into equation (2.1a) and taking first differences, one obtains equation (2.1c), the equilibrium condition in the market for currency and sight deposits. Equations (2.2a) and (2.2b) represent the balance sheet of the Reichsbank expressed in level form and in first differences respectively. $DA$ are domestic earning assets of the Reichsbank, $G^R$ and $S^R$ are gold and silver holdings respectively. $N$ are notes outstanding and $SL$ are other short-term liabilities. Equation (2.2b) can be solved for the sum of $\Delta N^{24}$ and $\Delta(SL)$ and substituted into equation (2.1c) to obtain the equilibrium condition in the market for bank notes and sight deposits, equation (2.3a). $\Delta S^P$, $\Delta S^R$ and $\Delta$ (NP) have been assumed for simplicity to be equal to zero, since silver holdings of the public and of the Reichsbank and notes issued by private issuing banks fluctuated relatively little. In addition, lack of adequate data would have prevented them from being used explicitly in the empirical work. Equation (2.4a) defines the balance-of-payments surplus as the sum of additions of gold to private circulation and to Reichsbank gold holdings. Equation (2.4b) is the balance-of-payments equation to be tested and is obtained by substituting (2.3a) into (2.4a).

The assumptions of purchasing power parity and of perfect capital market integration underlying equation (2.4b) did not hold during

*Table 2.13* Derivation of equation explaining German international gold-flows during the gold standard.

*Demand function for currency in circulation and sight deposits at the Reichsbank*

$$BU + SL = pf(y, r) \quad (2.1a)$$

*Supply of currency in circulation*

$$BU = S^p + G^p + N + NP \quad (2.1b)$$

*Equilibrium condition in the currency market*

$$f.\Delta p + p\frac{\partial f}{\partial y}\Delta y + p\frac{\partial f}{\partial r}\Delta r = \Delta S^p + \Delta G^p + \Delta N + \Delta(SL) + \Delta(NP) \quad (2.1c)$$

*Balance sheet of the Reichsbank*

$$\mathrm{DA} + G^R + S^R = N + SL \quad (2.2a)$$

$$\Delta(\mathrm{DA}) + \Delta G^R + \Delta S^R = \Delta N + \Delta(SL) \quad (2.2b)$$

*Equilibrium condition in the market for bank notes and sight deposits*

$$f\Delta p + \mathrm{pf}\,\eta_{f\cdot y}\Delta \mathrm{y} + \mathrm{pf}\eta_{f\cdot r}\Delta \mathrm{r} = \Delta G^p + \Delta G^R + \Delta(DA) \quad (2.3a)$$

*Balance-of-payments definition*

$$BP = \Delta G^p + \Delta G^R \quad (2.4a)$$

$$BP = f.\Delta p + pf\eta_{f\cdot y}\Delta y + pf\eta_{f\cdot r}\Delta r - \Delta(DA) \quad (2.4b)$$

*Legend*: (1) *Endogenous variables in the system of Equations (2.1c), (2.2b), (2.3a) and (2.4a)*:

- $\Delta N$ = changes in bank notes outstanding issued by the Reichsbank
- $N\Delta G^P$ = changes in gold in circulation
- $N\Delta G^R$ = changes in gold holdings of the Reichsbank
- $BP$ = balance of payments.

(2) *Exogenous variables*:

- $\Delta\ (BU)$ = changes in total currency in circulation
- $\Delta\ (DA)$ = changes in domestic earning assets of the Reichsbank
- $\Delta\ (NP)$ = changes in notes issued by private issuing banks and by the Treasury
- $\Delta p$ = changes in the consumer price level
- $\Delta r$ = changes in private short-term interest rate in Berlin
- $\Delta S^P$ = changes in silver coins in circulation
- $\Delta S^R$ = changes in silver holdings of the Reichsbank
- $\Delta\ (SL)$ = changes in short-term liabilities of the Reichsbank
- $\Delta y$ = changes in real NNP

*Other symbols*:

- $\eta f{\cdot}y$ = elasticity of demand for currency with respect to $y$
- $\eta f{\cdot}r$ = elasticity of demand for currency with respect to $r$
- $\Delta$ = difference operator.

*Assumptions*: $\Delta S^P = \Delta S^R = \Delta\ (NP) = 0$

the gold standard. However, this does not invalidate the major implications of the monetary approach to the balance-of-payments, that an increase in earning assets of the Reichsbank should lead to a gold outflow from Germany once equilibrium is reached in the currency and sight deposit market. Moreover, international gold-flows should be positively correlated with the real NNP and with the price level. By applying the same theory to foreign countries an increase in foreign real NNP and in the foreign price level is expected to influence positively the demand for currency abroad and hence negatively German gold holdings.[25] Therefore, the ratio of German to foreign NNP and of German to the foreign consumer price index and the difference between the Berlin and the London or Paris short-term rates have been substituted for the corresponding German variables in equation (2.4b). Thus the equation actually tested is:

$$BP = a_1\Delta(y/y_f) + a_2\Delta(p/p_f) + a_3\Delta(DA) + a_4\Delta\ (r-r_f) \qquad (2.4c)$$

where a subscript $f$ indicates a foreign variable.

Table 2.14 shows the ordinary least square and the two stage least square estimates of equation (2.4c). Estimates by two stage least square were necessary in order to eliminate the possible influence of gold flows on domestic earning assets. Lags of the explanatory variables were included in the regressions, to allow for the possibility that lags in the adjustment of the balance-of-payments might be longer than one year. Relative real NNP and relative consumer prices always have the expected positive sign and changes in earning assets the expected negative one. The interest rate differential was never significantly different from zero. It has a negative sign in the first period and a positive one in the second, possibly reflecting a higher responsiveness of capital flows to changes in the differential of domestic to foreign interest rates in the latter period. An insignificant coefficient of the interest rate differential in the regressions of Table 2.14 is not inconsistent with a very significant role of the differential in determining capital flows as found for the United Kingdom by Goodhart. He regressed the residual between gold-flows and the trade balance, a proxy for net capital flows, on the United Kingdom and United States and the United Kingdom and French interest rate differentials and found that both were very significant (Goodhart, 1972, chapter 14, p. 202).

Ordinary least-square estimates of Equation (2.4c) for the second period are inferior to the two-stage least-square estimates, while

*Table 2.14* Gold flows between Germany and the rest of the world: a test of some implications of the monetary approach to the balance of payments (annual data) 1878–1912 [a]

| *Method of estimation* | *Period* | *Intercept* | $\Delta(y/y_f)$ | $\Delta(y/y_f)_{-1}$ | $\Delta(p/p_f)$ | $\Delta(DA)$ | $\Delta(DA)_{-1}$ | $\Delta(r-r_f)$ | $R^2$ | $R^2adj$ | *DW* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| OLS | 1878–95 | 24.04 | — | 508.83 | 2881.02 | −0.42 | −0.36 | 20.47 | 0.63 | 0.48 | 0.85 |
| | | (1.36) | | (2.44) | (2.56) | (2.84) | (2.00) | (0.85) | | | |
| $2SLQ$[b] | | 26.40 | — | 118.25 | 3148.33 | −0.71 | — | −29.26 | 0.64 | 0.53 | 1.70 |
| | | (1.56) | | (0.43) | (2.95) | (3.11) | | (1.08) | | | |
| *OLS* | 1896–1912 | 112.02 | 697.13 | — | 3652.90 | −0.42 | — | 23.72 | 0.45 | 0.26 | 1.18 |
| | | (4.09) | (0.91) | | (2.65) | (2.08) | | (0.43) | | | |
| $2SLQ$[b] | | 135.86 | 1569.38 | — | 3877.88 | −1.05 | — | 17.96 | 0.77 | 0.69 | 1.31 |
| | | (7.35) | (3.23) | | (4.43) | (5.20) | | (0.51) | | | |

[a] The dependent variable is sum of changes in the gold stock in circulation and in the gold stock of the Reichsbank ($\Delta X9 + \Delta X10$). *Source*: Vergleichende Notenbankstatistik (1925),Mitchell (1975), Deutsche Bundesbank (1976) and Bourguignon and Levy-Leboyer (1984).

[b] Two-stage, least-square estimates. DA, the domestic assets of the Reichsbank is equal to the sum of claims on government (*MF*) and on banks and the private sector (A) (see Tables 1.32 and the model of Chapter 5).

*Legend*: $y, y_f$ = German real NNP index and foreign real GDP/NNP index where the latter is a weighted average of UK, US and French output indices (see Table 2.2 for weights used). All indices are 1913 = 100

$p, p_f$ = German and foreign consumer price indices (1913 = 100). Foreign index is a weighted average of UK, US and French indices with same weights as for output (see also Table 2.2)

$r, r_f$ = German and foreign private short-term interest rate. For the period 1878–95 the London rate has been used, for the later period the Paris rate. (see Section 2.1 for explanation)

$\Delta$ = First difference of a variable. A subscript −1 indicates a lagged variable.

there is not a big difference in the first period. This suggests that the reverse causation from gold-flows to earning assets may have been stronger in the second period. The bias in the ordinary least-square estimates of the coefficient of changes in earning assets in both periods is towards zero rather than minus one. The size of the coefficient of changes in earning assets in the two-stage least-square estimates is not significantly different from minus one in the second period. It is equal to –0.71 in the first period suggesting that increases in earning assets needed somewhat more than a year to exert their full effect on international gold-flows of Germany. Again this could be an indication of lower capital market integration in the first period. Finally, the values of the intercepts indicate that average annual gold inflows into Germany were about five times higher in the second period due to relative abundance of gold in the world markets.

The fact that international gold flows moved procyclically like earning assets and unlike the gold stock of the Reichsbank gives further indication that the Reichsbank did not systematically "sterilize" international gold flows. Per se gold flows between Germany and abroad weakened the anticyclical discount rate policy of the Reichsbank, because the foreign channel represented a source of gold which was alternative to the gold holdings of the Reichsbank at peaks of the business cycles when demand for gold by the private sector was high. However the procyclical movement of the Reichsbank domestic earning assets, coupled with the negative response of international gold flows to increases in earning assets, implied that the Reichsbank de facto counteracted the effects of the cycle on international gold flows. This behaviour tended to reinforce the effects of the cycle on the liquidity ratios of the Reichsbank by reducing the role of the foreign channel as the supplier of gold to the private sector.

Some authors have treated the balance of payments or gold-flows as equivalent to the current account of the balance of payments or to the trade balance in analysing the working of the gold standard system.[26] Some of the misunderstandings about the implications of the monetary approach to the balance of payments, and particularly its predictions that an increase in economic activity affects the balance of payments positively, arise from the fact that some authors confuse the balance of payments with the current account or the trade balance. A positive effect of economic activity and of an increase in the domestic relative to the foreign price level on the balance of payments is not inconsistent with a negative effect of the

*Table 2.15* Effects of relative price changes on the trade balance:[a] a test of Hume's adjustment mechanism (annual data) 1878–1912

| *Period* | *Intercept* | $\Delta(p/p_f)$ | $\Delta(p/p_f)_{-1}$ | $\Delta(y/y_f)_{-1}$ | $R^2$ | $\varrho$ |
|---|---|---|---|---|---|---|
| 1878–95 | 0.95 | −3.25 | −2.72 | — | 0.20 | 0.46 |
| | (17.76) | (1.72) | (1.45) | | | (2.19) |
| | 0.95 | −3.95 | −3.13 | −0.94 | 0.55 | −0.49 |
| | (22.55) | (2.69) | (2.17) | (3.28) | | (2.38) |
| 1896–1912 | 0.80 | −0.56 | −0.08 | — | 0.21 | −0.44 |
| | (74.34) | (1.89) | (0.27) | | | (2.00) |
| | 0.80 | −0.45 | −0.22 | −0.19 | 0.27 | 0.42 |
| | (75.03) | (1.44) | (0.66) | (0.96) | | (1.93) |

[a] The dependent variable is the ratio of nominal exports to nominal imports of goods. Numbers in parenthesis are t-statistics. the auto-correlation has been corrected by the Cochrane–Orcutt technique.
*Legend*: See Table 2.14.

former variables on the current account or on the trade balance. Table 2.15 shows that the effects of changes in relative consumer prices and relative real NNP/GDP on the trade balance were negative and highly significantly different from zero in the first period. Relative consumer prices and relative activity levels explain 55 per cent of the variance of the trade balance. In the second period they explain only 27 per cent of the variance of the trade balance and their coefficients have a low statistical significance. This can be explained by the fact that the German price level and the German business cycle tended in the latter period to be more synchronised with the corresponding foreign ones.

Since the cyclical behaviour of the trade balance and its response to relative price changes is opposite to the cyclical behaviour of the balance of payments, care must be taken not to confuse the former with the latter. For the analysis of the working of the gold standard and the behaviour of central banks in relation to the 'rules of the game', it is the former that is crucial, not the latter. In this respect, modelling the gold standard in terms of Hume's price specie flow is an excessive oversimplification that leads to misleading results and neglects the role of the central bank in the adjustment of the balance of payments.

**Notes**

1. The difference between the highest and the lowest level of gold holdings as a ratio of average annual gold holdings reached a maximum of 50.6 per cent in 1905 and a minimum of 22.9 in 1892. The difference between the highest and the lowest level of fiduciary notes outstanding as a fraction of average yearly total Reichsbank notes outstanding reached a maximum of 74.6 per cent in 1912 and a minimum of 23.8 per cent in 1877. Variability within the year of notes outstanding increased substantially in the second part of the gold standard period. It goes without saying that part of the variability of both assets and liabilities was caused by seasonal factors. A similar variability is observed for the gold holdings and fiduciary notes outstanding of the Bank of England, while it was substantially lower for the other central banks for which comparable data are available.
2. See Johnson (1958, 1973). For empirical tests for industrial countries in the post-1945 period, see Frenkel and Johnson (1976) and Tullio (1979, 1981).
3. Changes in domestic assets of the Reichsbank are compared here with the balance of payments defined as international gold flows rather than with changes in foreign assets of the Reichsbank, as in Bloomfield. The two variables were not equivalent because the public held substantial amounts of gold and because the Reichsbank held some foreign exchange, especially in the latter part of the period. The former comparison is more relevant when the focus is on the determinants of the balance of payments.
4. See Balassa (1964).
5. See Table 1.5 and Figure 1.3.
6. Owing to fixed exchange rates these ratios can be considered as measures of the real exchange rate. For the real Mark-dollar exchange rate (from 1880 to 1979) see Figure 1.10.
7. See Figure 2.2.
8. See Table 1.8.
9. See Table 2.2.
10. See Figure 2.2.
11. Including the growth of the size of the government sector both as a producer of non-traded goods and as a levier of indirect taxes.
12. It should be further mentioned that the annual real GDP data for France used here have been kindly obtained from Bourguignon and Levy-Leboyer (1984). However, the percentage changes by decade of their data do not correspond with the ones reported by Perroux (1955).
13. See Morgenstern (1959) Table 2, p. 45.
14. Regressions of yearly deviations from trend of German industrial production on deviations from trend of German wholesale prices are reported below for the two gold standard periods, where a is the intercept and b the coefficient of the independent variable:

| | *1878–95* | | | *1896–13* | |
|---|---|---|---|---|---|
| *a* | *b* | $R^2adj$ | *a* | *b* | $R^2adj$ |
| 0.18 | 0.99 | 0.18 | -0.05 | 0.32 | 0.28 |
| (0.25) | (1.38) | | (0.39) | (2.66) | |

15. Morgenstern found that German and UK short-term market interest rates were in the same phase of the specific interest rate cycle in 71.1 per cent of the months from February 1878 to August 1913 (see Morgenstern, 1959). The German and French rates were in the same phase in 70.4 per cent of the months and the German and the US rates in 64.1 per cent of the months.
16. The differential is always positive when annual averages are used, because the official rate was the rate charged on loans of varied quality, while the private rate refers to lower risk loans. However, during the period the official rate fell from time to time below the private rate.
17. McGouldrick finds that during the 6 business upswings the spread as defined here increased by 43 basis points on average. It fell by 42 basis points on average during the 5 downswings.
18. This is slightly less than half of the size of the coefficients found by Tanzi (1980) for the short-term US interest rates from 1959 to 1975.
19. Morgenstern (1959) Table 14, p. 93.
20. Bloomfield showed graphically that this negative correlation between the liquidity ratios and discount rate changes held for most gold standard countries.
21. The coefficients in the tables are rounded up and their multiplication does not give precisely the figures reported in the text.
22. Bloomfield (1959) held a similar view.
23. It would be interesting to pursue this comparison further and analyse the relative merits of one versus the other intermediate objective. This is, however, beyond the scope of this chapter.
24. $\Delta$ is the first difference operator.
25. Assuming that the foreign central banks do not fully accommodate the increased demand for currency abroad.
26. See, for instance, Gregory, Baltagi and Sailors (1984).

# 3 The Hyperinflation and Currency Depreciation in Germany, 1914–23

## INTRODUCTION

The worst inflation to plague Germany since unification occurred after the end of the First World War. For sixty months, between January 1919 and December 1923, the wholesale price index rose on average by 45.6 per cent per month. Like everyone else living through rapid inflation, the Germans directed their invectives against businessmen, the financial community and farmers, who were thought to have sold goods at higher than 'fair' prices. In fact, the rapid increase in the price level was caused by a rapid expansion of the stock of money induced by large government budget deficits.

Germany departed from the gold standard at the outbreak of the First World War. In November 1923, the Mark was made redeemable in the new 'rentenmark', after having fallen to an infinitesimal portion of its 1913 value. The depreciation of the Mark stretched over about ten years, but it was unevenly distributed during this period. From June 1914 to June 1919 the inflation rate, measured by the wholesale price index, averaged only 1.9 per cent per month.[1] It accelerated to an average of 8.7 per cent per month between July 1919 and June 1922, and to an average of 44.0 per cent per month between July 1922 and May 1923. From then on inflation accelerated extremely rapidly, reaching a peak of 10129 per cent in November 1923 with respect to October 1923.

Although inflation was much lower before May 1922, the factors which ultimately led to the collapse of the Mark originated at the beginning of the First World War. Government expenditure increased sharply during the war years leading to substantial government deficits, mainly because the structure of the fiscal system made it difficult to increase tax revenues rapidly. The deficits were financed to a large extent by monetary means. This led to a strong increase in real cash balances because of the system of wage and price controls during the war and of expectations that at the end of the war prices might return to prewar levels. After the end of the war, cash balances

continued to increase rapidly because of the attitude of the Reichsbank which kept nominal interest rates at an extremely low level, thus stimulating the re-discounting of Treasury bills and commercial bills by banks at the Reichsbank. The real exchange rate, which fluctuated relatively little during the war, depreciated during 1919 and 1920 thus contributing to the increase of inflation, and returned to purchasing power parity only in the last months of 1923, when price increases overtook the nominal exchange rate.

This chapter is divided in two parts: (1) a description of the main economic events and policy measures from 1914 to 1923 (Sections 3.1 to 3.4); and (2) an analysis of the dynamics of the exchange rate and prices by means of an econometric model (Section 3.5). Section 3.1 deals with the financing of war expenditures, price controls and inflation from 1914 to 1919. Section 3.2 deals with fiscal policy, monetary growth, inflation and exchange rate changes from 1919 to 1923. Section 3.3 concentrates on the monetary developments during the last stages of the hyperinflation period and the monetary reform covering the period from August to December 1923. Section 3.4 is devoted to the analysis of the behaviour of real economic variables and their relationship to monetary and financial developments during the period from 1919 to 1924. Finally, Section 3.5 presents a brief survey of the main theoretical and empirical studies on the German hyperinflation and analyses the dynamics of the exchange rate and prices with the help of a three equation disequilibrium model.

In this model, the equilibrium exchange rate is determined according to the monetary approach to exchange rate determination. Similarly, the equilibrium price level is determined by the supply of nominal cash balances and the real demand for them as implied by the quantity theory of money. The model explains the deviations of the actual exchange rate from purchasing power parity by allowing prices and the exchange rate to adjust at different speeds to monetary disequilibrium. Once it is recognised that the rate of change of the exchange rate differs in the short run from the rate of inflation, it becomes necessary to take into account substitution with foreign goods or foreign currency as well as substitution with domestic goods in the demand for real cash balances. Estimates of the model confirm the importance of monetary disturbances in price and exchange-rate movements and of the their different speed of adjustment in explaining the very large deviations of the latter from purchasing power parity. The model has been estimated simultaneously by a full information maximum likelihood method developed by Wymer

(1976), the same method used to estimate the 100-year disequilibrium model of the German economy presented in Chapter 5.

## 3.1 THE FINANCING OF WAR EXPENDITURE, PRICE CONTROLS AND INFLATION, 1914–18

The high inflation rates and the depreciation of the Mark in the decade 1914–23 were, to a large extent, the consequence of the strong increase in government expenditures and budget deficits, of the monetary financing during and in the aftermath of the First World War and of very expansionary monetary policies, particularly in 1920 1922, and 1923. Total government expenditure in relation to NNP increase from about 10 per cent in 1913 to about 73 per cent in 1917 (Chart 1.7). However, central government revenues remained at about one-eighth of central government expenditure in the years 1914 to 1918 (Table 3.1). The German government thought at first that the war would be short and did not raise taxes.[2] When new taxes were introduced in 1916, they were totally inadequate to finance increasing government expenditure. The difficulty in rapidly raising new taxes was largely connected to the inherited structure of the fiscal system. At the time of German unification, the central government was allowed to collect mainly indirect taxes, while direct taxation remained a prerogative of states and municipalities.[3] Besides having little leeway to rapidly increase direct tax revenues, the Reich was put in a difficult position by falling revenues from tariffs and export duties.

*Table 3.1* Central Government expenditure and revenue 1914–18 (in billions of Marks)[a]

| | *Expenditure* | *Revenue*[a] | *Budget deficit (as percentage of NNP)* |
|---|---|---|---|
| 1914 | 9.651 | 2.350 | 15.9 |
| 1915 | 26.689 | 1.735 | 51.1 |
| 1916 | 28.780 | 2.029 | 79.6 |
| 1917 | 53.261 | 7.830 | 62.3 |
| 1918 | 45.514 | 6.795 | 41.8 |

*Sources: Statisches Bundesamt, Statistische Jahrbuch fur das Deutsche Reich, 1921*; Bresciani-Turroni (1924).
[a] Fiscal years.
[b] Ordinary revenues.

*Table 3.2* Contributions of monetary financing of the government budget deficit to changes in currency in circulation, (in percent) 1914–18

| | *Monetary financing*[a] | *Currency in circulation*[b] | *Government debt held by the Reichsbank*[c] |
|---|---|---|---|
| 1914 | 33.6 | 16.1 | 21.8 |
| 1915 | 9.2 | 26.6 | 16.6 |
| 1916 | 8.0 | 17.0 | 13.6 |
| 1917 | 2.5 | 42.4 | 14.9 |
| 1918 | 1.1 | 53.2 | 20.9 |

[a] Ratio of Reichsbank claims on private sector and banks to claims on government, end of period data.
[b] Average of the period data; yearly percentage changes.
[c] As a proportion of central government debt.
*Sources*: Statistisches Reichsamt, Sonderhefte zu Wirtschaft und Statistik, *Zahlen zur Geldentwertung in Deutschland 1914 bis 1923* (1925); Deutsche Bundesbank, *Deutsches Geld – und Bankwesen in Zahlen 1876–1975*. (1976); Bresciani-Turroni (1937).

The central government budget deficit, as a proportion of NNP, increased from about 16 per cent in 1914 to about 80 per cent in 1916, before falling to about 42 per cent in 1918. In 1914, the central government financed the increased deficit largely by monetary means because of difficulties in raising the necessary financies through bond issues and taxes. In 1915, large amounts of government bonds and bills were sold to the private sector and banks. By the end of 1916, the Reichsbank was buying an increasingly large amount of Treasury bills owing to very low nominal interest rates.[4] Government debt held by the Reichsbank increased from 2.5 per cent of total central government debt in 1912 to 20.9 per cent in 1918 with the result that cash balances increased very rapidly from 1914 onwards, as shown in Table 3.2. Domestic prices increased less rapidly than the quantity of money because of wage and price controls, which were introduced in August 1914 and reinforced successively.[5] There was also the expectation of a return of the exchange rate to prewar levels, which induced some hoarding of money.[6] As a result, the ratio of currency in circulation to NNP increased from about 12 per cent in 1913 to about 36 per cent in 1918. The real exchange rate index[7] rose to 1.33 (1.0 = 1913) in 1918, implying a depreciation of about 5.7 per cent per year.[8] The rapid rise of real currency in circulation and the real depreciation of the exchange rate were at the origin of the inflationary process and

*Table 3.3* Central government expenditure and revenue, (annual and monthly data), 1919–23

| | | *Expenditure (in billion of gold Marks)* | *Revenue (in billion of gold Marks)* | *Budget deficit (in per cent of NNP)* |
|---|---|---|---|---|
| 1919 | | 8.6 | 2.6 | 33.9 |
| 1920 | | 9.3 | 3.2 | 19.0 |
| 1921 | | 6.7 | 2.9 | 10.2 |
| 1922 | | 4.0 | 1.5 | 6.2 |
| 1923 | | 5.3 | 0.5 | 17.2 |
| 1923 | Jan. | 0.20 | 0.07 | |
| | Feb. | 0.28 | 0.05 | |
| | Mar. | 0.70 | 0.10 | |
| | Apr. | 0.47 | 0.15 | |
| | May | 0.28 | 0.12 | |
| | Jun. | 0.50 | 0.05 | |
| | Jul. | 0.50 | 0.05 | |
| | Aug. | 1.01 | 0.10 | |
| | Sep. | 1.66 | 0.06 | |
| | Oct. | 0.88 | 0.02 | |
| | Nov. | 0.44 | 0.02 | |
| | Dec. | 0.20 | 0.07 | |

*Source*: Bresciani-Turroni (1937).

the even more rapid depreciation of the exchange rate between 1919 and 1923.

## 3.2 THE HYPERINFLATION PERIOD, 1919–23

In the months following the end of the war, upheavals in public sector finances continued to be the principal cause of the increase in currency in circulation, the high inflation rate and the depreciation of the exchange rate. Despite the elimination of war expenditure, other expenses started to burden the Reich.[9] These were related to the conditions imposed by the Armistice, demobilisation, and unemployment subsidies. In 1919 reparation payments imposed on Germany by the Versailles Treaty were estimated to be around 10 per cent of NNP, interest payments on public debt were around 10 per cent of NNP, while ordinary expenditure was around 12 per cent of NNP. Although the budget deficit in relation to NNP declined from 42 per cent in 1918 to 34 per cent in 1919, it remained extremely high (Table 3.3). A fiscal reform which would have kept the budget in balance

*Table 3.4* Contributions of monetary financing of the government budget deficit to changes in currency in circulation, (annual data), 1919–23

| | *Monetary*[a] *financing* | *Currency in*[b] *circulation* | *Government debt held by the Reichsbank*[c] | *Prices*[d] |
|---|---|---|---|---|
| 1919 | 0.9 | 80.3 | 26.3 | 91.2 |
| 1920 | 3.7 | 65.4 | 30.8 | 258.1 |
| 1921 | 0.8 | 33.8 | 39.6 | 28.6 |
| 1922 | 29.7 | 287.8 | 21.3 | 1 688.7 |
| 1923 | 0.1 | $2.13 \cdot 10^8$ | 40.0 | $4.86 \cdot 10^8$ |

[a] Ratio of Reichsbank claims on private sector and banks to claims on government; end of period data.
[b] Average of period data; yearly percentage changes.
[c] In per cent of central government debt.
[d] Percentage changes of yearly averages of wholesale prices.
*Sources*: Deutsche Bundesbank, *Deutsches Geld- und Bankwesen in Zahlen 1876–1975* (1976). Bresciani-Turroni (1937).

would have required an increase in fiscal pressure to about 35 per cent of NNP from an estimated 12 per cent in 1913. At the end of the war, however, the disruption of political life prevented any such measures being taken. In 1919 currency in circulation increased by about 80 per cent (Table 3.4) and domestic wholesale prices by about 91 per cent. The real exchange rate depreciated greatly, particularly after July 1919, because of monetary disequilibrium and of expectations of exchange rate changes following the financial obligations imposed on Germany by the Treaty of Versailles. Fears of revolutionary movements also contributed to a 'flight from the Mark'.

At the end of 1919 and in 1920, the new socialist government introduced a radical fiscal reform by creating a taxation system centralised under the Reich, with states and municipalities passing into a fully subordinate position. The main elements of the reform were: (1) the substitution of the income tax of the states with an income tax of the Reich; (2) the introduction of a corporate income tax with retention at source. As a result, in 1920 the Reich's revenues increased, although at a slow rate owing to lags in the implementation of the fiscal law. The budget deficit in relation to NNP declined to 19 per cent (Table 3.3). However, public sector debt held by the Reichsbank continued to increase, reaching 31 per cent of central government debt, despite the strong reduction of the fiscal stimulus. Moreover, the maintenance of very low nominal interest rates in-

*Table 3.5* Currency in circulation, the exchange rate and prices (percent changes with respect to the previous quarter) 1919–23

| | *Currency in circulation*[a] | *Exchange rate*[b] | *Prices*[c] |
|---|---|---|---|
| 1919 I | 12.5 | 25.5 | 11.8 |
| II | 14.7 | 34.8 | 12.4 |
| III | –0.1 | 71.7 | 60.1 |
| IV | 18.6 | 94.2 | 62.9 |
| 1920 I | 18.8 | 79.4 | 112.8 |
| II | 14.6 | –53.4 | –19.1 |
| III | 11.0 | 48.2 | 8.3 |
| IV | 7.8 | 25.9 | –3.9 |
| 1921 I | –1.5 | –14.4 | –7.1 |
| II | 5.6 | 11.1 | 2.1 |
| III | 11.8 | 51.3 | 51.3 |
| IV | 29.5 | 82.9 | 68.7 |
| 1922 I | 14.3 | 48.1 | 55.8 |
| II | 28.6 | 11.7 | 29.4 |
| III | 84.0 | 361.8 | 308.3 |
| IV | 289.5 | 417.7 | 413.9 |
| 1923 I | 331.1 | 179.1 | 231.1 |
| II | 213.8 | 419.3 | 297.0 |
| III | 1 622.9 | 897.8 | 1 234.4 |
| IV | 17 580.7 | 42 483.3 | 52 678.8 |

[a] End of quarter data.
[b] Mark–Dollar exchange rate; end of quarter data.
[c] Wholesale price index; end of quarter data.
*Source*: Statistisches Reichsamt, Sonderheft No. 1 zu Wirtschaft und Statistik, *Zahlen aur Geldentwertung in Deutschland 1914 bis 1923* (1925).

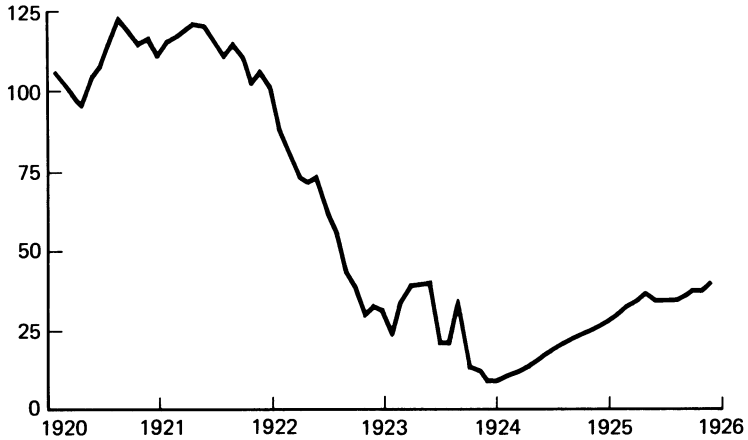
duced a strong re-discounting of commercial bills by banks at the Reichsbank, thus adding to the creation of the monetary base.

As a consequence of the very expansionary monetary policy of the Reichsbank in 1920, currency in circulation increased by about 65 per cent while prices increased by 258 per cent. Inflation showed a strong acceleration in the first quarter of 1920 and then a deceleration until the second quarter of 1921 (Table 3.5). The deceleration during the second half of 1920 was caused by favourable developments of foreign prices combined with the restrictive fiscal policy of the Reich. Prices in major industrial countries fell because of the rundown in stocks of raw materials accumulated during the war and of the very restrictive monetary policies in the United States and the United Kingdom, which led to a strong appreciation of the dollar and high interest rates almost everywhere.

In 1921 and 1922 the budget deficit in relation to NNP declined to 10 and 6 per cent respectively. However, monetary policy remained extremely expansionary and currency in circulation increased by 34 per cent in 1921 and 288 per cent in 1922. Not only did the Reichsbank continue to discount Treasury bills from commercial banks more and more rapidly, but it also favoured the creation of commercial bills by the private non-banking sector which were discounted directly at the Reichsbank at a much lower rate than the one charged by commercial banks. The discount rate on these bills was 6 per cent in 1921, and was raised to 10 per cent in 1922. These policies implied that the Reichsbank was satisfying whatever demand for credit arose in the private sector. The Reichsbank was reluctant to increase the discount rate because it thought it would lead to a rise in the cost of production and hence prices, while it denied in official statements that a rise in the discount rate would have a depressing effect on inflation. The Reichsbank's official theory was that inflation was caused by the depreciation of the exchange rate and that it was the duty of the bank to finance the increased demand for money due to the increased price level.[10]

In the second half of 1921, expectations of inflation, as reflected in the resumed depreciation of the Mark, again caused inflation to accelerate. From July 1921 to June 1922 inflation averaged 51.2 per cent per quarter,[11] while the rate of growth of currency in circulation averaged only 22.5 per cent per quarter. This development contrasted with the experience of the period from the first quarter of 1919 to the second quarter of 1921 when monetary growth exceeded inflation in seven out of ten quarters. The growth of money and prices in 1921 and 1922 may suggest that monetary policy could not be considered responsible for the resumption of domestic inflation and exchange rate depreciation. However, on one hand a large monetary overhang was inherited from the war period so that slight changes in expectations of inflation were sufficient to reduce the desired demand for money and bring about a depreciation of the exchange rate and an acceleration of domestic inflation. In the four years from 1919 to 1922, monetary policy was unable to eliminate the monetary overhang, despite the broad successes of fiscal policy in reducing public sector deficits and the favourable foreign price developments in 1920 and 1921. On the other hand, the disruption caused to Germany's finances by the reparations was probably greater that the actual reparations figures would suggest. The extent of Germany's total reparations payments and their required schedule was

*Figure 3.1* Real currency in circulation, February 1920–December 1925, (Bargeldumlauf deflated by CPI) (1913 = 100)




for a long time uncertain, thus casting a shadow over Germany's prospects for a stable currency.

In the period from the third quarter 1922 to the second quarter 1923, the increase in expectations of inflation induced further reductions in the real demand for currency, and inflation moved to a much higher level averaging 312.5[12] per cent per quarter. Figure 3.1 shows the sharp decline of real currency holdings in 1922 and in the second half of 1923. The declining trend in real currency holdings was reversed only after the stabilisation. In 1923, fiscal policy no longer had a restraining influence on expectations of exchange rate changes and inflation, and in the third quarter 1923 the monetary situation became explosive. In the first months of 1923, fiscal policy in Germany was deeply affected by the occupation of the Ruhr by French and Belgian armies. Not only did government expenditures rise rapidly because of the 'passive resistance' and because government subsidies were extended to the Ruhr industries but also, given the method of assessing taxes in nominal terms and lags between the time taxes were levied and the time when they were collected, revenues were reduced, because of underestimation of the prospective rate of inflation by the government. Some important sources of revenue also were lost to the German government as proceeds from taxes on coal, export duties and custom-house dues fell. These developments led to large increases in the budget deficit which were financed mainly by monetary means. At the same time, the Reichsbank provided large

amounts of credit to the Ruhr industries. As a consequence, currency in circulation and prices increased extremely rapidly, with domestic prices rising faster than the exchange rate in the second half of 1923. The rapid acceleration of inflation led to a marked shortening of the length of contracts and this allowed prices to adjust quickly to monetary disequilibrium, eliminating the previous large deviations from purchasing power parity.

## 3.3 THE LAST STAGE OF THE HYPERINFLATION PERIOD AND THE STABILISATION OF PRICES

Table 3.6 shows the weekly inflation rates from 7 August 1923 to 27 December 1923. The inflation rate reached a peak during the week ending 13 November 1923. Thereafter, the inflation rate decelerated and became negative in the week ending 11 December 1923. On 18 August a memorandum was submitted by the Reichsbank to the government stating that it would not continue the unlimited financing of the government deficit and on 16 November all re-discounting of Treasury bills was discontinued. This date marked the end of the hyperinflation period. The limitation of monetary financing to the government was made possible by drastic fiscal policy measures:[13] (1) government loans and grants for the 'Passive Resistance' were suspended in October; (2) the government budget was freed temporarily from the burdens of reparations by pushing these on to private industries;[14] (3) the expenses of the civil administration were reduced by the dismissal of a great number of public sector employees; (4) the financial recovery of the railway system eliminated an important source of the deficit; and (5) interest payments on the public debt virtually disappeared because of its destruction by inflation.[15] No measures could be taken on the revenue side because of the high inflation rate which would have reduced the yield of new taxes due to collection lags. Once the price level was stabilised, real tax revenues increased rapidly and in January 1924 the budget was balanced for the first time since the beginning of the First World War.

Monetary developments followed closely those of the budget deficit in 1923. The growth in currency in circulation reached a peak in the week ending 13 November 1923, and decelerated thereafter following the decision of the Reichsbank to limit monetary financing of the government to 1.2 billion rentenmarks agreed upon at the Cabinet meeting of 15 October 1923. The rentenmark was a legal

*Table 3.6* Prices and the exchange rate August–December 1923 (percentage changes over previous week)

| *Week ending* | | *Cost of living index* | *Week ending* | | *Exchange rate*[a] |
|---|---|---|---|---|---|
| Aug. | 7 | 82.0 | Aug. | 7 | 200.0 |
| | 14 | 111.3 | | 15 | 18.2 |
| | 21 | 191.3 | | 23 | 88.2 |
| | 28 | 72.5 | | 31 | 102.8 |
| Sep. | 4 | 52.5 | Sep. | 7 | 413.5 |
| | 11 | 50.0 | | 15 | 70.6 |
| | 18 | 238.9 | | 22 | 23.7 |
| | 25 | 132.8 | | 29 | 45.4 |
| Oct. | 2 | 97.2 | Oct. | 5 | 275.1 |
| | 9 | 44.3 | | 15 | 526.8 |
| | 16 | 170.1 | | 23 | 1 384.9 |
| | 23 | 534.2 | | 31 | 30.1 |
| | 30 | 333.6 | | | |
| Nov. | 5 | 356.7 | Nov. | 7 | 767.1 |
| | 13 | 618.9[b] | | 15 | 300.0 |
| | 20 | 121.8 | | 20 | 66.7 |
| | 27 | 262.8 | | 27 | — |
| Dec. | 4 | 93.6 | Dec. | 4 | — |
| | 11 | −1.3 | | 11 | — |
| | 18 | −17.9 | | 18 | — |
| | 27 | −3.5 | | 27 | — |

[a] Mark-Dollar exchange rate.
[b] Highest weekly inflation rate which was reached just before the discounting of Treasury bills by the Reichsbank was discontinued (16 November 1923).
*Source*: Statistisches Reichsamt, Sonderfelt No. 1. Wirtschaft aund Statistik. *Zahlen zur Geldentwertung in Deutschland 1914 bis 1923* (1925).

means of payment and a unit of account introduced on 15 October 1923 equal to $10^{12}$ Marks. At that date the paper Mark was preserved and the new rentenmark was added to the existing stock of Marks in circulation. The introduction of the rentenmark had a strong psychological effect. This measure would not have been enough to end the hyperinflation, however, had it not been accompanied by measures to reduce the budget deficit and limit its monetary financing.

While a maximum limit was set for the monetary financing of the government, no such limit existed for the financing of the private sector. Short-term credit of the Reichsbank to the private sector continued to increase by 65 per cent in December 1923 and by 84 per cent in January 1924. On 7 April 1924 the Reichsbank set a maximum limit to the outstanding short-term credit to the private sector at the

level reached at the end of March 1924. This measure was probably triggered by the observation that the monthly inflation rate in March 1924 was positive for the first time since November 1923.

The nominal discount rate was kept at 90 per cent from September 15, 1923 to January 29, 1924. The demand for currency increased as economic activity rose and expected inflation fell. During the last months of the hyperinflation the Mark was no longer fully performing the functions of store of value, unit of account and medium of exchange. There was a tendency to substitute the Mark with either foreign currencies or with goods, and the available foreign currency tended to be hoarded according to Gresham's law. The partial return to barter increased transaction costs while inflation led to large misallocations of resources and both led to a fall in output. With the stabilisation of prices the German economy reverted to a normal level of activity, which was one of the causes of the increase in real demand for currency together with the reduction of inflation (Figure 3.1). In August 1924, the German government introduced the Reichsmark as the new legal means of payment by converting the old Mark in the ratio of 1 Reichsmark to $10^{12}$ marks. This was a minor event in the process of price stabilisation, the main effect of which was to reduce accounting and transaction costs, particularly the cost of carrying a large number of bills.

## 3.4 INFLATION AND ECONOMIC ACTIVITY

Table 3.7 shows the indices of national product in Germany, the United States, and the United Kingdom.[16] In 1919 net national product per capita in Germany was about half of its 1913 level,[17] while those in the United States and the United Kingdom were around the prewar levels. The low level of output in Germany with respect to other countries was due to several causes: (1) Alsace, Lorraine and the Saar coal mines were ceded to France, Northern Schleswig was ceded to Denmark, and Upper Silesia to Poland. These regions accounted for about one-third of Germany's coal production, three-quarters of Germany's iron ore production, about 40 per cent of Germany's blast furnaces and 10 per cent of her iron and steel foundries; [18] (2) the intensive use of agricultural land during the war and the lack of fertilisers had reduced the potential production per hectar within the new boundaries; (3) the stock of

*Table 3.7* Index of national product per capita: international comparisons, 1913–1924 (1913 = 100)

| | *Germany*[a] | *United States* | *United Kingdom* |
|---|---|---|---|
| 1919 | 55.0 | 99.0 | 91.0 |
| 1920 | 66.0 | 94.0 | 89.0 |
| 1921 | 73.0 | 70.0 | 85.0 |
| 1922 | 80.0 | 91.0 | 85.0 |
| 1923 | 61.0 | 102.0 | 91.0 |
| 1924 | 80.1 | 91.3 | 95.1 |

[a] Estimated on the basis of output in industry, agriculture, and commercial transportation.
*Source*: Graham (1930).

physical capital had been greatly reduced during the war because of lack of investments and because livestock and inventories had drastically diminished.

From 1919 to 1922 net national product per capita in Germany grew rapidly at an estimated average geometric rate of about 12.5 per cent per year.[19] This contrasted with the experience of other countries, particularly the United States and the United Kingdom where national product per capita declined on average by 2.8 per cent and 2.3 per cent respectively. The fall of output in these countries was mostly a consequence of the very restrictive monetary policy introduced in May 1920 in the United States and the policies implemented in the United Kingdom which aimed at a return to prewar gold parities. Germany seemed relatively isolated from these disturbances, partly because of the freely floating exchange rate system adopted at the end of the war.[20]

In 1923, net national product per capita dropped sharply in Germany. It is difficult to separate the relative influence of the hyperinflation, the loss of territories and the social unrest that followed. There is evidence however, that the index of net national product per capita was 42 (1913 = 100) in the last four months of 1923,[21] as opposed to 61 for the average of the year and 80 in 1922. If these figures are correct, the index of net national product was 76.4 in the first eight months of the year, indicating that the occupation of the Ruhr was probably not a major factor in the 1923 fall of output per capita. It is therefore more likely that the fall of the index in 1923 was caused by the hyperinflation, making the opportunity cost of holding

*Table 3.8* Unemployment, the real wage rate and output, 1919–25

| | *Unemployment rate*[a] | *Output per capita*[b] | *Real wages*[b] |
|---|---|---|---|
| 1919 | 3.7 | -11.5 | 26.7 |
| 1920 | 3.8 | 22.2 | -34.6 |
| 1921 | 2.8 | 9.2 | 18.1 |
| 1922 | 1.5 | 10.0 | -53.6 |
| 1923 | 10.2 | -23.1 | 49.3 |
| 1924 | 13.5 | 21.2 | 5.7 |
| 1925 | 6.7 | 19.1 | 3.6 |

[a] in per cent of the labour force.
[b] Yearly rate of change.
*Source*: Bresciani-Turroni (1937)

money so high that there was a strong incentive to revert to barter, thus increasing transaction costs, and to substitute money with leisure time, thus reducing the incentive to work.

The strong increase in output in Germany between 1920 and 1922 can be explained partly by changes in some key relative prices caused by expansionary monetary policies. According to economic theory, an increase in the general price level stimulates real economic activity only if some prices change with respect to the general price level. Real wages in Germany declined by about 35 per cent in 1920, recovered only partially in 1921 and were reduced by about 54 per cent in 1922 (Table 3.8). Nominal wages were indexed to the cost of living index with a lag which became shorter at the end of 1922 (six weeks), and was reduced further to a fortnight by the middle of 1923. In the last six months of 1923 nominal wages were adjusted more than once a week according to the projections of changes in the cost of living index rather than its current or past changes.

The real interest rate fluctuated greatly during this period because of the slow adjustment of nominal interest rates to expected inflation and because of the discount rate policy of the Reichsbank. Table 3.9 shows the changes in the official discount rate. The latter was maintained at an extremely low level until the very last months of the hyperinflation when a new facility was introduced indexing the discount rate to the pound sterling exchange rate. As a consequence of this policy, interest rates on loans by commercial banks were kept low, thus stimulating the demand for credit by the private sector.[22] Although there are no consistent statistics on interest rates on bank loans, indirect evidence suggests that real financial interest rates were highly negative, particularly in 1922. Official statistics on investment

*Table 3.9* Discount rates of the Reichsbank, 1915–23 (in per cent)

| | |
|---|---|
| 23 Dec. 1914 – 27 Jul. 1922 | 5 |
| 28 Jul. 1922 – 27 Aug. 1922 | 6 |
| 28 Aug. 1922 – 20 Sep. 1922 | 7 |
| 21 Sep. 1922 – 12 Nov. 1922 | 8 |
| 13 Nov. 1922 – 17 Jan. 1923 | 10 |
| 18 Jan. 1923 – 22 Apr. 1923 | 12 |
| 23 Apr. 1923 – 1 Aug. 1923 | 18 |
| 2 Aug. 1923 – 14 Sep. 1923 | 30 |
| 15 Sep. 1923 – 29 Jan. 1924 | 90[a] |

[a] According to statements of the Reichsbank, this rate was for practical purposes not effective in 1924. Lombard loans indexed to foreign exchange had been introduced on 15 September 1923.
*Source*: Deutsche Bundesbank (1976).

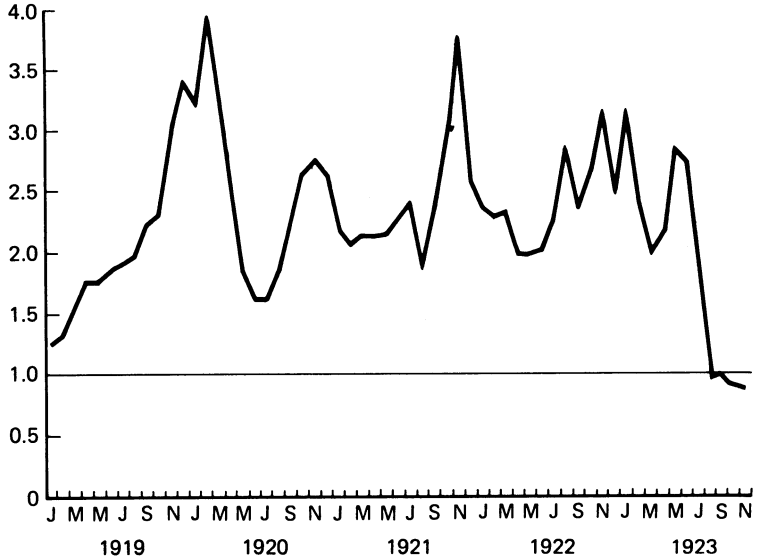
are not available for those years. There is evidence, however, that a shift of resources took place from industries producing consumption goods to industries producing investment goods. The production of steel in 1922 reached the level of 1913 in the 1922 German territories,[23] while net national product per capita was still about 20 per cent below its 1913 level. Production of steel increased by 8.7 per cent in 1921 and by 16.2 per cent in 1922. Employment in iron and steel industries was 25 per cent higher in 1921 than in 1913, and in 1922 it was 40 per cent higher. The strong increase in the production of investment goods suggests that real financial interest rates must have been quite low thus favouring an increase in investment.

The sharp depreciation of the real exchange rate during 1919 to 1922 (Figure 3.2) also contributed to stimulate production in those years. As a result, real exports of goods increased by an estimated 22 and 39 per cent respectively in 1921 and 1922, despite the fall in the international business cycle. In 1923, real exports of goods fell by an estimated 15 per cent, despite the recovery in the international business cycle owing to the strong appreciation of the real exchange rate and to the disruption of German production in that year.

## 3.5 A MONTHLY DISEQUILIBRIUM MODEL OF PRICES AND THE DOLLAR–MARK EXCHANGE RATE, APRIL 1920–JULY 1923.

The analysis of the previous sections showed the importance of monetary disturbances in the process of inflation and exchange rate

*Figure 3.2* Real exchange rate index,[a] January 1919–November 1923 (1913 = 1)




[a]In Marks per US dollar, deflated by respective consumer price indices

depreciation. Moreover, it indicated that the assumption of purchasing power parity, although a reasonable characteristic of the steady state of an economic system, did not hold in Germany in the short-run. The real exchange depreciated during most of the period under analysis, with the exception of 1923 when the real exchange rate returned to the level predicted by purchasing power parity. This suggests that monetary disturbances acted rapidly on the exchange rate and only subsequently on domestic prices.

This section is intended to analyse, with the help of a small econometric model, the dynamics of the exchange rate and prices during the hyperinflation period. The section is divided in two parts: the first one presenting a brief survey of the theoretical and empirical literature on the German hyperinflation and exchange rate determination, which is intended to show how the model presented at the end of this chapter is differentiated from those previously estimated; and the second one presenting a three-equations disequilibrium model of the money supply, the exchange rate and prices. The model explains the equilibrium exchange rate in terms of the monetary approach to

exchange rate determination. Similarly, the equilibrium price level is determined by the supply of nominal cash balances and the real demand for them. The model also explains deviations of the real exchange rate from purchasing power parity since the speed of adjustment of the exchange rate and prices to their partial equilibrium levels may differ. It also allows for currency substitution in the demand for real cash balances, as is appropriate once it is recognised that the rate of inflation or expected inflation is different in the short run from the change of the exchange rate corrected for foreign inflation. Finally, expectations of inflation are assumed to be adaptive as suggested by the initially very slow response of prices to monetary growth.

## A brief survey of the literature on German hyperinflation

This survey is divided in three parts: the first part dealing with the quantity theory of money and the estimates of the demand for money; the second part dealing with the theory of exchange rate determination; and the third part evaluating the contribution of the rational expectations theory to the understanding of the German hyperinflation.

### *The quantity theory of money*

The most important contributions to the understanding of the German hyperinflation are those of Bresciani-Turroni (1937) and Cagan (1956). Although at a different level of formal presentation, both authors applied the quantity theory of money to the explanation of the hyperinflation, thus assuming the existence of a stable demand function for money. Cagan gave a precise functional form to the demand for real cash balances and assumed that in periods of hyperinflation the demand for real cash balances is influenced only by the expected rate of inflation. Cagan's model is:

$$m(t) = \gamma e^{-\beta\pi^e(t)} \tag{3.1}$$

where $m(t)$ are the real money balances and $\pi^e(t)$ is the expected rate of inflation, with the expected rate of inflation being formed according to the adaptive expectation scheme:

$$D\pi^e(t) = \lambda\,[D\ln p(t) - \pi^e(t)] \tag{3.2}$$

where $D$ is the differential operator.

Assuming that the money market always clears, substitution of $\pi^e(t)$ from equation (3.2) into of the logarithm of equation (3.1) gives the rate of inflation:

$$\mathrm{Dlnp(t)} = \frac{\lambda}{1-\beta\lambda}\left[\ln M(t) - \ln\gamma - \ln p(t)\right] + \frac{\lambda}{1-\beta\lambda} D\ln M(t) \tag{3.3}$$

where $M(t)$ are nominal cash balances. This equation is dynamically stable if the product of the parameters $\beta\lambda$ is smaller than one.

Equations (3.1) and (3.3) are expressed in continuous time. In discrete time the expected rate of inflation is formed according to the adaptive expectations scheme:

$$\Delta\pi_t^e = \lambda\left[\Delta\ln p_t - \pi_{t-1}^e\right] \tag{3.2a}$$

and can be expressed as a function of a distributed lag of current and past inflation rates:

$$\pi_t^e = \lambda \sum_{i=0}^{\infty} (1-\lambda)^i \Delta\ln p_{t-i} \tag{3.2b}$$

Substitution of equation (3.2b) into the logarithm of equation (3.1) gives:

$$\ln p_t = \left[1 - \frac{\lambda}{1-\beta\lambda}\right]\ln p_{t-1} + \frac{1}{1-\beta\lambda}\left[\ln M_t - \lambda \ln\gamma\right] - \frac{1-\lambda}{1-\beta\lambda}\ln M_{t-1} \tag{3.4}$$

This equation is dynamically stable if the absolute value of the ratio

$$1 - \frac{\lambda}{1-\beta\lambda}$$

is smaller than one.[24]

Several other authors dealt with the demand for real cash balances during the German hyperinflation period. Bisignano (1975) and Frenkel (1977) showed that the semi-logarithmic form of the demand for real cash balances is the most appropriate for Germany, although this is not the case for other hyperinflations experienced elsewhere in this century. Bisignano showed that the double-logarithmic form of the demand for real cash balances performs better than the semi-logarithmic one for the Polish and the Hungarian hyperinflations. It is interesting to note that both authors reach the same conclusion

*Table 3.10* *Stability of the inflationary process in Germany:* summary of results by previous authors, (estimated values of the product of $\beta$ and $\lambda$)

| | $\beta\lambda$ |
|---|---|
| Cagan (1956) | 1.09 |
| Bisignano (1975)[a] | 0.56 |
| Khan (1975)[a] | 0.71 |
| Friedman (1978) | 1.29–1.06[b] |

[a] These authors corrected the residuals in the demand for real cash balances for auto-correlation.

[b] The first product is obtained by applying the more stringent stability condition derived from the discrete version of Cagan's model, i.e. $(\beta + 1)\lambda < 1$, to Cagan's parameter estimates, while the second one is obtained by applying the same condition to Khan's parameters estimates.

starting from different models of formation of expectations. Frenkel also showed that the demand for real cash balances was stable during the hyperinflation period. He performed a test of the stability of the parameters of the demand for real cash balances in both the semi-logarithmic and double-logarithmic forms using dummy variables for the last nine months of the hyperinflation period.

Various authors have also analysed the dynamic stability of the model. Table 3.10 shows the values of the product $\beta\lambda$ estimated by Cagan (1956), Khan (1975), Bisignano (1975), and Benjamin Friedman (1978). The estimates of the parameters $\beta$ and $\lambda$ were obtained by estimating a demand for real cash balances. They imply a stable inflationary process according to equation (3.3). Although the empirical estimates of the parameters $\beta$ and $\lambda$ obtained by Cagan imply a product of the two parameters which is larger than one, this product is not significantly greater than one.

The adaptive expectation mechanism assumed by Cagan in equation (3.2) implies that the adjustment parameter $\lambda$ is constant from the beginning to the end of the hyperinflation period. Several authors, including Cagan, cast doubts on the validity of this assumption. They argued that the cost of adjustment increases with the level or the variability of inflation. Cagan found that the adjustment parameter was higher during the latter part of the hyperinflation period for all countries he analysed, with the exception of Germany. He found this result puzzling and advanced the hypothesis that changes in the adjustment parameter $\lambda$ may not be continuous, but may be characterised by sudden upward shifts, presumably when the public first looses confidence in the prospect for stable or lower prices. However,

he did not pursue this idea to its full extent by changing the sample period in order to find when the hypothesised sudden upward shift could have occurred in Germany.

Khan (1977a) re-estimated Cagan's model by assuming the adjustment parameter $\lambda$ to be a function of inflation and the variability of inflation:

$$\lambda = \lambda_0 + \lambda_1 |Dlnp(t)| + \lambda_2 |D^2 lnp(t)| \tag{3.5}$$

where both inflation and the acceleration of inflation are expressed in absolute values. His estimates showed that only the acceleration of inflation is a significant explanatory variable. Jacobs (1977c) introduced the non-linearity into the formation of expectations as follows:

$$\lambda = \lambda_1 \sqrt{\pi^c(t)} \tag{3.6}$$

in which the adjustment parameter $\lambda$ is a function of the square root of expected inflation. The parameter $\lambda_1$ is significantly different from zero for the eight countries analysed by Jacobs.

Cagan thought that the introduction of a variable adjustment parameter would eliminate most of the auto-correlation of the residuals present in his estimates of the demand for real cash balances. This is not the case, however, as Khan (1977a) and Jacobs (1977c) showed, although Khan's estimates reveal some reduction in auto-correlation. Khan (1975, 1977b) and Bisignano (1975) tried to eliminate the auto-correlation by specifying an auto-correlation function of the first order and by re-estimating Cagan's model. Khan used a restricted least-square method in his 1975 paper, and a combination of non-linear least-square and the search method described by Dhrymes (1969) in his 1977 paper, while Bisignano used Baysian inference methods. Although these different methods are useful in taking into account existing auto-correlation, they do not explain what causes it. Khan justified the use of this procedure as a second-best choice in the case in which no information is available on missing explanatory variables.

Equation (3.1) contains the expected rate of inflation as the only explanatory variable. Even accepting Cagan's argument that real income can be neglected, other explanatory variables can be missing. In effect his equation assumes that the relevant substitution is only between cash balances and domestic goods or equivalently that the exchange rate always moves to equate the difference between foreign and domestic inflation rates so that there is no need to include currency substitution into the model. If this assumption does not

hold, as the previous sections seem to indicate, the omitted variables could be reflected in auto-correlation of the residuals of the estimated demand for real cash balances. Putting it another way, the auto-correlation of the residuals could be caused by the mis-specification of the adjustment of prices to money which is much more complicated than the one implied by Cagan's reduced form Equations (3.3) or (3.4). If that is the case a structural model is required in which the exchange rate and its deviations from purchasing power parity play a crucial role.

The problem of the unsatisfactory specification of the mechanism which links inflation to money creation was pointed out by Jacobs (1975), although he did not suggest an alternative. He showed that the non-stochastic form of Cagan's system of differential equations (3.1) to (3.3) can be mathematically solved in two equivalent ways: (1) the first one, in which real cash balances are a function of current and past inflation rates; (2) the second one in which the rate of inflation is a function of current and past rates of growth of the nominal cash balances. Although both solutions are mathematically equivalent, they yield different estimates of the underlying parameters since the error processes differ. Jacobs showed that the second solution of the differential equation system gives a very poor fit as compared to the first one. He advanced as an explanation that if there is a sudden increase in the price level which is not directly associated with the change in the nominal stock of money, this gives a good fit of the first solution and a poor one of the second solution. In other words, changes in the price level not directly related to changes in nominal cash balances will degrade the quality of the fit in the second case. Jacobs' estimates imply, therefore, that the observed money supply did not produce the observed price movements according to equations (3.3) or (3.4) and that the specification of the dynamic structure of the model is incomplete. Estimates of equations (3.1) and (3.3) are reported in Table 3.11. The parameters of the two equations have been estimated using a maximum likelihood procedure developed by Wymer (1976). The two equations have been estimated for the period April 1920 to July 1923. The estimates of $\beta$ and $\lambda$ in the upper part of Table 3.11 are not significantly different from those of Cagan, who obtained point estimates of 5.46 and 0.20 respectively, although his sample period was slightly shorter (September 1920 to July 1923). These estimates confirm Jacob's results and indicate that Equation (3.3) is an incomplete specification of the inflationary process in Germany in the early 1920s.

*Table 3.11* Least-squares estimates of the demand for money and inflation, derived from Equations (3.1) and (3.2) (monthly data) April 1920–July 1923

| | *Estimated parameters* | | *Asymptotic standard errors* |
|---|---|---|---|
| Demand for real cash balances | $\beta$ | 5.545 | 0.331 |
| | $\lambda$ | 0.188 | 0.019 |
| | $\gamma$ | 0.014 | 0.007 |
| | $R^2$ | 0.9195 | |
| Inflation | $\beta$ | 0.448 | 10.678 |
| | $\lambda$ | –0.057 | 0.135 |
| | $\gamma$ | –0.013 | 0.022 |
| | $R^2$ | 0.6447 | |

*The monetary theory of exchange rate determination*

The previous discussion and the description of events in Sections 3.1 to 3.3 suggest the need to consider also the exchange rate and its dynamics in the analysis of the inflationary process. Frenkel's (1976, 1977) important contribution was to bring the exchange rate into the focus of the analysis and to suggest the use of the forward premium or discount as a directly observable measure of expectations of exchange rate changes. He still assumed that purchasing power parity held during the whole hyperinflation period. By arguing that the foreign price level can be neglected because of its low variability with respect to the German one, he was able to write equation (3.1) as

$$ln\, S_t = ln\, M_t + \beta\, \pi^e{}_t - ln\gamma \tag{3.7}$$

where $S_t$ is the exchange rate.

Frenkel estimated equation (3.7) in level form, using as a proxy for expected inflation the forward premium or discount of the exchange rate. His estimates are subject to various criticisms. First, by estimating equation (3.7) in level form the empirical results are biased by exponential growth of the variables on both sides of the equation. Second, the forward premium or discount is not a good predictor of inflation, as shown by Salemi (1980), and cannot therefore be used as a proxy for the expected inflation rate. Third, the assumption that purchasing power parity held during the hyperinfla-

tion period is not appropriate as shown in Section 3.3. Frenkel's empirical justification for this assumption is based on his linear regression of the price level on the exchange rate, which is again biased by the exponential growth in both variables.

Abel *et al.* (1979) showed that very large deviations from purchasing power parity occurred during the hyperinflation period in Germany and as a logical consequence introduced separately the expected rate of change of the exchange rate and the expected rate of inflation in the demand for real cash balances. They used the forward premium or discount as a proxy for the expected rate of change of the exchange rate and the actual inflation rate as a proxy for the expected one. The use of the forward premium or discount as a proxy for expected exchange rate changes is supported by empirical evidence in Frenkel (1980) in which it is shown that the forward premium or discount is a good predictor of exchange rate changes. Abel *et al.* found that both variables are significant in the demand function for real cash balances and that the substitution between domestic and foreign assets is stronger than the one between domestic currency and goods. They showed that the exclusion of the expected rate of inflation from the equation introduces an upward bias in the estimates of the parameter of the expected rate of change of the exchange rate.

This analysis suggests that it is important to consider substitution between domestic currency and foreign currency separately in the demand function for real cash balances. Adding this evidence to that resulting from the first part of this survey, it follows that it is necessary to specify a model of inflation and exchange rate changes which contains hypotheses about the dynamic relationships among cash balances, the exchange rate and prices and in addition takes into account currency substitution. Without specifying a formal mathematical model, the dynamics of inflation and exchange rate changes had already been considered by Bresciani-Turroni (1937) in his analysis of the causes of the German hyperinflation. Bresciani-Turroni thoroughly analysed the economic events between 1914 and 1923; he summarized his opinion on the cause of the monetary disorders in Germany after the First World War as follows:

> During the months following the end of the war, the government budget deficit remained the primary cause of the increase in issues of paper money and the devaluation of the exchange rate.[25]

Bresciani-Turroni maintained that the chain of causation could not run from the devaluation of the exchange rate to budget deficits, as many German analysts and officials believed, because it was evident that:

> a discrepancy between demand and supply of foreign exchange cannot cause a continuous fall of the exchange rate unless it is accompanied by a continuous increase in issues of paper money.[26]

On the dynamic adjustment of prices to money, Bresciani-Turroni attributed a great importance to the behaviour of the exchange rate and concluded that after the end of the war and of the removals of price and exchange controls:

> the new money by flowing directly to the foreign exchange market was depressing the external value of the mark first and was causing an increase in prices afterwards.[27]

*Adaptive versus rational expectations*

An important issue, which so far remains unresolved, is whether the correct model of formation of expectations to explain the German hyperinflation is Cagan's adaptive expectations scheme or the rational expectations paradigm. According to the latter, expectations are said to be rational if they depend on the same variables which economic theory says actually determine that variable. In general, price expectations formed according to equation (3.2) can be considered rational if the rate of growth of money is a function of current and past rates of growth of prices. As shown by Sargent and Wallace (1973), in this case the best way to forecast inflation rates is to extrapolate lagged rates of inflation. However, assuming that money is exogenous, expectations formed according to equation (3.2) cannot be said to be rational unless the parameter $\lambda$ assumes a very large value. If the adjustment parameter $\lambda$ is infinite, then it follows from equation (3.2) that the expected rate of inflation is always equal to the actual rate of inflation. Hence the expected rate of inflation is formed according to equation (3.3), which is what economic theory predicts.

It follows that the debate over rational versus adaptive expectations during the German hyperinflation can be resolved on empirical grounds by correctly estimating the parameter $\lambda$ and by showing that

the money supply process was not only explained by current and past rates of inflation. Present estimates of the $\lambda$ parameter indicate that it is far below infinity. However, in the works of Khan and Jacobs (1977a), the parameter $\lambda$, being itself a function of actual rates of inflation or expected rates of inflation, reached values which are close to infinity during the last stages of the hyperinflation. Using the last observation of the sample period, the $\lambda$ parameter reaches the value of 3.86, according to Khan's estimates. It reaches the value of 3.00, according to Jacob's estimates. These two figures correspond to mean adjustment lags of 7.8 days and 10 days respectively. Extrapolating the estimates of Khan and Jacobs to the peak of the hyperinflation in the month from 27 October to 27 November 1923, the mean adjustment lags are 0.4 days and 1.1 days respectively.

As far as the endogeneity of the money stock is concerned, the empirical evidence is less clear-cut. Most of the authors, who performed a Granger causality test between money and price,[28] found that the direction of causality was mostly from prices to money although they also found evidence of a bi-directional causality. The finding that prices caused money during the German hyperinflation is explained by Sargent and Wallace by assuming that the government was trying to maintain its expenditures constant in real terms. If it is also assumed that the only government revenues are the ones from inflation, then it can be shown that the money supply becomes endogenous and a function of the price level. However, the description of events in Sections 3.1 to 3.3 indicates that the simple money supply rule described by Sargent and Wallace would be a reasonable approximation of policy behaviour only for the period from the occupation of the Ruhr in February 1923 until the end of the hyperinflation. It follows from this that the causality tests should be performed with the exclusion of 1923 from the sample period. Protopapadakis (1983a) cast doubts on the conclusion that the money supply was endogenous during the German hyperinflation. He showed that the hypothesis that prices cause money is rejected if the tests are performed for the period up to mid-1922, but is accepted if the tests are performed for the whole period up to July 1923. He also showed that the linear ARIMA model used by Sargent and Wallace to pre-whiten the series of money and prices is unstable over time, as has to be expected on the basis of the discussion of Sections 3.1 to 3.3. By estimating ARIMA models for different subperiods, a simple way to introduce non-linearities, and by performing the causality tests again, he showed that the case for money influencing prices is much stronger

than the one for price influencing money both before and after mid-1922. Thus these more sophisticated tests suggest that the assumption that money was not explained only by prices is to be preferred to Sargent and Wallace's case for money depending on prices in a mechanical way.

Jacobs (1977c) incorporated a more flexible money supply rule in his non-linear money demand model. He assumed that the only source of government revenue is the inflation tax and that the government changes the rate of growth of money in such a way as to reduce the discrepancy between desired and actual revenues, where desired revenues are an increasing function of time. The interesting result is that the introduction of the above money supply rule does not significantly improve the fit of the model with respect to the same money demand model with exogenous money supply.

The Sargent and Wallace assumption of rational expectations and endogenous money has an important implication for the theory of inflation. As Friedman (1978) correctly pointed out, the inflation process under Sargent and Wallace's hypothesis becomes simply a 'random walk with noise'. This is unsatisfactory because in such a framework there is no longer a theory of inflation. Furthermore, statistical tests performed by Friedman show that in four out of seven hyperinflations in this century (including Germany) the hypothesis that inflation is a random walk is rejected at the 99 per cent significance level.

Thus some doubts are cast on the contribution of the rational expectations literature to the proper understanding of the German hyperinflation. Assuming expectations to be rational has not added much to the previous work of Cagan, Khan, Jacobs, Frenkel and Abel *et al.*, neither has it solved the mis-specification error which causes auto-correlation of the residuals in the demand for real cash balances.

## A disequilibrium model of the German hyperinflation

The description of the main economic events in Germany from 1914 to 1923 and the brief survey of the literature on the German hyperinflation indicate that it is necessary to specify a joint model of inflation and exchange rate depreciation with the following characteristics:

1. the nominal exchange rate should be able to diverge from purchasing power parity in the short run;

2. currency substitution between domestic and foreign currencies or goods should be considered explicitly;
3. the monetary approach to exchange rate determination and the quantity theory of money should be imposed as long-term properties on a disequilibrium model of inflation and exchange rate determination;
4. the dynamic adjustment of prices and the exchange rate to monetary disturbances should be made explicit;
5. expectations of inflation are formed adaptively.

Table 3.12 describes a three-equation disequilibrium model for prices, the exchange rate and money. The model is specified in continuous time according to the belief that macroeconomic phenomena, being the result of the behaviour of a large number of economic agents, are better described by continuous functions, although decisions taken by single economic agents may be discrete. In a model specified in continuous time the estimates of the speeds of adjustment of the various market have also the advantage of being unbiased and independent of the length of the observation period to which the discrete data refer. Thus it is possible to obtain consistent estimates of mean adjustment lags which could be much shorter than the observation period and may be close to zero. The model is specified as a system of first-order linear differential equations. When the system is out of equilibrium desired or partial equilibrium levels of the endogenous variables differ from the actual ones. For economy of notation the error terms are omitted in the table.

Equation (3.8) assumes that changes in the nominal exchange rate are determined by discrepancies between the partial equilibrium level of the exchange rate and its actual level. The partial equilibrium level of the exchange rate (Equation (3.8a)) is determined in the money market as predicted by the monetary approach to exchange rate determination. Equation (3.8c) is a demand function for real cash balances. Cash balances have been used instead of the stock of money because no monthly observations exist on bank deposits, although yearly figures exist. The demand for real cash balances is assumed to depend on the expected and actual rate of inflation, reflecting substitution with domestic financial assets and goods, on the rate of change of the exchange rate, reflecting currency substitution, and on real income. Currency substitution has been approximated by the rate of change of the actual exchange rate, instead of the expected one to keep the model as simple as possible and because

*Table 3.12* A disequilibrium model of the exchange rate and prices[a]

1. *Exchange rate*

$$D\ln S = \alpha_1 \ln(\hat{S}/S) \tag{3.8}$$

where $\hat{S}$ is the partial equilibrium level of the exchange rate

$$\hat{S} = \hat{p}/p_{us} \tag{3.8a}$$

where $\hat{p}$ is the partial equilibrium level of prices:

$$\hat{p} = BU/\hat{bu} \tag{3.8b}$$

and $\hat{bu}$ is the partial equilibrium level of the demand for real cash balances:

$$\hat{bu} = \gamma e^{-\beta_1 \pi^e} e^{-\beta_2 D\ln p} e^{-\beta_3 D\ln S} y^{\beta_4} \tag{3.8c}$$

2. *Prices*

$$D\ln p = \alpha_2 \ln(\hat{p}/p) + \delta_1 \ln(\dot{y}/\bar{y}) \tag{3.9}$$

and expected inflation is formed according to:

$$D\pi^e = \lambda(D\ln p - \pi^e) \tag{3.9a}$$

3. *Money supply*

$$D^2 \ln BU = \alpha_3 \left[ \frac{y \cdot p}{BU} \right] + \alpha_4 D \left[ \frac{y \cdot p}{BU} \right] + \delta_2 \ln \left( \bar{y}/y \right) + \delta_3 D\ln \left( \bar{y}/y \right) \tag{3.10}$$

where $\bar{y}$ is potential output

$$\bar{y} = y_0 e^{\delta_4 t}$$

*Legend*:

*Endogenous*:

$S$ = Mark–dollar exchange rate
$p$ = wholesale price index
$BU$ = currency in circulation.

*Exogenous*:

$p_{us}$ = US wholesale price index
$y$ = real output in Germany
$t$ = time trend.

[a] Adjustment parameters are denoted by $\alpha_i$, and $\lambda$, elasticities by $\beta_i$ and other parameters by $\delta_i$.

the forward premium of discount which could have been used as a proxy for the expected rate of change is available only from mid-1921, which would limit the sample period substantially.

Equation (3.9) states that the inflation rate is determined by the discrepancy between the partial equilibrium level of prices and their

actual level. The partial equilibrium level of prices is determined in equation (3.8b) by the supply of nominal cash balances and the demand for real cash balances as predicted by the quantity theory of money. Thus, the steady state solution of this model implies that prices are formed according to the quantity theory of money and that purchasing power parity holds. However, the exchange rate does not move according to purchasing power parity in the short-run. The dynamics of inflation and the exchange rate depend crucially on the adjustment parameters $\alpha_1$ and $\alpha_2$; if the exchange rate adjustment parameter $\alpha_1$ is larger than the price adjustment parameter $\alpha_2$, the exchange rate is reacting more rapidly than prices to monetary disequilibrium, thus producing a real depreciation of the exchange rate while the opposite is true if $\alpha_2$ is greater than $\alpha_1$. Equation (3.9a) postulates that expectations of inflation are formed adaptively.

Equation (3.10) is a simple money supply process with the acceleration in nominal cash balances depending on nominal income expressed as a ratio to nominal cash balances and its derivative, and on the position of the economy in the cycle. Equation (3.10) can also be thought of as derived from an equation in which the government deficit as a proportion of nominal cash balances, its change and the position of the economy in the cycle significantly influence the money supply process. Since no reliable observations are available on nominal government expenditure and revenue on a monthly basis, the deficit can be approximated in the following way. Assuming that government expenditure and revenue are a fixed proportion of nominal income, where a and b are the proportionality factors for government expenditure and revenue respectively, one can write:

$$G = a\,(y \cdot p) \tag{3.11}$$
$$T = b\,(y \cdot p) \tag{3.12}$$

The difference between equation (3.11) and equation (3.12) can then be substituted for the government budget deficit to obtain Equation (3.10).

The last two terms in Equation (3.10) represent the reaction function of the monetary authorities to deviations of actual from potential output. These two terms can be interpreted as a linearisation of a non-linear model, in which parameters $\alpha_3$ and $\alpha_4$ change in time according to the gap between actual and potential output.[29]

Estimates of the parameters of this model are presented in Table 3.13. The parameters of the exact discrete model equivalent to the

*Table 3.13* Parameter estimates of the model of Table 3.12, April 1920–July 1923

| *Estimated parameters* | | *Asympotic standard error* | *Mean adjustment lag (in days)* |
|---|---|---|---|
| $\alpha_1$ | 227.000[a] | — | 0.1 |
| $\alpha_2$ | 1.604 | 0.424 | 18.7 |
| $\alpha_3$ | 0.059 | 0.019 | |
| $\alpha_4$ | 0.511 | 0.061 | |
| $\delta_1$ | 0.166 | 0.122 | |
| $\delta_2$ | 3.341 | 1.124 | |
| $\delta_3$ | 0.403 | 0.078 | |
| $\beta_1$ | 5.654 | 0.324 | |
| $\beta_2$ | 0.672 | 0.188 | |
| $\beta_3$ | 0.078 | 0.031 | |
| $\beta_4$ | 0.067 | 0.102 | |
| $\lambda_1$ | 0.268 | 0.026 | 111.9 |
| $\delta_4$ | –0.001 | 0.006 | |

*Note*: Chi-square value of the log-likelihood ratio 75.707[b]
Carter–Nagar chi-square value of the over-identified model 603.93[c]
Carter–Nager $R^2$ of over-identified model 0.834

[a] In preliminary estimates, using an approximate discrete version of the continuous model, the parameter $\alpha_1$ was equal to 5.2 and significantly differently from zero. This implies a mean adjustment lag of 5.5 days. Using an exact discrete version of the continuous model, for any value of $\alpha_1$ greater than 50.0, all other parameters remain unchanged and the likelihood function is flat. The high value of this coefficient which corresponds to an extremely low mean time lag, indicates that equation (3.8) is really of zero order. For this reason the parameter $\alpha_1$ was set to 227 in final estimates.

[b] The value at the 5 per cent level of the chi-square distribution with 63 degrees of freedom is 82.5, so that the hypothesis that the over-identifying restrictions are not consistent with the sample must be rejected.

[c] The critical value at the 5 per cent level of the chi-square distribution with 15 degrees of freedom is 25.0, so the hypothesis that this model is not consistent with the data must be rejected.

continuous time model have been estimated simultaneously by full information maximum likelihood.[30] A full information maximum likelihood estimator is perhaps the most satisfactory method since it enables non-linear within and across equations restrictions to be imposed on the system and is consistent and asymptotically efficient. The exact discrete model was used because it gives more efficient

parameter estimates, which is particularly important when using a data set which is characterised by extreme variations. The sample period is April 1920 to July 1923. All the estimated parameters are significantly different from zero, with the exception of the income elasticity of the demand for real cash balances. The parameter $\alpha_1$ turned out to be very large, indicating that adjustment was extremely rapid and thus that the exchange rate was maintained in partial equilibrium at all times.[31] The value of $\alpha_2$ implies a mean adjustment lag of about nineteen days indicating that disequilibrium in the money market affected prices with a relatively long lag. The $\lambda$ parameter is about 0.27, implying a mean adjustment lag of 3.7 months. This is more plausible than Cagan's estimate which implied a mean-time lag of about 5.5 months. These results explain the very long deviations of the real exchange rate from purchasing power parity during German hyperinflation.[32]

The estimates show that the degree of foreign currency substitution was high and significant the German hyperinflation, although it is much lower than the degree of substitution of money with goods and domestic financial assets. The estimated income elasticity of demand for real cash balances is 0.1 and not significantly different from zero. This may, however, be the result of the way in which the monthly output series was reconstructed. German output statistics are available only on a yearly basis (Graham, 1930), and the interpolation was made by using monthly data of real imports of goods. Furthermore, the precision of the estimates of the income elasticity could have been affected by the low variability of monthly output with respect to the extremely high variability of nominal variables. The parameters $\alpha_3$ and $\alpha_4$ turn out to be significantly different from zero and in the range of 0.06 and 0.5 respectively. Parameter $\alpha_3$ corresponds $\alpha_3^1$ $(a - b)$, where $a$ and $b$ are the shares of government expenditure and revenue in nominal income. The average ratio of the central government budget deficit in nominal income for the sample period was about 13.2 per cent, so that the $\alpha_3^1$ parameters is in the range of 45 per cent. The average share of the central government debt held by the Reichsbank during the sample period was 33 per cent, which is within the confidence interval of the estimated parameter.

The chi-square statistic of the likelihood ratio indicates that the hypothesis that the over-identifying restrictions are consistent with the data cannot be rejected. It has to be noted that the chi-square statistic of the likelihood ratio is an asymptotic test and that it is biased towards rejection in small samples. The Carter–Nagar system $R^2$ and the Carter–Nagar chi-square statistic of the over-identified

*Table 3.14* *Ex post* mean and root-mean square errors of forecast of model of Table 3.12 (in per cent)

| | *Static* | *Dynamic* |
|---|---|---|
| $D\ln S$ | 23.1 | 27.1 |
| $D\ln p$ | 17.1 | 18.2 |
| $D\ln BU$ | 4.1 | 8.2 |
| $\ln S$ | 17.1 | 32.5 |
| $\ln p$ | 18.7 | 29.3 |
| $\ln BU$ | 3.8 | 27.4 |

model indicate that the model is consistent with the data. The *ex post* root mean square error (RMSE) of the static (or one period ahead) and dynamic forecasts are presented in Table 3.14. Since all variables are in logarithms, the RMSE gives the average error as a proportion of the actual level of variables. The RMSE of the static forecast is about 23 per cent for the exchange rate, and 17 per cent for prices, while the RMSE for cash balances is about 4 per cent. The RSME of the dynamic forecast are similar to those of the static forecast for the rate of change of the variables, while they differ substantially for the level of the variables because of cumulation of errors in the dynamic forecast. Table 3.15 reports the results of a test on the auto-correlation of the residuals. The residuals of each behavioural equation have been regressed both on their lagged values and on the lagged residuals of the other equations. Neither the auto-correlation parameters nor the cross-correlation ones were significantly different from zero, indicating an absence of auto-correlation.

The system of differential equations reported in Table 3.12 can be represented as follows:

$$Dy\ (t) = Ay\ (t) + BZ(t) + u(t)$$

where $y(t)$ is a vector of endogenous variables, $Z(t)$ is a vector of exogenous variables, and $u(t)$ a vector of white noise disturbances. The endogenous part of the system $\mathrm{D}y(t) = Ay(t)$ can be characterised by a set of eigenvalues containing all the dynamic information about the system. The estimated model is dynamically stable as all the real parts of the eigenvalues are negative (Table 3.16), and the complex conjugate pair of eigenvalues implies that the model converges to equilibrium in cycles which have a period of about three months. The stability of the estimated model confirms the findings by

*Table 3.15* Test for auto-correlation of the residuals of equations of model of Table 3.12[a]

| *Dependent variables* | *Independent variables* $u_{S,t-1}$ | $u_{S,t-2}$ | $u_{P,t-1}$ | $u_{P,t-2}$ | $u_{BU,t-1}$ | $u_{BU,t-2}$ |
|---|---|---|---|---|---|---|
| $u_{S,t}$ | –0.113 | | | | | |
| | (.060) | | | | | |
| $u_{S,t}$ | –0.111 | –0.049 | | | | |
| | (0.680) | (0.280) | | | | |
| $u_{S,t}$ | –0.232 | | 0.256 | | 0.701 | |
| | (1.140) | | (1.030) | | (0.770) | |
| $u_{P,t}$ | | | 0.006 | | | |
| | | | (0.040) | | | |
| $u_{P,t}$ | | | 0.001 | 0.129 | | |
| | | | (0.010) | (0.780) | | |
| $u_{P,t}$ | –0.039 | | 0.034 | | 0.078 | |
| | (0.230) | | (0.160) | | (0.100) | |
| $u_{BU,t}$ | | | | | –0.149 | |
| | | | | | (0.870) | |
| $u_{BU,t}$ | | | | | –0.143 | 0.029 |
| | | | | | (0.790) | (0.160) |
| $u_{BU,t}$ | 0.032 | | –0.029 | | –0.159 | |
| | (0.820) | | (0.630) | | (0.910) | |

[a] Numbers in parentheses are *t*-statistics.

*Table 3.16* Stability analysis of model of Table 3.12[a]

| *Eigenvalues* | | *Asymptotic standard errors* | |
|---|---|---|---|
| *Real* | *Imaginary* | *Real* | *Imaginary* |
| –0.268 | | 0.026 | |
| –0.285 | | 0.177 | |
| –0.842 | | 0.520 | |
| –1.117 | ±2.335 | 0.309 | 0.304 |

[a] Although a system of three second order differential equations would usually have six non-zero distinct eigenvalues, in the present model each differential equation depends on the rate of change of the exchange rate, prices and cash balances as well as on the level of cash balances deflated by either prices or the exchange rate. Hence one eigenvalue is zero and can be neglected. This does not affect the estimation of the model. It may be noted, however, that if the restrictions implicit in the theory on which the model is based were not enforced during estimation this result would almost certainly not hold.

*Table 3.17* Sensitivity analysis of the stability of the model of Table 3.12 with respect to the parameters of the system

| *Parameters* | | *Eigenvalues* | | | | |
|---|---|---|---|---|---|---|
| | | *Real* | *Real* | *Real* | *Real* | *Imaginary* |
| | | –0.268 | –0.285 | –0.842 | –1.117 | 2.335 |
| $\alpha_2$ | 1.604 | 0.0 | 0.001 | 0.649 | –4.452 | –2.377 |
| $\alpha_3$ | 0.059 | 0.0 | –7.780 | 8.395 | –0.307 | –0.730 |
| $\alpha_4$ | 0.511 | 0.0 | 2.219 | –7.068 | 1.975 | 0.129 |
| $\beta_1$ | 5.654 | 0.0 | –0.064 | 0.733 | –0.375 | 1.269 |
| $\beta_2$ | 0.672 | 0.0 | 0.007 | –2.300 | –9.021 | –8.415 |
| $\beta_3$ | 0.078 | 0.0 | 0.001 | –0.075 | 6.980 | –15.422 |
| $\lambda$ | 0.268 | –1.0 | –1.977 | 19.963 | –9.722 | 23.790 |

other authors that the German inflationary process was not feeding upon itself but was caused by fiscal deficits and excessive monetary growth.

An important point about the dynamics of inflation is given by the effects of parameter changes, particularly adjustment parameters, on the stability of the system. The sensitivity of the eigenvalues of the system with respect to the parameters of the model is presented in Table 3.17. The derivatives of the eigenvalues with respect to the parameter $\alpha_3$ indicate that small changes in this parameter have important effects on the overall stability of the system. An increase in the parameter $\alpha_3$ tends to decrease the stability of the system by making the real parts of the third eigenvalue more positive.[33] An increase in the parameter $\alpha_4$ also tends to make the system less stable by reducing the real part of the second, fourth and fifth eigenvalues. These last results indicate that in the last stage of the hyperinflation the system could have become unstable, because a larger part of the deficit was monetised in that period. The parameters $\lambda_1$ $\beta_1$ and $\beta_3$ have also a positive effect on the real part of the third, fourth and fifth eigenvalues, thereby reducing the dynamic stability of the system. However, small changes in these parameters should not cause the model to become unstable given the very large negative real parts. An increase in these parameters will reduce the adjustment interval between changes in the driving force of the system (cash balances) hitting against a stable demand function for real cash balances and reductions in that demand, leading to a further increase in inflation.

A crucial assumption in the monetary analysis of inflation is the stability of the demand for money. According to the theory, structural parameters of the demand for real cash balances should be

*Table 3.18* Parameter estimates of the model of Table 3.12, (April 1920–March 1923)

| *Estimated parameters* | | *Asympotic standard error* | *Mean adjustment lag (in days)* |
|---|---|---|---|
| $\alpha_1$ | 227.000[a] | — | 0.1 |
| $\alpha_2$ | 1.259 | 0.336 | 23.8 |
| $\alpha_3$ | 0.045 | 0.016 | |
| $\alpha_4$ | 0.421 | 0.064 | |
| $\delta_1$ | 0.333 | 0.179 | |
| $\delta_2$ | 2.899 | 1.135 | |
| $\delta_3$ | 0.352 | 0.195 | |
| $\beta_1$ | 6.062 | 0.479 | |
| $\beta_2$ | 0.852 | 0.252 | |
| $\beta_3$ | 0.093 | 0.039 | |
| $\beta_4$ | 0.352 | 0.195 | |
| $\lambda$ | 0.304 | 0.038 | 98.7 |
| $\delta_4$ | –0.001 | 0.011 | |

*Note*: Chi-square value of the log-likelihood ratio 65.755[a]
Carter–Nagar chi-square value of the over-identified model 1076.720[b]
Carter–Nager $R^2$ of over-identified model 0.906

[a] In preliminary estimates, using an approximate discrete version of the continuous model, the parameter $\alpha_1$ was equal to 4.9 and significantly differently from zero. This implies a mean adjustment lag of 6.1 days. Using an exact discrete version of the continuous model, for any value of $\alpha_1$ greater than 50.0, all other parameter remain unchanged and the likelihood function is flat. The high value of this coefficient which corresponds to an extremely low mean time lag, indicates that equation (3.8) is really of zero order. For this reason, the parameter $\alpha_1$ was set equal to 227 in final estimates.

[b] The critical value at the 5 per cent level of the chi-square distribution with 63 degrees of freedom is 83.5, so that the hypothesis that the over-identifying restrictions are not consistent with the sample must be rejected.

[c] The critical value at the 5 per cent level of the chi-square distribution with 15 degrees of freedom is 25.0, so that hypothesis that this model is not consistent with the data must be rejected.

stable, while it cannot be excluded *a priori* that adjustment parameters shift as inflation accelerates. The model presented in Table 3.12 has been re-estimated for the period April 1920 to March 1923. The months from April 1923 onwards were excluded from the sample period because of the substantial acceleration of inflation in that period. Empirical estimates of the model are presented in Table 3.18.

The parameters of the demand for real cash balances are within the confidence interval of the parameters estimated in the sample period April 1920 to July 1923, thereby confirming previous findings by other authors that the demand for real cash balances was stable during the hyperinflation period. The results are not so clear-cut for the parameters $\alpha_4$ and $\lambda$.[34]

## CONCLUSION

This chapter has briefly presented the main economic events during the German hyperinflation (Sections 3.1 to 3.4). It has surveyed the empirical literature on German hyperinflation (Section 3.5) pointing out some of the shortcomings and it has presented a disequilibrium model of the exchange rate, prices and the supply of nominal cash balances together with its estimates.

The empirical evidence presented in Tables 3.13 and 3.18 supports the hypothesis that the quantity theory of money and the monetary approach to the exchange rate are valid paradigms to explain the determination of prices and the exchange rate in the steady state, but that it is necessary to consider explicitly the short-term dynamics of prices. It was also found that the exchange rate was continuously in partial equilibrium. This indicates that the exchange rate was reacting immediately to changes in money the supply, or in the real demand for it, while prices reacted with a relatively long lag to monetary disequilibrium, thereby explaining the large real depreciation of the Mark–dollar rate and its fluctuations. The dynamic stability of the model and the stability of the structural parameters of the demand for real cash balances support the hypothesis that inflation was caused by the very expansionary monetary policies adopted by the German authorities which in turn were largely determined by the government budget deficits.

### Appendix

#### Stability conditions of Cagan's model

In the literature, the assertion is frequently found that the stability condition of Cagan's model is verified if the product of the parameters $\beta$ and $\lambda$ is smaller than one. This condition is, however, true only for the continuous time version of Cagan's model, while the condition for its discrete version is more stringent. Hereafter, the formal derivation of these conditions is reported in both cases.

*Continuous time model*

Since Equation (3.2) can be written as:

$$\pi^e(t) = \frac{\lambda}{\lambda + D} D\ln p(t) \tag{3.13}$$

Substituting equation (3.13) into the logarithm of equation (3.1) and solving for $D\ln p(t)$ gives:

$$D\ln p(t) = \frac{\lambda}{1 - \beta\lambda}[\ln M(t) - \ln \gamma - \ln p(t)] + \frac{1}{1 - \beta\lambda} D \ln M(t) \tag{3.14}$$

It can be easily verified that equation (3.14) is dynamically stable if

$$\frac{\lambda}{1 - \beta\lambda} > 0 \text{ or } \beta\lambda < 1$$

*Discrete time model*

Since the discrete version of equation (3.2) can be written as:

$$\pi_t^e = \frac{\lambda}{1 - (1 - \lambda)L} \Delta \ln p_t \tag{3.15}$$

where $L$ is a lag operator, substitution of equation (3.15) into the logarithm of Equation (3.1) gives:

$$\ln p_t = \left(1 - \frac{\lambda}{1 - \beta\lambda}\right) \ln p_{t-1} + \frac{1}{1 - \beta\lambda}(\ln M_t - \lambda \ln\gamma) - \frac{1 - \lambda}{1 - \beta\lambda} \ln M_{t-1}. \tag{3.16}$$

It can be easily verified that equation (3.16) is dynamically stable if:

$$\left| 1 - \frac{\lambda}{1 - \beta\lambda} \right| < 1$$

or,

$$-1 < 1 - \frac{\lambda}{1 - \beta\lambda} < 1.$$

The stability condition defined by Friedman (1978) as

$$\lambda(1 + \beta) < 1$$

is only part of the overall stability condition of this model. Friedman's condition can be written also as:

$$1 - \frac{\lambda}{1 - \beta\lambda} > 0$$

and in this case the model would converge to equilibrium in a monotonic way. However, the model is stable also in the case in which

$$-1 < 1 - \frac{\lambda}{1 - \beta\lambda} < 0$$

and in this case the model would converge to equilibrium with oscillations.

**Notes**

1. Average geometric growth rate.
2. See Helferrich (1925) p. 209.
3. The political motivation behind this decision was Bismarck's desire to keep under the control of the state of Prussia the right to collect direct tax revenues, which were thought to be a more flexible instrument of policy.
4. The nominal short-term private interest rate averaged about 4.1 per cent between 1914 and 1918. With wholesale price inflation averaging 18.1 per cent per year (geometric average), real interest rates turned extremely negative, especially in 1915 and 1918.
5. In August 1914, the German government fixed maximum prices for foodstuff and a series of other raw material prices. This system was reinforced successively in 1915 by the extension of controls to other goods and services, including wages. Domestic prices rose substantially during the first part of the year before the reinforcement of controls.
6. See Cassel 1923 p. 57.
7. Measured by the ratio of United States consumer price index, expressed in Marks, to the German consumer price index.
8. Average geometric growth rate.
9. Haller (1976) estimates that war expenditures reached about 50 per cent of NNP at the end of the war.
10. See Bresciani-Turroni (1937).
11. Ibid. p. 144.
12. Average arithmetic growth rate.
13. See Bresciani-Turroni (1937) pp. 144–50.
14. The German coal industry took the commitment to deliver coal on reparation account in exchange for a credit *vis-à-vis* the government to be repaid later in foreign currencies.
15. Interest and amortisation of the public debt were only 3 per cent of total government expenditures in 1924 as opposed to an estimated 30 per cent in 1919 (see Bresciani-Turroni (1937) p. 356; and also Haller (1976)).
16. Net national product has been deflated by population in order to take into account the losses in territories of Germany in the aftermath of the First World War and in 1923.
17. Net national product for Germany for the period 1919 to 1923 are very rough estimates due to the lack of official data, and therefore are to be interpreted with some caution.
18. See Karsten and Pedersen (1964).
19. From 1918 to 1922 the growth rate in Germany averaged only 6.5 per cent per year.

20. A similar development occurred in Spain in the years from 1929 to 1933, when the floating exchange rate isolated the Spanish economy from the fall in the international business cycle.
21. See Cagan (1956).
22. The ratio of commercial bills to Treasury bills in the portfolio of the Reichbank was 2.4 per cent at the end of June 1922 and rose to 36 per cent at the end of December 1922 and to 60 per cent at the end of February 1923.
23. See Bresciani-Turroni (1937) p. 198.
24. For a formal derivation of this condition see the appendix to this chapter.
25. See Bresciani-Turroni (1937) p. 19.
26. Ibid. p. 46.
27. Ibid. p. 72.
28. See Sargent and Wallace (1973), Frenkel (1977), Evans (1978), Salemi and Sargent (1979) and Salemi (1979).
29. The fact that parameters $a$ and $b$ in equations (3.11) and (3.12) are not identified makes it difficult to interpret equation (3.10).
30. The iterative procedure is Newton–Raphson followed by quasi-Newton once the gradient is small or the likelihood is almost stationary.
31. In preliminary estimates, using an approximate discrete version of the continuous model, parameter $\alpha_1$ was equal to 5.2 and significantly different from zero. This implies a mean adjustment lag of 5.5 days. Using an exact discrete version of the continuous model, parameter $\alpha_1$, is much higher and in the final estimates of the model it was set equal to 227. This implies that equation (3.8) is static, that is that the exchange rate is at its partial equilibrium level.
32. Several estimation attempts were made on slightly different versions of the model presented in Table 3.12. They included: the use of the forward premium or discount as a proxy for the rate of change of the expected exchange rate in the demand for real cash balances; and the introduction of non linearities in equations (3.8) and (3.9). The introduction of non-linearities in equations (3.8) and (3.9) seems to facilitate the estimation of the model for a period beyond July 1923. In the version of the model with exogenous nominal cash balances, the value of $\dot{\lambda}$ remains close to Cagan's estimate, while it increases remarkably when the supply of nominal cash balances becomes endogenous.
33. A positive sign in front of the derivatives in Table 3.17 indicates that an increase in the value of the parameter makes the real part of the eigenvalue less negative.
34. The RMSE are very similar to those presented in Table 3.14. In addition, the stability analysis indicates that the model is dynamically stable for this subperiod.

# 4 The German Depression of the 1930s: the Role of Monetary Policy, Fiscal Policy, and of the International Business Cycle

## INTRODUCTION

In the economic literature there are three different explanations of the origin, the causes, and the length and depth of the 1929–33 world depression. The first one maintains that the depression had a single cause, namely errors in carrying out monetary policy in the United States. It argues that the origin of the depression was in the United States rather than in Europe, its causes were monetary rather than real and that they originated from policy rather than from the nature of institutions, both national and international. This point of view is best represented by Friedman and Schwartz (1963). They argued that the strong and prolonged decline in prices and real output in the world economy is to be attributed mainly to an unprecedented decline in the quantity of money in the United States. This fall in the money stock was largely caused by bank failures in the United States in 1930–33, although they argue it could have been prevented by active monetary policy. Meltzer (1976) also argued that inappropriate Federal Reserve policy in 1929–31 was at the origin of the strong decline in output and prices in the United States and with a lag in the rest of the world. According to Meltzer, this inappropriate monetary policy was due to the Federal Reserve System Board focusing on nominal interest rates and member banks borrowing as a measure of ease and tightness of policy. Hawtrey (1947) also held the view that restrictive monetary policy in the United States and the United Kingdom in 1928 and 1929 were at the origin of the depression. He maintained that France's large gold acquisitions in those years had a

major influence on the degree of restriction of monetary policy in the two reserve currency centres.

A second point of view maintains that the origin of the depression was the result of a series of historical coincidences. Structural dislocation in Europe after the First World War, the financial crisis in Europe in 1931, and the United States' unwillingness to write off war debts, are some of the historical coincidences cited in the literature. Another historical factor is the one exposed by Schumpeter (1939). He maintained that in the early 1930s three different cycles of different periodicities simultaneously reached their depression peak. These were the long-term Kontrantieff cycle, an intermediate Juglar nine-year cycle and a short-term Kitchin cycle in inventories.

A third point of view rejects the previous ones as dominant causes of the depression, but rather insists on the failure of the international monetary system to offset the events which pushed the world economy in the direction of depression. The claim of this viewpoint is that it was not the gold standard as such which failed, but rather the way in which it was operated in the 1920s and early 1930s. In a properly functioning gold standard, losses of gold, fall of prices or currency appreciation do not explain a generalised depression unless the expansionary factors which are the counterparts of the above-mentioned depressive factors fail to operate. This point of view maintains that the explanation of the depth of the world depression was the inability of the United Kingdom to continue its role as underwriter to the system, which it had performed up to 1913, and the reluctance of the United States to take up that function (Kindleberger, 1973).

The purpose of this chapter is first to analyse German economic developments in that period, with particular emphasis on domestic and external macroeconomic changes and second to present a model isolating the effect of domestic and foreign influences on the German business cycle. The first section will analyse the relevant domestic and external macroeconomic changes from 1925 to 1933. The aim of this section is simply to suggest a consistent framework of analysis that highlights the likely effects of particular disturbances on the income level and the balance of payments. The second section presents a small model analysing the effects of monetary and fiscal policy and of the international business cycle on the developments of nominal income and the balance of payments. The main conclusion of the analysis of this chapter is that, although international developments were a major determinant of the German depression, monet-

ary, fiscal and exchange rate policies in Germany were major factors determining the length and depth of the depression.

International developments were dominated by the inability of the United Kingdom and the unwillingness of the United States to provide countercyclical lending and an open market for goods. These developments affected Germany in three ways. First, they were behind the halt in lending to Germany in 1929. International lending developments affected Germany because the authorities were unwilling to devalue the Mark, owing to inflationary fears, thus leading to a sharp deterioration of the balance-of-payments, particularly in 1929. The German authorities reacted to balance-of-payments developments with a policy of monetary and fiscal deflation, which was particularly destabilising in the second half of 1929 and 1930. Second, these events, both in Germany and abroad, led to a widespread increase in protectionism and competitive devaluations , leading to further deflationary effect on world output. The inability of the authorities in Germany to reflate the economy in the face of a mounting unemployment in 1930–31 and the adoption of further deflationary measures in 1931 were the main causes of the length and depth of the depression in Germany. Finally, these developments led to a change in the political regime and the pursuit of an independent economic path, largely cut off from that of the rest of the world economy by a system of foreign exchange controls.

## 4.1 THE GERMAN ECONOMY FROM 1925 TO 1933: AN OVERVIEW

In the second half of the 1920s, the German economy was characterised by a number of disturbing developments both of internal and of external origin. The internal disturbing developments included a substantial increase in real wages (Table 4.1), largely as a result of internal pressures towards income redistribution. From 1925 to 1930 real wages increased by 4.6 per cent per year on average. There was also a deterioration of German industry's international competitiveness. Unit labour costs in industry increased on average by 2.6 per cent from 1925 to 1930 against a decline of about 2 per cent in the United States from 1925 to 1929 and of 7 per cent in the United Kingdom from 1921 to 1931 (Table 1.18 on page 46). Despite the strong deterioration in competitiveness, the German authorities were unwilling to devalue the Mark, because of inflationary fears which

*Table 4.1* The real wage rate in Germany (1925 = 100) (annual data) 1925–33

| | Nominal wage rate | Real wage rate |
|---|---|---|
| 1925 | 100.0 | 100.0 |
| 1926 | 104.2 | 104.0 |
| 1927 | 113.1 | 108.5 |
| 1928 | 123.3 | 115.3 |
| 1929 | 130.8 | 120.4 |
| 1930 | 131.7 | 126.1 |
| 1931 | 120.7 | 125.7 |
| 1932 | 104.0 | 122.3 |
| 1933 | 100.8 | 121.2 |

*Source*: Hoffmann (1965) and Deutsche Bundesbank (1976) (see also Appendix 2).

developed from the experience with the floating exchange rate during the hyperinflation in the early 1920s. However, the German export share grew in the second half of the 1920s as reported in Chapter 1 (Tables 1.17 and 1.19). Thus, despite the strong deterioration in competitiveness during this period, German industry was able to retain market shares at the cost of a large squeeze in profit margins (Table 1.16).

The second major disturbing economic development in the second half of the 1920s was related to the rapid increase in spending activities of local governments (Table 4.2). The latter was due to the modification of the fiscal law of February 1924, whereby the local governments became again more independent from the Reich. This constituted a major departure from the fiscal law of March 1920, which had greatly reduced the autonomy of local governments. Not only were the tasks of the local governments increased but they were also granted financial autonomy through increased sources of revenues allocated to them and the possibility of entering in the capital markets both domestically and internationally. The strong demand for capital, not only from industry but also from the federal and local governments and the insufficiency of domestic saving, caused almost continuous tensions in the German money markets in the years under analysis. The decision of the monetary authorities to retain a system of fixed exchange rates made it also very difficult to control the money supply. Capital movements, particularly short-term capital movements, tended to offset movements in the domestic component

*Table 4.2* The government budget deficit (in per cent of NNP) (annual data) 1925–33

| | *Government expenditures* | | *Government revenues* | | *Government budget deficit* | |
|---|---|---|---|---|---|---|
| | *Reich* | *Public sector*[a] | *Reich* | *Public sector*[a] | *Reich* | *Public sector*[a] |
| 1925 | 16.4 | — | 17.2 | — | –0.8 | — |
| 1926 | 17.5 | 38.4 | 16.1 | 38.0 | 1.4 | 0.4 |
| 1927 | 17.9 | 39.2 | 17.8 | 38.3 | 0.1 | 0.9 |
| 1928 | 19.6 | 43.6 | 18.9 | 41.7 | 0.7 | 1.9 |
| 1929 | 23.0 | 47.4 | 21.1 | 45.4 | 1.9 | 2.0 |
| 1930 | 25.9 | 48.0 | 24.9 | 46.6 | 1.0 | 1.4 |
| 1931 | 21.2 | 42.3 | 20.3 | 41.0 | 0.9 | 1.3 |
| 1932 | 17.2 | 38.3 | 16.2 | 37.0 | 1.0 | 1.3 |
| 1933 | 18.7 | 39.2 | 17.0 | 38.0 | 1.7 | 1.2 |

*Source:* Institut fur Kojunkturforschung (1933) and Hoffmann (1965)
[a] Reich, Länder and Gemeinden.

of the monetary base. When the Reichsbank expanded the domestic component of the monetary base by lowering its discount rate, the differential between foreign and domestic rates was reduced and capital tended to flow out. On the other hand, when it raise its rate in order to check domestic monetary expansion, the interest rate differential widened, and foreign capital tended to enter Germany partly offsetting the restrictive monetary policy, thus making the German economy more sensitive to foreign disturbances.

In the period under analysis reparations and the payments of war debts were a third disturbing factor aggravating the severity of the depression. The history of reparations is familiar and can be divided in three periods, from 1919 to 1924, from 1924 to 1930, and from 1930 to 1931. By the end of the first period the amount of reparations had been defined according to the Dawes Plan which involved a schedule of annual payments of one billion gold Marks in the first year and rising to 2.5 billion in the fifth year, varying thereafter according to changes of world economic conditions. The third period culminated in the Hoover moratorium on reparations in 1931. The situation at the end of the war was such that the main bulk of reparations were due from Germany to the United Kingdom and France, with a small amount due to the United States. On the contrary the main bulk of war debts were due from the United Kingdom to the United States

and to France. In the second half of the 1920s the situation was such that no clear solution was possible. On the one hand, Germany wanted to cancel reparations while it was not willing to default on commercial debts. The United Kingdom was willing to cancel reparations, but only if war debts were also cancelled. France insisted on receiving reparations, but would have been willing to cancel war debts, while the United States was not prepared to cancel both. Although reparations and war debts were not by themselves responsible for the depression they played a major role, together with the lack of leadership in the international financial system, in the flows of international lending. The abrupt interruption of this lending was one of the key factors in causing the German depression lending and explains why the recession in Germany started in 1929 earlier than in the United States.

The German economy experienced in this period two major recessions: one in 1925–26 and the other from 1929 to 1933 (Tables 4.3 and 4.4). The causes of the first recession were mainly domestic, while the ones of the second were mainly international. The first recession was caused mainly by the tightness of monetary policy in Germany in 1924–25. As already mentioned in Chapter 3, in March 1924 the Reichsbank initiated a tight stance of monetary policy, following the rapid increase in economic activity and renewed fears of inflation. The Reichsbank imposed a maximum limit to the outstanding short-term bank credit to the private sector at the level reached at the end of March 1924. During 1924, high interest rates in Germany, compared to those abroad, attracted a substantial amount of foreign capital. This rapid inflow of foreign capital helped to financed a rapid increased in investment in the second half of 1924 and early 1925. High real interest rates and the continuation of a tight monetary policy in 1926 (Tables 4.5 and 4.6) led eventually to a decline in inventory accumulation and a sharp fall of investments in 1926 together with lower interest rates and a fall in international lending. Nominal short-term interest rates, which averaged over 11 per cent the first quarter of 1925, were as low as 5.8 per cent the second quarter of 1926 while real interest rates were negative in the first half of 1925 and increased to 6 per cent in the last quarter remaining at high levels in the course of 1926.

By the end of March 1926, the economic situation stopped deteriorating, until about July of the same year when economic activity began to expand again. Investment, particularly in the building sector and in the productive equipment sector, was particularly favoured by the more expansionary stance of monetary policy. In early 1926

*Table 4.3* Industrial production in Germany (1928 = 100) (quarterly data), 1925–33

| | | *Level* | *Annual changes*[a] |
|---|---|---|---|
| 1925 | I | 85.0 | 47.1 |
| | II | 86.3 | 25.8 |
| | III | 82.6 | 17.8 |
| | IV | 79.1 | –0.8 |
| 1926 | I | 77.2 | –9.2 |
| | II | 74.8 | –13.3 |
| | III | 79.8 | –3.4 |
| | IV | 89.0 | 12.5 |
| 1927 | I | 93.1 | 20.6 |
| | II | 101.3 | 35.4 |
| | III | 102.7 | 28.7 |
| | IV | 103.4 | 16.2 |
| 1928 | I | 101.9 | 9.5 |
| | II | 103.6 | 2.3 |
| | III | 103.0 | 0.3 |
| | IV | 91.5 | –11.5 |
| 1929 | I | 95.0 | –6.8 |
| | II | 109.1 | 5.3 |
| | III | 103.3 | 0.3 |
| | IV | 99.1 | 8.3 |
| 1930 | I | 93.1 | –2.0 |
| | II | 86.7 | –20.5 |
| | III | 79.2 | –23.3 |
| | IV | 75.0 | –24.3 |
| 1931 | I | 74.1 | –20.4 |
| | II | 68.0 | –21.6 |
| | III | 62.3 | –21.3 |
| | IV | 55.7 | –25.7 |
| 1932 | I | 57.1 | –22.9 |
| | II | 56.2 | –17.4 |
| | III | 57.8 | –7.2 |
| | IV | 59.7 | 7.2 |
| 1933 | I | 63.3 | 10.9 |
| | II | 65.9 | 17.3 |
| | III | 69.9 | 20.9 |
| | IV | 70.0 | 17.3 |

*Source*: League of Nations, *Monthly Bulletin of Statistics*, various issues.
[a] Per cent changes with respect to the same quarter of previous year.

*Table 4.4* Unemployment (in '000s) (quarterly data) 1925–32

| | | *Unemployed* | *Average unemployment rate*[a] |
|---|---|---|---|
| 1925 | I | 648 | |
| | II | 401 | |
| | III | 503 | |
| | IV | 1712 | 2.6 |
| 1926 | I | 2243 | |
| | II | 2081 | |
| | III | 1781 | |
| | IV | 2127 | 6.5 |
| 1927 | I | 1708 | |
| | II | 1061 | |
| | III | 772 | |
| | IV | 1714 | 3.9 |
| 1928 | I | 1489 | |
| | II | 1075 | |
| | III | 1030 | |
| | IV | 2265 | 4.8 |
| 1929 | I | 2484 | |
| | II | 1260 | |
| | III | 1324 | |
| | IV | 2851 | 5.8 |
| 1930 | I | 3041 | |
| | II | 2641 | |
| | III | 3004 | |
| | IV | 4384 | 9.7 |
| 1931 | I | 4744 | |
| | II | 3954 | |
| | III | 4355 | |
| | IV | 5668 | 14.3 |
| 1932 | I | 6034 | |
| | II | 5476 | |
| | III | 5103 | |
| | IV | 5773 | 17.6 |

[a] In per cent of the labour force, average for the year.
*Source*: Institut fur Konjunkturforschung (1933).

the Reichsbank announced that its credit restraining policy which had been in effect since April 1924 would be terminated. Currency in circulation increased by 11.9 per cent in 1926 and the monetary base by 6.2 per cent (Table 4.5). This increase followed mainly as a result

*Table 4.5* Domestic and external component of the monetary base (annual data), 1925–34

| | *Monetary base*[a,b] | *External component*[c] | *Domestic component*[c] | *Currency in circulation*[a,d] |
|---|---|---|---|---|
| 1925 | 3.4 | 3.7 | –0.3 | 21.2 |
| 1926 | 6.2 | 12.5 | –6.3 | 11.9 |
| 1927 | 17.8 | –9.5 | 27.3 | 9.2 |
| 1928 | 11.0 | 16.2 | –5.2 | 5.1 |
| 1929 | 1.4 | –2.6 | 4.0 | –0.8 |
| 1930 | –7.1 | –1.8 | –5.3 | –3.4 |
| 1931 | 0.4 | –28.5 | 28.9 | 4.1 |
| 1932 | –25.1 | –3.9 | –21.2 | –15.0 |
| 1933 | 4.8 | –8.9 | 13.7 | 1.3 |
| 1934 | 11.9 | –9.4 | 21.3 | 4.5 |

[a] Annual Percentage Changes.
[b] Defined as sum of International reserves held by the Reichsbank (IR) Reichsbank advances to banks and the private sector (A) and claims on the government sector (MF)
[c] Contribution to the growth of the monetary base; calculated as absolute change in component as per cent of total monetary base at the end of the previous year. The external component is defined as IR and the domestic one as the sum of A and MF (see also Appendix 2 and Table 1.32).
[d] Including currency issued by banks other than the Reichsbank.
*Source*: Deutsche Bundesbank, *Deutsches Geld- und Bankwesen in Zahlen, 1876–1975* (1976).

of a rapid growth in international reserves, which in turn was mainly due to the strong surplus in the capital account, especially in the second half of the year. Therefore the Minister of Finance suspended on 4 December 1926, the exemption of German issues placed abroad from the capital income tax, in order to discourage foreign capital inflows.

This economic expansion continued in early 1927. The fall in interest rates led to a rise in inventory investments in 1927 with the Reichsbank continuing its policy of easing monetary conditions. The discount rate was lowered twice. The low interest rates and the elimination of the exemption of the capital income tax resulted in almost a complete halt of capital inflows from abroad in the early months of 1927, but the rapid expansion of economic activity and investment, together with low domestic saving and increasing demand for funds by the federal and local governments pushed up interest rates again during the second half of 1927, resulting in an

*Table 4.6* Nominal and real short- and long-term interest rates[a] (quarterly data), 1925–32

| | *Short*[b] | | *Long*[c] | |
|---|---|---|---|---|
| | *Nominal* | *Real* | *Nominal* | *Real* |
| 1925 I | 11.26 | –0.31 | — | — |
| II | 10.68 | –1.30 | — | — |
| III | 10.59 | –1.39 | — | — |
| IV | 10.29 | 6.01 | — | — |
| 1926 I | 6.78 | 5.09 | — | — |
| II | 5.77 | 4.18 | — | — |
| III | 6.23 | 8.23 | — | — |
| IV | 7.39 | 5.27 | — | — |
| 1927 I | 7.28 | 2.51 | — | — |
| II | 8.24 | 3.12 | — | — |
| III | 8.28 | 4.69 | — | — |
| IV | 9.05 | 4.13 | — | — |
| 1928 I | 7.89 | 3.96 | 6.89 | 2.96 |
| II | 8.07 | 5.56 | 7.01 | 4.51 |
| III | 8.70 | 5.16 | 7.13 | 3.59 |
| IV | 8.89 | 7.96 | 7.19 | 6.26 |
| 1929 I | 7.65 | 3.73 | 7.24 | 3.33 |
| II | 10.00 | 8.68 | 7.39 | 6.07 |
| III | 9.74 | 8.89 | 7.44 | 6.59 |
| IV | 9.35 | 9.42 | 7.54 | 7.61 |
| 1930 I | 6.93 | 11.91 | 7.42 | 12.40 |
| II | 4.96 | 8.74 | 7.04 | 10.82 |
| III | 4.89 | 9.25 | 7.03 | 11.39 |
| IV | 7.36 | 14.57 | 7.25 | 14.46 |
| 1931 I | 6.41 | 13.81 | 7.16 | 14.56 |
| II | 7.04 | 13.68 | 7.28 | 13.92 |
| III | 9.11 | 17.89 | 8.52 | 17.30 |
| IV | 9.59 | 17.50 | — | — |
| 1932 I | 7.48 | 18.59 | — | — |
| II | 6.48 | 18.38 | 9.93 | 21.83 |
| III | 6.27 | 17.09 | 8.90 | 19.72 |
| IV | 5.79 | 14.99 | 7.86 | 17.06 |

[a] Last month of quarter. Real interest rates were computed as $r - \pi$ where $r$ is the nominal interest rate and $\pi$ is the rate of inflation during the preceding twelve months. The rate of inflation used is based on the cost of living index from Institut für Konjunkturforschung (1933).
[b] Monatsgeld.
[c] Rendite der 6 per cent Wertpapiere. Data are not available before 1928.
*Source*: Institut für Konjunkturforschung (1933).

*Table 4.7* Nominal and real long term interest rates in Germany and in the United States (annual data) 1925–33.[a]

| | *Germany*[b] | | *United States*[c] | |
|---|---|---|---|---|
| | *Nominal* | *Real* | *Nominal* | *Real* |
| 1925 | 9.50 | 1.10 | 4.88 | 2.58 |
| 1926 | 8.30 | 8.30 | 4.73 | 3.63 |
| 1927 | 7.90 | 3.70 | 4.57 | 6.77 |
| 1928 | 7.00 | 4.30 | 4.55 | 5.65 |
| 1929 | 7.40 | 6.10 | 4.73 | 4.73 |
| 1930 | 7.20 | 11.10 | 4.55 | 6.85 |
| 1931 | 7.00 | 15.10 | 4.58 | 13.48 |
| 1932 | 8.40 | 19.40 | 5.01 | 15.41 |
| 1933 | 7.20 | 9.70 | 4.49 | 9.59 |

[a] Real interest rates have been computed as in Table 4.6. The rate of inflation used is based on the figures published in Appendix 2.
[b] Rendite der festverzinzlichen Wertpapiere.
[c] Long term government bond yield (see also Appendix 2).
*Source*: Deutsche Bundesbank, *Deutsches Geld- und Bankwesen in Zahlen 1876–1975* (1976) and US Department of Commerce, (1979).

extremely rapid increase of capital inflows from abroad. The short-term interest rate, which was as low as 7.3 per cent in the first quarter of 1927, increased to about 9.1 per cent in the last quarter of the year. In 1927, net capital inflows from abroad including errors and omissions totalled 3.8 billion Reichsmark (Table 4.8), but these only partly compensated the high current account deficit and reparation payments, so that international reserves of the Reichsbank declined by about 0.5 billion Reichsmark.

In 1928, economic activity remained high, but the growth of industrial production virtually stopped. Nominal interest rates remained high with respect to foreign markets (Table 4.7) and capital inflows from abroad continued at an increasing rate. During 1928, the Reichsbank was able to control the increase in currency in circulation by increasing its discount rate in succesive stages, so that the large increase in international reserves was partly offset by a decline in the domestic components (Table 4.5). Although the return in 1928 to an acceptable rate of growth of currency might suggest a return to monetary stability after the disruptions of the early 1920s, such a conclusion would be premature. At the end of 1928, the German economy was still not able to finance the rapid increase in the federal and local government expenditure and the war reparation payments

*Table 4.8* Balance of payments developments annual data 1924–33 (in billions of Reichsmark)

| | *Trade balance* | *Net services* | *Current account balance*[a] | *Transfers* | *Capital movements*[b] |
|---|---|---|---|---|---|
| 1925 | –2.4 | 0.5 | –1.9 | –1.1 | 3.1 |
| 1926 | 0.8 | 0.4 | 1.2 | –1.2 | 0.6 |
| 1927 | –3.0 | 0.3 | –2.7 | –1.6 | 3.8 |
| 1928 | –1.3 | 0.1 | –1.2 | –2.0 | 4.1 |
| 1929 | –0.1 | –0.1 | –0.2 | –2.3 | 2.3 |
| 1930 | 1.6 | –0.5 | 1.1 | –1.7 | 0.5 |
| 1931 | 2.8 | –0.8 | 2.0 | –1.0 | –2.7 |
| 1932 | 1.1 | –0.6 | 0.5 | –0.2 | –0.5 |
| 1933 | 0.7 | –0.4 | 0.3 | –0.1 | –0.6 |

[a] Excluding reparation payments and other transfers.
[b] Including errors and omissions.
*Source*: Deutsche Bundesbank, *Deutsches Geld- und Bankwesen in Zahlen, 1876–1975* (1976) Table 1.01, p. 322.

without a further inflow of funds from abroad. The halt of capital inflows from abroad at the end of 1928 and in 1929, the high real interest rates and declining United States output later in the year led to a decline in investment and in economic activity at the end of 1929. For the year as a whole real output in Germany fell by 4.3 per cent, while in the United States it increased by 6.7 per cent.

The beginning of the recession in 1929–30 in Germany can be attributed to the halting of the capital inflows. In 1929 total capital inflows declined to 2.3 billion Reichsmarks from about 4.1 billion in 1928 (Table 4.8) while long-term capital inflows totalled only 0.3 billion Reichsmarks compared to 1.4 billion Reichsmarks in 1928 (Table 4.9). German long-term borrowing in New York had already declined drastically in the second half of 1928 and came to a virtual standstill in 1929 (Table 4.12).

There were two reasons behind the drastic fall in capital flows from the United States to Germany since the second half of 1928. First, the risk perception of Germany as a borrower must have changed during the course of 1928 due to the very negative outturn of the German current account and transfer balances both in 1927 and 1928. This is shown by the fact that long term lending to Germany fell much more than lending to other European and Latin American countries. The second reason relates to policy development in the United States which, had become one of the major international financial markets after the First World War.

*Table 4.9* Capital movements (in billions of Reichsmark), 1924–33

| | *Long-term capital movements* | | *Short-term capital movements* | | *Other capital* |
|---|---|---|---|---|---|
| | *Total* | *Government* | *Total* | *Banks* | |
| 1924 | 1.0 | 1.0 | 0.5 | — | 1.0 |
| 1925 | 1.1 | 1.1 | 0.1 | — | 0.2 |
| 1926 | 1.5 | 1.4 | 0.2 | — | — |
| 1927 | 1.4 | 1.3 | 1.8 | 1.8 | –0.1 |
| 1928 | 1.4 | 1.3 | 1.3 | 1.2 | 0.1 |
| 1929 | 0.3 | 0.3 | 0.8 | 0.5 | 0.2 |
| 1930 | 1.1 | 1.1 | 0.1 | –0.4 | 0.3 |
| 1931 | 0.4 | 0.3 | 0.5 | –0.2 | 0.3 |
| 1932 | 0.1 | — | –0.8 | –0.2 | — |
| 1933 | — | — | –0.7 | — | — |

*Source*: Deutsche Bundesbank, *Deutsches Geld- und Bankwesen in Zahlen, 1876–1975* (1976), Table 1.07 p. 328.

Apparently in 1928 and 1929 there was a shift in the demand for money in the United States, owing to the boom in the stock market. Field (1984) argued that the increase in the volume of stock exchange transactions associated with the speculation in the stock market raised the transaction demand for money in the United States. Using monthly data over the period 1919–29, Field found that the level of trading on the New York stock market had significant effects on the demand for narrow money, holding income and interest rates constant. Thus according to Field, the inability of the Federal Reserve Board to recognise the effects of stock exchange transactions on the demand for narrow money together with the Federal Reserve's contractionary policy, was an important factor in precipitating the depression in the United States. Hawtrey (1947) held the view that the world scarcity of gold and its maldistribution, coupled with the aggressive gold purchases of France in 1928 and 1929 added to the degree of monetary contraction in the United States. As Meltzer (1976) has pointed out the Federal Reserve focused on nominal interest rates and member banks borrowing in setting its monetary policy, ignoring the distinction between nominal and real interest rates. Thus falling short-term nominal interest rates after the stock market crash of October 1929 were misinterpreted as evidence of an easing of monetary policy, while they actually reflected deflationary expectations. These developments in the United States economy were important in causing a virtual halt of net United States capital

*Table 4.10* International reserves of the Reichsbank (quarterly data), 1925–32 (in millions of Reichsmarks)

| | *International reserves* | *Changes in international reserves.*[a] |
|---|---|---|
| 1925 I | 1338 | 325 |
| II | 1416 | 78 |
| III | 1494 | 78 |
| IV | 1611 | 117 |
| 1926 I | 1972 | 361 |
| II | 1817 | –155 |
| III | 2120 | 303 |
| IV | 2351 | 231 |
| 1927 I | 2055 | –296 |
| II | 1870 | –185 |
| III | 2006 | 136 |
| IV | 2147 | 141 |
| 1928 I | 2120 | –27 |
| II | 2334 | 214 |
| III | 2576 | 242 |
| IV | 2885 | 309 |
| 1929 I | 2719 | –166 |
| II | 2272 | –447 |
| III | 2547 | 275 |
| IV | 2687 | 140 |
| 1930 I | 2883 | 196 |
| II | 3078 | 195 |
| III | 2650 | –428 |
| IV | 2685 | 35 |
| 1931 I | 2512 | –173 |
| II | 1721 | –291 |
| III | 1440 | –281 |
| IV | 1156 | –284 |
| 1932 I | 1021 | –135 |
| II | 962 | –59 |
| III | 929 | –33 |
| IV | 920 | –9 |

[a] Absolute changes with respect to previous quarter.
*Source*: Institut fur Konjunkturforschung (1933).

*Table 4.11* United States balance of international payments (annual data) 1925–30 (in billions of dollars)

| | *1925* | *1926* | *1927* | *1928* | *1929* | *1930* |
|---|---|---|---|---|---|---|
| Balance of goods and services | 1.1 | 0.8 | 1.1 | 1.3 | 1.2 | 1.0 |
| Transfers, net | –0.4 | –0.4 | –0.4 | –0.2 | –0.3 | –0.3 |
| Net capital movements; | –0.7 | –0.3 | –0.4 | –1.1 | –0.2 | –0.5 |
| of which: | | | | | | |
| short-term | –0.1 | 0.4 | 0.6 | –0.4 | — | –0.5 |
| long-term | –0.6 | –0.7 | –1.0 | –0.7 | –0.2 | — |
| Errors and omissions | –0.1 | –0.1 | –0.4 | –0.1 | –0.4 | 0.3 |
| Changes in international reserves (– sign=increase in reserves) | 0.1 | — | 0.1 | 0.2 | –0.3 | –0.5 |

*Source*: US Department of Commerce (1979).

*Table 4.12* Net capital issues on foreign account in the United States (quarterly data) 1928–30 (in millions of dollars)[a]

| | | *Germany* | *Other European countries* | *Latin America* | *Total* |
|---|---|---|---|---|---|
| 1928 | I | 46.7 | 13.2 | 86.4 | 312.1 |
| | II | 153.8 | 32.0 | 74.3 | 529.7 |
| | III | 14.2 | 16.1 | 81.9 | 118.9 |
| | IV | 62.4 | 11.7 | 88.4 | 270.4 |
| 1929 | I | 21.0 | 42.9 | 73.4 | 264.3 |
| | II | — | 3.9 | 70.3 | 193.6 |
| | III | — | 14.0 | 29.8 | 79.7 |
| | IV | 8.5 | 24.23 | 2.5 | 133.8 |
| 1930 | I | 43.3 | — | 39.3 | 269.3 |
| | II | 113.5 | — | 143.0 | 429.6 |
| | III | 10.0 | — | 16.1 | 100.1 |
| | IV | — | — | 0.6 | 106.3 |

[a] Excluding refunding.

*Source*: Ohlin, *The Course and Phases of the World Economic Depression* (1931).

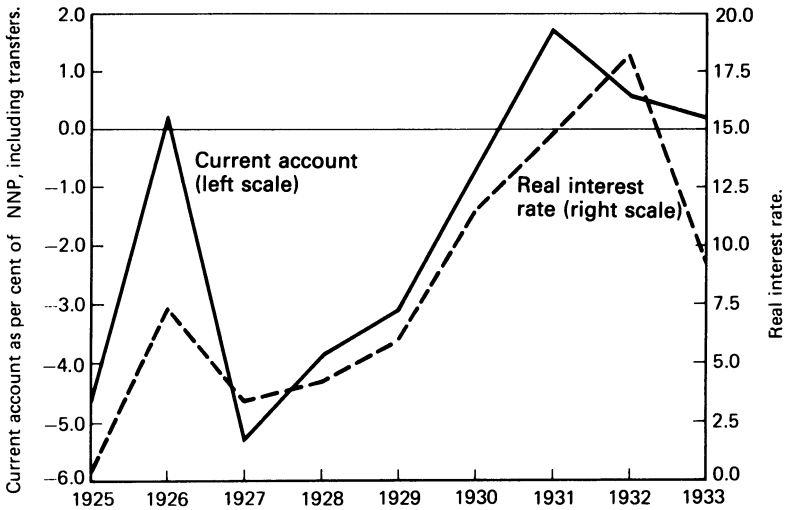
outflows (Tables 4.11 and 4.12) and thus in triggering the recession in Germany. The restrictive monetary policy led to a sudden collapse of business, commodity prices and imports in the US at the end of 1929.

The almost simultaneous reduction of imports and lending of the United States was exactly the opposite of what usually happened in the United Kingdom during the pre-1914 gold standard. During the pre-1914 gold standard, United Kingdom domestic economic activity and foreign lending generally moved in the opposite direction. Declining economic activity stimulated United Kingdom foreign lending, while expanding economic activity was accompanied by declining UK foreign lending and increased imports which provided an export stimulus abroad. In such a way countercyclical lending stabilised the international system. In 1929, the United States economy failed to provide such countercyclical lending. Furthermore, the United States closed its goods market by introducing trade restrictions in 1929 (The Scott-Hawely Tariff Bill), following the strong decline in economic activity.

The German economy was severely hit by these developments because of the needs of financing the large current account deficits (Table 4.8) and war repayments. In order to restore the external balance the German authorities were then faced with the alternatives of either departing from the gold standard and the fixed exchange rate system and maintaining full employment, or deflating their economy; fears of inflation led the monetary authorities to follow the second alternative. Nominal short-term interest rates were raised sharply in the second quarter of 1929. Real short-term interest rates reached about 9.4 per cent in the last quarter of 1929 and about 14.6 per cent in the last quarter of 1930. They remained between 13.7 and 18.6 per cent until the end of 1932. The monetary base of the Reichsbank declined by 7.1 per cent in 1930 (Table 4.5). Nominal and real short-term interest rates remained from 1929 to 1932 much higher than rates in the United States (Table 4.7). However, the uncertainty over the political situation in Germany and the fears that the collapse of the Kredit–Anstalt in Vienna would influence the situation of German banks had considerably reduced the sensitivity of foreign capital to interest rate differentials.

The international downturn of the business cycle in 1930 was followed by further deflationary policies in Germany. Such policies arose out of a fear of inflation, German obligations under the Young Plan, the high current account deficit, and the erroneous notion that profits could be restored by pushing wages down as far as prices had

*Figure 4.1* Real short-term interest rate and current account developments, 1925–33




fallen. In 1930 the German government also initiated a policy of balancing the government budget. Taxes on income, turnover and beer were raised, while new taxes were imposed on unmarried persons, warehouses and mineral water. Expenditures were substantially reduced. Following these developments and the severe downturn of the international business cycle, German industrial production declined by 17.8 per cent in 1930, 22.1 per cent in 1931 and 11.3 per cent in 1932 (Table 4.3). Real NNP fell by 4.3 per cent in 1929, 4.6 per cent in 1930, 11.0 per cent in 1931 and 4.8 per cent in 1932. The rate of unemployment rose steadily from 5.8 per cent of the labour force at the end of 1929 to 17.6 per cent at the end of 1932 (Table 4.4).

The sharply deflationary policies produced a remarkable swing in the trade balance which from a peak deficit of 3 billion Reichsmark in 1927 moved to virtual balance in 1929 and a surplus of 2.8 billion in 1931 (Table 4.8). The current account also recorded a remarkable swing. Figure 4.1 shows the close correlation between the current account and the level of real interest rates during the period.

In 1931 other external shocks produced further deflationary effects on the German economy. First, the 30 per cent depreciation of sterling in 1930 and the consequent response of other countries involved an appreciation of the mark not only against sterling but

also against those currencies which had followed sterling off gold. They included the Danish and the Swedish krona. Both countries were particularly important in German foreign trade. Second, in 1931 the German economy was hit also by higher tariffs elsewhere. In the months from October 1931 to March 1932 the United Kingdom, Denmark, Sweden, the Netherlands, France, Belgium and Switzerland applied across-the-board tariffs and imposed quotas and Switzerland also denounced a trade agreement with Germany. These developments had a powerful deflationary pressure on Germany, with German exports falling even more sharply than world trade. Although Germany could have devalued to alleviate the deflationary pressures from abroad it did not do so. The reasons which have been advanced to explain the attitude of the German authorities toward devaluation range from the conditions of the Young Plan to the desire to hold down the local currency cost of foreign debt. It is likely, however, that the German authorities regarded devaluation as inflationary, despite the fact that at the end of 1931 unemployment had reached 14.3 per cent of the labour force. There were proposals for devaluation and credit expansion, in particular a plan to expand bank credit to finance public works proposed by William Lautenbach, an official at the Ministry of Economics, was rejected out of hand by the German government.

In May 1932, the Bruning government fell. Bruning's successor, Von Papen, adopted expansionary monetary and fiscal policies, including earlier suggestions by Lautenbach to pay for public works with tax certificates that could be used by companies to pay taxes to the Reich in the years 1934–38, when they would have been paid out by budget surpluses. In June and July 1932, war reparations were cancelled *de facto* at the Lausanne Conference, removing one of the factors that had aggravated the crisis in 1929. During 1932 and in 1933 the monetary base increased after having declined for two years in a row. However, only in the course of 1933 did real short-term interest rates decline sharply (Table 4.7). In 1933, Germany started to recover from the depression. Industrial production which had already increased in the first quarter rose by 16.6 per cent in 1933 (Table 4.3) and NNP increased by 13.4 per cent. Despite the fact that the last democratic government had already taken the appropriate fiscal and monetary policy measures in 1932, the social cement in the country crumbled under the severe and prolonged recession in 1929–32 and the Nazi party gained power. The reformers who were politically opposed to Hitler, ironically supplied him with the ideas that previ-

ous democratic German governments had refused to use.

This brief description of economic events in the second half of the 1920s and early 1930s indicate that, although the origin of the depression in Germany was the fall in United States lending and output, there were several factors aggravating the impact of the United States recession on German output: the high real wages at the start of the United States recession, the imbalance between domestic saving and investment and the ensuing large current account deficits, the government deficits and war reparations. Subsequent events indicate, however, that the inability of the German authorities to reflate the economy and eventually to depart from the gold standard and the fixed exhange rate regime, and thus the lack of adequate monetary, fiscal and exchange rate policies were the major factor behind the severity of the recession. The next section of this chapter will try to determine, through more analytical methods, the relative importance of monetary policy, fiscal policy and of the United States business cycle in influencing the depression of the early 1930s in Germany.

## 4.2 EFFECTS OF MONETARY AND FISCAL POLICY ON THE LEVEL OF GERMAN NOMINAL INCOME

This section analyses by means of simple regression techniques the relative importance of monetary policy, fiscal policy and of the United States business cycle in the determination of the depression in Germany in the early 1930s. The analysis is carried out by estimating reduced form nominal income equations which include monetary and fiscal policy indicators as the independent variables. The first type of reduced form equation used is of the following form:

$$NNP = a\,M^{b}F^{c} \tag{4.1}$$

where all variables are in nominal terms. NNP measures nominal net national product; monetary policy is represented by *M* defined as either currency in circulation or the domestic counterpart of currency in circulation; the former were used instead of narrow or broad money because no official figures on the latter exist for this period. Fiscal policy is represented by *F* defined either as nominal government expenditure or as the government budget deficit. Equation (4.1) neglects the problem of reverse causation between NNP and monetary variables and NNP and fiscal variables and disregards the

*Table 4.13* Effects of monetary and fiscal policies on the level of nominal net national product (annual data) 1924–33[a] [b]

| | *Currency in circulation* | *Domestic counterpart of currency* | *Government budget deficit* | *Government expenditure* | $R^2_{adj}$ | *DW* | ϱ |
|---|---|---|---|---|---|---|---|
| (1) | 1.11 (11.04) | – | 2.22 (1.64) | – | 0.74 | 2.07 | 0.74 |
| (2) | 0.88 (5.27) | – | – | 0.86 (1.42) | 0.72 | 1.94 | 0.74 |
| (3) | – | 0.17 (8.63) | 0.15 (1.76) | – | 0.37 | 1.61 | 0.87 |
| (4) | – | 0.59 (2.22) | – | 1.63 (2.50) | 0.58 | 1.78 | 0.94 |

[a] All equations have been estimated with ordinary least squares, corrected for auto-correlation of residuals. ϱ indicates the coefficient of auto-correlation of residuals. Numbers in parenthesis under the estimated parameters are t-values. Tests performed for 1925 to 1933 do not show significant changes in parameter values.
[b] All variables are expressed in natural logarithms.

influence of US output. These two shortcomings will be amended below.

Estimates of equation 4.1 are presented in Table 4.13. Equation 4.1 has been estimated by ordinary least squares using annual data from 1924 to 1933. All variables are expressed in natural logarithms. Equation 4.1 was also estimated from 1925 to 1933 but no significant changes in the parameters occurred. The results indicate that monetary policy variables were more important than fiscal policy variables in influencing German nominal net national product. The first regression presented in Table 4.13 contains currency in circulation and the government budget deficit as independent variables. The coefficient of currency in circulation is significantly different from zero while the parameter of the government budget deficit is not significantly different from zero. The same is true when nominal government expenditure are used instead of the government budget deficit as a measure of fiscal policy (regression 2). However, the results are not so clear-cut when the domestic counterpart of currency in circulation is used instead of currency in circulation as a measure of monetary policy. In this case the significance of the monetary policy variable is substantially reduced, while nominal government expenditures are significantly affecting the level of nominal income. Table 4.14 presents the

*Table 4.14* Effects of changes in monetary and fiscal policies on changes in nominal net national product, (annual data) 1924–33[a,b]

| | *Currency in circulation* | *Domestic counterpart of currency* | *Government budget deficit* | *Government expenditure* | $R^2_{adj}$ | *DW* | ϱ |
|---|---|---|---|---|---|---|---|
| (1) | 0.93<br>(2.48) | – | 0.92<br>(2.47) | – | 0.66 | 1.78 | 0.42 |
| (2) | 0.75<br>(1.80) | – | – | 0.92<br>(1.27) | 0.49 | 1.72 | 0.19 |
| (3) | – | 0.43<br>(2.40) | 0.56<br>(1.99) | – | 0.66 | 1.73 | 0.46 |
| (4) | – | 0.63<br>(1.92) | – | 1.16<br>(1.49) | 0.41 | 2.09 | 0.48 |

[a] All equations have been estimated with ordinary least squares, corrected for auto-correlation of residuals. ϱ indicates the coefficient of auto-correlation of residuals. Numbers in parenthesis under the estimated parameters are t-values. Tests performed for 1925 to 1933 do not show significant changes in parameter values.
[b] All variables are expressed as first differences of natural logarithms.

same regressions as in Table 4.13, but using the first differences of the variables. The results do not change substantially.

One criticism that is raised against this type of approach is that when a monetary aggregate like currency in circulation is used as a measure of monetary policy, this variable is not truly exogenous. Changes in currency in circulation may themselves be induced by changes in net national product. However, not only money is endogenous, but also fiscal policy variables can be endogenous. The government budget deficit is definitely endogenous and depends on the level of net national product. Government expenditure may also be endogenous if the government tries to stabilise nominal income. Another criticism is that equation (4.1) could be mis-specified because important foreign variables are missing. This suggests that the results presented in Tables 4.13 and 4.14 could be biased because the reduced forms are incorrectly specified.

The description of policy developments at the beginning of this chapter indicates that the government was not systematically attempting to change government expenditure to stabilise nominal

*Table 4.15* A model of money and nominal income[a]

| | |
|---|---|
| *1. Nominal Income* | |
| $D\ln \mathrm{NNP} = \alpha_1 \ln(\hat{NNP}/NNP)$ | (4.2) |
| $\hat{\mathrm{NNP}} = \gamma_1 BU^{\beta_1} G^{\beta_2} Y_{us}^{\beta_3}$ | (4.2a) |
| *2. International reserves* | |
| $D\ln IR = \alpha_2 \ln(\hat{IR}/IR)$ | (4.3) |
| $\hat{IR} = \gamma_2 NNP^{\beta_4} e^{-\beta_5 mr} e^{\beta_6 \sigma_{IR}}$ | (4.3a) |
| *3. Currency in circulation* | |
| $BU = DA + IR$ | (4.4) |

[a] Adjustment parameters are denoted by $\alpha$, elasticities by $\beta$ and other parameters by $\gamma$. A circumflex above a variable indicates a desired or partial equilibrium quantity.

*Legend*:
- $BU$ = currency in circulation
- $DA$ = domestic counterpart of currency in circulation
- $G$ = nominal government expenditure
- $IR$ = international reserves
- $mr$ = import – output ratio
- $\sigma_{IR}$ = measure of variability of international reserves
- $NNP$ = nominal net national product in Germany
- $Y_{us}$ = nominal US GDP.

income and therefore that this source of bias was not relevant for the period under analysis. In the remainder of this chapter, the level of nominal government expenditure rather than the budget deficit will therefore be used as a proxy for fiscal policy. The level of United States nominal GDP will be introduced as an additional explanatory variable and in order to take into account the reverse causation between currency and income a three-equation model of income, money and international reserves will be considered. The model is summarised in Table 4.15. The equilibrium level of income is determined by combining the traditional IS-LM curves. The level of nominal income is then determined in Equation (4.2a) by the money stock, proxied by currency in circulation, government expenditures and foreign income:

$$\mathrm{NNP} = \gamma_1 BU^{\beta_1} G^{\beta_2} Y_{us}^{\beta_3} \tag{4.2a}$$

where $BU$ is currency in circulation, $G$ nominal government expenditures and $Y_{us}$ the level of United States nominal income.

Currency in circulation is defined as the sum of international reserves and the domestic counterpart of currency:

$$BU = IR + DA \tag{4.4}$$

where *IR* are international reserves and *DA* the domestic counterpart of currency in circulation. The domestic counterpart is assumed to be exogenous and under the control of the monetary authorities. Later on, the model will be extended in order to test the hypothesis that German monetary authorities manipulated the domestic counterpart of currency in circulation in order to achieve a desired level of international reserves. International reserves are assumed to be determined by a demand function of the following type:

$$IR = \gamma_2 \mathrm{NNP}^{\beta_4} e^{-\beta_5 mr} e^{\beta_6 \sigma_{IR}} \tag{4.3a}$$

where $\sigma_{IR}$ is a measure of variability of international reserves and *mr* is the average ratio of imports to NNP. The introduction of a measure of international reserves variability, proxied by the variance of four quarterly deviations of *IR* from trend from time *t*–3 to time *t*, is justified by the role of international reserves as a buffer stock to accommodate fluctuations in international payments and receipts. The expected sign of this variable is positive. The expected sign of *mr* is instead negative implying that the cost of not having reserves, and hence the demand for reserves, is inversely related to the marginal propensity to import. The rationale for the negative relationship between the demand for international reserves and the marginal propensity to import is related to the fact that it costs less in terms of foregone output to balance the external accounts in the face of a decline in international receipts when the marginal propensity to import is high.

Equations (4.2a) and (4.3a) can be estimated simultaneously in order to ascertain the relative importance of monetary and fiscal policy in determining the level of nominal income. However, Equations (4.2a) and (4.3a) assume that the economy is always on its long-run equilibrium path. In order to allow short-run deviations from the long-run equilibrium, the disequilibrium is introduced as follows:

$$D\ln \mathrm{NNP} = \alpha_1 \ln(\widehat{\mathrm{NNP}}/\mathrm{NNP}) \tag{4.2}$$

$$D\ln IR = \alpha_2 \ln(\widehat{IR}/IR) \tag{4.3}$$

where $\widehat{\mathrm{NNP}}$ and $\widehat{IR}$ denote respectively the partial equilibrium level of income and the desired level of international reserves described by equations (4.2a) and (4.3a).

Equations (4.2) to (4.4) have been estimated simultaneously by

*Table 4.16* Parameter estimates of the model of Table 4.15, 1st quarter 1925–4th quarter 1932

| | *Estimated parameters* | *Asymptotic standard errors* | *Mean adjustment lags (in quarters)* |
|---|---|---|---|
| $\alpha_1$ | 0.967 | 0.391 | 1.034 |
| $\alpha_2$ | 0.962 | 0.199 | 1.039 |
| $\beta_1$ | 0.480 | 0.261 | |
| $\beta_2$ | 0.012 | 0.167 | |
| $\beta_3$ | 0.673 | 0.104 | |
| $\beta_4$ | 0.763 | 0.217 | |
| $\beta_5$ | 2.242 | 1.961 | |
| $\beta_6$ | 0.776 | 0.079 | |

*Note*: Chi-square value of the log-likelihood ratio. 50.212[a]
Carter–Nagar chi-square statistic for the over-identified model. 95.303[b]
Carter–Nagar $R^2$ for the over-identified model. 0.606

[a] The approximate critical value of the chi-square distribution with 10 degrees of freedom at the 1 per cent level is 23.2, so that the hypothesis that the over-identifying restrictions are consistent with the sample must be rejected.

[b] The approximate critical value of the chi-square distribution with 10 degrees of freedom at the 1 per cent level is 23.2, so that the hypothesis that the model is not consistent with the data must be rejected.

using a full information maximum likelihood estimator. The equations were estimated for the period 1925–32 using quarterly data. The estimates of the parameters of the model are presented in Table 4.16. Estimates of the adjustment parameters indicate that the authorities were quick to adjust the level of international reserves to the desired level. The $\alpha_2$ parameter implies a mean adjustment lag of about one quarter. The private sector adjusted with similar lags to the disequilibrium between the actual and the equilibrium level of income. All the parameters of the demand for international reserves turn out to be significantly different from zero and with the correct signs with the exception of the import–output ratio. However, the variable which should be in the demand for international reserves is the marginal propensity to import rather than the average propensity to import, as used in the present estimates. The coefficient of the average propensity to import appears with the wrong sign in several estimates of the demand for international reserves. Using an adjustment mechanism,

which emphasises the role of relative prices, the price level and the demand for money, Frenkel (1974) has shown that under certain conditions the demand for reserves is positively associated with the average propensity to import. Several authors argue that the average propensity to import should not be used as a proxy for the cost of output adjustment but rather as a proxy for the openness of the economy, thus measuring the extent to which an economy is vulnerable to external disruptions and explaining the positive relationships with the demand for reserves. However, the absence of data on the marginal propensity to import meant that the average propensity to import had to be used in the present estimates.

Estimates of equation (4.2a) indicate that the monetary policy variable significantly affected the level of nominal income while government expenditures did not, as already shown by the results obtained in the least square estimates of equation (4.1). The coefficient of government expenditure has a positive sign, but is much smaller than that of the monetary policy variable and insignificantly different from zero. According to the present estimates a change of 1 per cent in currency in circulation would have induced a change of about 0.5 per cent in the level of nominal income, while a change of 1 per cent in government expenditures would have induced a change of 0.01 per cent in the level of nominal income. The estimated elasticity with respect to foreign income is almost 0.7. The estimate of the elasticity of currency in circulation in equation (4.2a) indicates that a countercyclical monetary policy could have more than compensated the negative effect of the downfall in the international business cycle. But a more expansionary monetary policy would have required a flexible exchange rate and/or severe exchange controls. As already remarked in Section 4.1, the unwillingness of the German authorities to implement countercyclical policies was a major determinant of the long and severe recession in Germany in the early 1930s.

The chi-square statistics of the log-likelihood ratio indicates that the hypothesis that the over-identifying restrictions are consistent with the data must be rejected. However, it has to be noted that the chi-square statistic of the log-likelihood ratio is an asymptotic test and that it is biased toward rejection in small samples. Conversely the Carter–Nagar system $R^2$ and the Carter–Nagar chi-square statistic of the over-identified model indicate that the model is consistent with the data. The *ex post* root mean square errors (RMSE) of the static forecast are presented in Table 4.17. Since all the variables are in logarithms, the RMSE gives the average errors as a proportion

*Table 4.17* *Ex post* root-mean square errors of forecast of the model of Table 4.15

| | *Root mean square errors* |
|---|---|
| ln *NNP* | 0.663 |
| ln *IR* | 0.487 |
| ln *BU* | 0.219 |

*Table 4.18* Stability analysis of model of Table 4.15

| *Eigenvalues: real part* | *Standard errors: real part* |
|---|---|
| −1.247 | 0.325 |
| −0.667 | 0.181 |
| −0.072 | 0.013 |

of the observed levels of the variables. The RMSE of the static forecast is about 0.7 per cent for nominal income, 0.5 per cent for international reserves and about 0.2 per cent for currency in circulation. The estimated model is dynamically stable as all the real parts of the eigenvalues are negative (Table 4.18).

One problem which has been so far neglected is whether the authorities in Germany actively used monetary policy in order to achieve a desired level of reserves, or at least tried to prevent reserves from falling further below the desired level. The review of economic and policy developments in Section 4.1 seems to indicate that the authorities in Germany were constrained by war reparations and the fixity of exchange rates in managing their monetary policy and that they did actively change the domestic counterpart of currency in circulation to try to prevent further falls in reserves. One simple way to test this hypothesis is to make the domestic counterpart of currency in circulation endogenous and see whether its changes were determined by the gap between desired and the actual level of international reserves:

*Table 4.19* An extended model of money and nominal income[a]

*1. Nominal Income*

$$D\ln NNP = \alpha_1 \ln(\widehat{NNP}/NNP) \quad (4.2)$$

$$\widehat{NNP} = \gamma_1 BU^{\beta_1} G^{\beta_2} Y_{us}^{\beta_3} \quad (4.2a)$$

*2. International reserves*

$$D\ln IR = \alpha_2 \ln(\widehat{IR}/IR) \quad (4.3)$$

$$\widehat{IR} = \gamma_2 NNP^{\beta_4} e^{-\beta_5 mr} e^{\beta_6 \sigma_{IR}} \quad (4.3a)$$

*3. Currency in circulation*

$$BU = IR + DA \quad (4.4)$$

*4. Domestics counterpart of currency in circulation*

$$D\ln DA = \gamma_3 \ln(IR/\widehat{IR}) \quad (4.5)$$

[a] Adjustment parameters are denoted by $\alpha$, elasticities by $\beta$ and other parameters by $\gamma$. A circumflex above a variable indicates a desired or partial equilibrium quantity.

*Legend*:

| | | |
|---|---|---|
| $BU$ | = | currency in circulation |
| $DA$ | = | domestic counterpart of currency in circulation |
| $G$ | = | nominal government expenditure |
| $IR$ | = | international reserves |
| $mr$ | = | import–output ratio |
| $\sigma_{IR}$ | = | measure of variability of international reserves |
| $NNP$ | = | nominal net national product in Germany |
| $Y_{us}$ | = | nominal US GDP. |

$$D\ln DA = \gamma_3 \ln(IR/\widehat{IR}) \quad (4.5)$$

where $\widehat{IR}$ is the level of desired international reserves as defined by Equation (4.3a).

Equation (4.5) has been added to the model described in Table 4.15. The extended model is reproduced in Table 4.19. The model has been estimated again by using a full information maximum likelihood estimator. Estimates of the parameters of the extended model are presented in Table 4.20. The estimate of parameter $\alpha_1$, turn out to be similar to the one in Table 4.16, while the estimate of parameter $\alpha_2$ is much smaller. It implies a mean time lag of about 1.5 quarters. The parameter $\gamma_3$ turns out to be about 0.15 and significantly different from zero, implying that 15 per cent of the discrepancy between actual and desired reserves were reflected on the domestic counterpart of currency in circulation within the same quarter. The estimated parameters in equation (4.2a) turn out to be similar to the ones in Table 4.16 and indicate that while monetary policy was a significant variable in determining nominal income, government expenditure did not have a significant effect.

*Table 4.20* Parameter estimates of the model of Table 4.19, 1st quarter 1925–4th quarter 1932

| | *Estimated parameters* | *Asymptotic standard errors* | *Mean adjustment lags (in quarters)* |
|---|---|---|---|
| $\alpha_1$ | 0.971 | 0.385 | 1.030 |
| $\alpha_2$ | 0.698 | 0.148 | 1.433 |
| $\gamma_3$ | 0.149 | 0.074 | |
| $\beta_1$ | 0.515 | 0.238 | |
| $\beta_2$ | −0.003 | 0.166 | |
| $\beta_3$ | 0.671 | 0.103 | |
| $\beta_4$ | 0.451 | 0.204 | |
| $\beta_5$ | 0.367 | 1.056 | |
| $\beta_6$ | 0.804 | 0.073 | |

*Note*: Chi-square value of the log-likelihood ratio. 52.442[a]

Carter–Nagar chi-square statistic of the over-identified model. 158.772[b]

Carter–Nagar $R^2$ statistic of the over-identified model. 0.631

[a] The approximate value of the chi-square distribution with 15 degrees of freedom is 30.6, so that the hypothesis that the over-identifying restrictions are consistent with the sample must be rejected.

[b] The approximate value of the chi-square distribution with 12 degrees of freedom is 26.2, so that the hypothesis that the model is not consistent with the data must be rejected.

The chi-square statistic of the log-likelihood ratio indicates that the hypothesis that the overidentifying restrictions are consistent with the data must be rejected while the Carter–Nagar statistics indicate again that the model is consistent with the data. The *ex post* root mean square errors (RMSE) for the static forecast are presented in Table 4.21. The RMSE are very similar to those presented in Table 4.17 and are in general very low. The estimated model is dynamically stable as all the real parts of the eigenvalues are negative (Table 4.22).

An important aspect regarding the dynamics of the system are the effects of parameter changes on the stability of the system. The sensitivity of the eigenvalues with respect to the parameters changes is presented in Table 4.23. The derivatives of the eigenvalues with respect to parameter $\gamma_3$ indicate that small changes in this parameter have important effects on the overall stability of the system. An

*Table 4.21* *Ex post* root-mean square error of forecast of the model of Table 4.19

| | |
|---|---|
| ln NNP | 0.662 |
| ln *IR* | 0.511 |
| ln *DA* | 0.391 |
| ln *BU* | 0.192 |

*Table 4.22* Stability analysis of model of Table 4.19[a]

| *Eigenvalues: real part* | *Standard errors: real part* |
|---|---|
| −1.021 | 0.349 |
| −0.637 | 0.139 |
| −0.068 | 0.009 |

[a] There is one additional eigenvalue which is equal to zero, because the explanatory variables of Equations (4.3) and (4.5) of Table 4.19 are the same. This does not affect the estimation of the model. It may be noted, however, that if the restriction implicit in the model were not enforced during estimation, this result would be unlikely to hold.

increase in parameters $\gamma_3$ tends to decrease the stability of the system by making the real part of the first eigenvalue more positive. An increase in the parameters $\beta_1$ and $\beta_4$ also tends to make the system less stable by reducing the real parts of the second eigenvalue.

The estimates presented in Table 4.16 and Table 4.20 indicate that the gap between the desired and actual level of international reserves was a major factor in the determination of monetary policy in Germany in the period under analysis. They also indicate that, although the system was stable, a higher elasticity of the domestic counterpart of currency in circulation to the gap between actual and desired international reserves would have made the system less stable. Finally, they also support the hypothesis that the inability or unwillingness of the authorities in Germany to adopt a more steady monetary policy and to change the exchange rate regime were major determinants of the length and depth of the depression in Germany in the early 1930s.

Going back to the original question of what started the German

*Table 4.23* Sensitivity analysis of the stability of the model of Table 4.19 with respect to the parameters of the system.[a]

| *Parameters* | | *Eigenvalues* | | |
|---|---|---|---|---|
| | | *Real* | *Real* | *Real* |
| | | −1.021 | −0.637 | −0.068 |
| $\alpha_1$ | 0.971 | −0.895 | −0.106 | 0.001 |
| $\alpha_2$ | 0.698 | −0.275 | −0.729 | 0.004 |
| $\gamma_3$ | 0.148 | 0.386 | −0.376 | −0.011 |
| $\beta_1$ | 0.515 | −0.83 | 0.105 | −0.022 |
| $\beta_4$ | 0.451 | −0.094 | 0.119 | −0.025 |

[a] A positive sign indicates that an increase in the parameter would tend to make the real part less negative and the system less stable.

depression in 1929, this chapter has added some evidence about the important role played by international lending and the subsequent fall in United States output. The inability or the unwillingness of the United Kingdom and the United States to provide countercyclical lending and open markets for goods was a very significant factor in starting the recession in Germany. The policy responses of the German authorities to these developments were in turn the main factors behind the depth and length of the depression in Germany, as shown both by the historical account of Section 4.1 and by the empirical tests of this section. Although not explicitly analysed in this chapter, German economic developments have probably added a substantial deflationary effect to the international business cycle.

Although making historical comparisons can be misleading, the experience of the 1930s has some relevance for developments today. In the early 1980s the increasing budget deficits in the United States and the monetary policy adopted by that country in order to finance these deficits has threatened its ability to provide countercyclical lending in case a world recession should occur and has increased the danger of protectionism. On the other hand, it is not yet clear that the European Community will be able to provide the necessary leadership should the United States fail to do so. There are heavy restrictions on the free movements of goods in the European market, particularly in agriculture, fibres, iron and steel, it is doubtful whether the European Community, as a block, could stabilise the international flows of capital countercyclically because of the lack of a monetary integration and of a common capital market in Europe. Extrapolation on the future course of events is very difficult. However, the

experience of the 1930s indicates that the possible outcome, in which the United States is unable to provide the leadership to the world economy and the European Community is unwilling or not yet able to do so is certainly worrisome.

# 5 An Annual Macroeconomic Disequilibrium Growth Model of the German Economy, 1880–1979

## INTRODUCTION

In this chapter a disequilibrium macroeconomic model of the German economy is presented. The model is specified in continuous time and is estimated from 1880 to 1979 on annual data. It explains the trends and fluctuations in the rate of capital accumulation, output, employment, and the balance-of-payments. Its long-run properties are founded in neoclassical theory. The main aims of the model are first, to explain the interdependence between the main economic aggregates in Germany during the last one hundred years and to show that despite enormous structural changes in the economy and changes in territory, the behaviour of the German private sector from 1880 to 1979 was stable. The model presented here and the description of the main economic developments presented in Chapter 1 are therefore highly complementary. The second aim is to test within the structural model the validity of the quantity theory of money as an hypothesis about the determination of the price level, and of the Fisher equation as an hypothesis about the determination of nominal interest rate, following Lucas' (1980) suggestion. The third aim is to test by simulating the model to what extent the remarkable rate of growth of German real net national product per capita from 1950 to the end of the 1960s war affected previous war destructions and losses of territory.

By way of further introduction, a brief discussion of current knowledge of the role of monetary and fiscal policy is presented. This provides a better understanding of the short- and long-run characteristics of this model. In the 1950s and 1960s the conventional wisdom about the relation between inflation and economic activity accepted the hypothesis of a stable relationship, and assumed that the relation-

ship was independent of both past and current monetary and fiscal policy. Accordingly, a government could use monetary and fiscal policy to achieve a target level of output and employment provided it was willing to accept the inflation rate which was associated with that level of output and employment. Friedman (1968) questioned this conventional wisdom by asserting that a stable relationship between output and inflation does not exist in the long-run as economic agents adjust their expectations to changes in government policy. This hypothesis does not imply that monetary and fiscal policies do not affect the level of economic activity in the short run. In the present model, inflationary expectations are assumed to depend positively on the domestic and foreign components of the monetary base and negatively on the rate of growth of real NNP. Thus, economic agents are assumed to know in a broad sense the structure of the economy and the determinants of inflation. However, monetary and fiscal policy can still affect the level of economic activity in the short run because transaction costs and lagged adjustment of actual to desired or expected quantities and prices are incorporated into the disequilibrium of the model.

An important mechanism through which monetary and fiscal policies affect the level of economic activity in the short run is the Fisher equation. In the present model monetary and fiscal policies affect investment in the short run via their effect on the difference between the marginal product of capital and the nominal interest rate corrected for expectations of inflation. In this model the nominal interest rate adjusts with a lag to changes in expectations of inflation, thus causing deviations of the real financial interest rate from its equilibrium level. It is found that the long-run effect of monetary policy is neutral, as predicted by neoclassical theory.

This chapter is structured in the following way: Section 5.1 presents the macroeconomic model; Section 5.2 presents the empirical estimates of the parameters of the model, together with the stability analysis and its within sample predictive performance; Section 5.3 outlines in detail the results of the stimulation isolating the effect of the war on the post-Second World War German economic growth. This simulation will tell what would have been the rate of growth of net national product per capita in each decade from 1950 to 1979 in the absence of the war and in what year of the postwar period actual German NNP per capita reached again the level it would have reached in the absence of the war.

## 5.1 THE STRUCTURE OF THE MODEL

The model is a disequilibrium model of the German economy. The model is non-linear in both variables and parameters, although a version of the model which is log-linear in the variables has been used for estimation. The model has been estimated with annual data from 1880 to 1979. It was felt important to allow for disequilibrium because of the large shocks and long periods of disequilibrium which the German economy experienced in the last one hundred years. If the observations are in fact generated by a disequilibrium structure, estimating the model in equilibrium form would result in a bias caused by incorrect specification.

Although this is a disequilibrium model, the long-term properties are neoclassical. In particular, the specification of the price-employment sector is based on a Cobb-Douglas production function[1]. In the short run, output can be off the production function but it is constrained by it in the steady state. The principal mechanisms which readjust the economy after a shock are the balance-of-payments, which adjusts the actual quantity of money, and the real wealth effect on consumption. As far as the transmission mechanism of monetary and fiscal policy is concerned, the nominal interest rate is determined by the open economy version of the Fisher equation. The inclusion of the Fisher equation has important implications for determining the strength of monetary and fiscal policy, since the slower the adjustment of the nominal interest rate to changes in expectations of inflation, the stronger the short-run effects of policy on the real economy.

Table 5.1 contains the list of the variables and Table 5.2 the equations of the model. There are 16 endogenous variables (9 stochastic equations and 7 identities). All output and expenditure variables are defined in real terms, while financial variables are expressed in nominal terms. Real quantities are denoted by small letters and nominal ones by capital letters, unless otherwise indicated. Behavioural equations are generally linear in the natural logarithms of the variables, so that elasticities are constant, but interest rates and expectations of inflation are introduced as natural numbers. Most identities are linear in the level of the variables, so that the model is non-linear in natural logarithms. For purpose of estimation the identities have been linearised around the sample means. For economy of notation the error terms are omitted in Table 5.2.

*Table 5.1* List of variables in macroeconomic model

| | |
|---|---|
| *Endogenous variables* | |
| $BP$ | = government bonds held outside the central bank |
| $BU$ | = currency in circulation |
| $c$ | = real private consumption |
| $f$ | = real stock of wealth |
| i | = real import of goods |
| $IR$ | = net international reserves |
| $k$ | = rate of capital accumulation |
| $K$ | = real stock of capital |
| $L$ | = civilian employment |
| $NF$ | = net foreign asset of Germany |
| $p$ | = consumer price index |
| $\pi$ | = inflation rate; $\pi^e$ = expected inflation rate |
| $r$ | = nominal interest rate |
| $w$ | = annual income per worker |
| $x$ | = real export of goods |
| $y$ | = real net national product |
| *Exogenous variables* | |
| $A$ | = claims of the Reichs/Bundesbank on the private sector |
| $BR$ | = commercial bank deposits at the Reichs/Bundesbank, and other residual items in balance sheet of the Reichs/Bundesbank |
| $G$ | = nominal government expenditures |
| $MF$ | = monetary financing of the government |
| $p_i$ | = unit values of exports |
| $pO$ | = total population |
| $p_x$ | = unit values of exports |
| $p_{xs}$ | = unit values of US exports in US dollar |
| $p_{us}$ | = US consumer price index |
| Rg | = difference between the trade balance and the current account balance on a national account basis |
| $Rf$ | = residual in the balance of payments identity |
| $r_{us}$ | = nominal US interest rate |
| $Ry$ | = residual in gross domestic product identity |
| $S$ | = Mark/Reichsmark/Deutschmark price per US dollar |
| $t$ | = time trend |
| $T$ | = central government revenues, net of transfers, nominal |
| $y_{us}$ | = real US gross domestic product |

The model is specified in continuous time according to the belief that macroeconomic phenomena, being the result of the behaviour of a large number of economic agents, are better described by continuous functions, although decisions taken by single economic agents

*Table 5.2* The Macroeconomic model

1. *Real private consumption per person employed*

$$D\ln c = \alpha_1 \ln[(\hat{c/PO})/(c/PO)] + D\ln PO \quad (5.1)$$

$$\hat{c/PO} = \gamma_1 (f/PO)^{\beta_1} e^{-\beta_2(r-\pi^e)}(L/PO)^{\beta_3} \quad (5.1a)$$

$$\pi^e = \beta_4 D\ln IR + \beta_5 D\ln A + \beta_6 D\ln MF - \beta_7 D\ln y \quad (5.1b)$$

2. *Real private investment*

$$Dk = \alpha_2[\gamma_2((\beta_8(y/K) - r + \pi^e) + \gamma_3 - k] \quad (5.2)$$

3. *Consumer price inflation*

$$D\pi = \alpha_3 D\ln(\hat{p}/p) + \alpha_4(\pi^e - \pi) \quad (5.3)$$

$$\hat{p} = \gamma_4 \left[\frac{wL}{(1-\beta_8)y}\right]^{\beta_9} [S \cdot p_{x_{us}}]^{1-\beta_9} \quad (5.3a)$$

4. *Annual income per worker*

$$D\ln w = \alpha_5 \ln(\hat{w}/w) \quad (5.4)$$

$$\hat{w} = \gamma_5\left[(1-\beta_8)\frac{y \cdot p}{Le^{\lambda_2 t}}\right]^{\beta_{10}} \quad (5.4a)$$

5. *Civilian employment*

$$D\ln l = \alpha_6 \ln(\hat{l}/l) \quad (5.5)$$

$$\hat{l} = \gamma_6 [y/Le^{\lambda_3 t}]^{\beta_{11}} (w/p)^{-\beta_{12}} \quad (5.5a)$$

$$\hat{l} = L/PO \quad (5.5b)$$

6. *Real imports of goods per person employed*

$$D\ln i = \alpha_7 \ln[(i/PO)/(i/PO)] + D\ln PO \quad (5.6)$$

$$(\widehat{i/PO}) = \gamma_7 (y/PO)^{\beta_{13}} (p/p_i)^{\beta_{14}} \quad (5.6a)$$

7. *Real export of goods per person employed*

$$D\ln x = \alpha_8 ln[(\widehat{x/PO})/(x/PO)] + D\ln PO \quad (5.7)$$

$$(\widehat{x/PO}) = \gamma_8 y_{us}^{\beta_{15}} (p_{x_{us}} \cdot S/p_x)^{\beta_{16}} \quad (5.7a)$$

8. *Nominal interest rate*

$$Dr = \alpha_9(\hat{r} - r) \quad (5.8)$$

$$\hat{r} = \beta_{17}(r_{us} - D\ln p_{us} + \pi^e) \quad (5.8a)$$

*Table continued next page.*

*Table 5.2 continued*

9. *Demand for currency*

$$D\ln BU = \alpha_{10}\ln(b\hat{u}/bu) + D\ln(PO \cdot p)$$

$$b\hat{u} = \gamma_9 e^{-\beta_{18}\pi^e} e^{-\beta_{19}(r-\pi^e)} e^{-\beta_{20}(r_{us}+D\ln S)}(y/PO)^{\beta_{21}}(f/PO)^{\beta_{22}} \quad (5.9)$$

$$bu = BU/PO.p \quad (5.9a)$$

10. *Net national product*

$$y = c + g + x - i + Dk + Ry \quad (5.10)$$

11. *Government Budget constraint*

$$G - T = DBP + DMF \quad (5.11)$$

12. *Definition of Wealth*

$$f = K + \frac{1}{p}(BP + MF) + \frac{S}{p}\int_{t=-\infty}^{0}\frac{1}{S_t}(x_t p_{xt} - i_t p_{it} + R_{gt})dt \quad (5.12)$$

13. *Supply of currency*

$$BU = MF + A + IR - BR \quad (5.13)$$

14. *Balance of payments identity*

$$DIR = xp_x - ip_i - DNF + Rf \quad (5.14)$$

15. *Definition of the stock of capital*

$$D\ln K = k \quad (5.15)$$

16. *Definition of the price level*

$$D\ln p = \pi \quad (5.16)$$

may be discrete. In a model specified in continuous time the estimates of the speeds of adjustment of the various markets have also the advantage of being unbiased and independent of the length of the observation period to which the discrete date refer. The model is specified as a system of first order linear differential equations. Desired or partial equilibrium levels of the endogenous variables are allowed to be different from their observed levels so that the system is not necessarily in equilibrium. Lags are assumed to be related to costs of information, uncertainty, the existence of fixed contracts, and in general real world frictions. Adjustment parameters are denoted by $\alpha$, long-run elasticities by $\beta$ and marginal or average

propensities by $\gamma$. Natural logarithms are denoted by ln and the symbol $D$ indicates the differential operator. A circumflex above a variable indicates a desired or partial equilibrium quantity.

In all stochastic equations explaining NNP components, the demand for labour and the demand for currency, desired quantities are deflated by total population. The deflation by total population was done to take into account changes in population due to territorial changes in 1919, 1923, 1925[2] and 1946. The division of Germany after the Second World War could therefore be dealt with without the extensive use of dummy variables. Equation (5.1a) describes desired real private consumption as a function of real wealth, the real financial interest rate and the ratio of civilian employment to population. The latter variable is a proxy for uncertainty about income and job prospects. Households adjust actual consumption to the desired level with a lag due to the existence of uncertainty, costs of obtaining information, and in general real world frictions. In Equation (5.1b) the quantity theory of money has been imposed upon the formation of expectations of inflation. The latter are determined by the rates of change of the domestic and foreign components of the monetary base and the rate of change of real NNP. According to the quantity theory the weighted sum of the parameters $\beta_4$, $\beta_5$, and $\beta_6$ should be equal to one. The parameter $\beta_7$ is expected to be equal to one if velocity does not change over time.

Equation (5.2) determines changes in net private investment and it is a development of the capital stock adjustment principle. The desired rate of growth of the stock of real capital is assumed to be a linear function of the discrepancy between the marginal product of capital and the real financial interest rate. The marginal product of capital is derived from a Cobb-Douglas production function and is therefore proportional to the average product of capital multiplied by the share of capital in output ($\beta_8$). Initially, the production function assumed was the more general Constant Elasticity of Substitution (CES) production function, but early estimates suggested that the absolute value of the elasticity of substitution was not significantly different from 1. $\gamma_3$ is the desired rate of growth of the capital stock when the marginal product of capital equals the real interest rate and there is no risk. The acceleration of the actual stock of real capital is assumed to be a function of the discrepancy between the desired and the actual growth of the stock of real capital.

Equation (5.3) explains the rate of change of inflation. It implies that in the steady state the rate of change of inflation is equal to zero,

but in disequilibrium the dynamics of inflation is determined by two components: (1) the discrepancy between the partial equilibrium level of inflation and actual inflation, where the former is a geometric average of a domestic and a foreign component. The domestic component is derived from a Cobb-Douglas production function by equating the marginal product of labour to the product wage, while the foreign component is given by the United States export price level[3] adjusted for exchange rate changes; (2) the discrepancy between the expected rate of inflation and the actual one. Parameter $\alpha_4$ is crucial in determining the efficacy of monetary and fiscal policy, since the higher its value the lower the efficacy of monetary and fiscal policy.

Equation (5.4) explains the rate of change of wages and it is derived from the Cobb-Douglas marginal productivity condition. Using (5.4a) and assuming that $\beta_{10}$ is equal to 1, equation (5.4), can be written as:

$$D\ln(w) = \alpha_5[\ln\gamma_5(1 - \beta_8)y/Le^{\lambda_2 t}) - \ln(w/p)] \qquad (5.4a)$$

which states that whenever the marginal product of labour is higher than the real wage rate, wages tend to rise and vice versa when it is smaller. Equation (5.5) explains the share of civilian employment in total population, i.e. the participation rate. This equation implies that hiring and firing workers is costly and this leads firms to adjust employment gradually to the level implied by the marginal productivity condition, rather than attempting to maintain this condition continually through time. Equation (5.5a), is a demand function for labour derived from a Cobb-Douglas production function. Desired employment is therefore assumed to depend on output and the real wage rate. Equations (5.6) and (5.6a) explain real imports of goods per capita. Desired imports depend on NNP and the relative price between domestic and imported goods. Real exports are explained by Equations (5.7) and (5.7a). No systematic supply effects on exports could be isolated. Hence desired exports are determined exclusively by foreign demand, i.e. real United States GDP[3] and relative prices.

The last three stochastic equations of the model explain financial variables. Equation (5.8) is the Fisher equation extended to an open economy with perfect capital market integration in the long run. Equation (5.9) is a standard demand function for currency homogeneous of degree one in prices (both *ex ante* and *ex post*). The relevant substitutions are with domestic and foreign assets and goods. By

using currency and the monetary base as the main monetary aggregates in the model[4] a problem arising from the increasing degree of intermediation of banks is sidestepped: when bank deposits and loans grow because of an increasing degree of intermediation, outside money of the private sector does not grow as much.[5] If the relevant concept in the analysis of inflation is outside money, an increase in bank deposits due merely to an increase in financial intermediation is not inflationary. It is only a structural change which occurs in the financial sector of the economy. Although the exclusion of checking deposits from the definition of money used here entails a strong assumption about the term structure of assets and liabilities of commercial banks, it was thought preferable to use currency and the monetary base. This choice is supported by estimates of the model as shown below, and is consistent with the concept of money relevant for the quantity theory of money which was largely developed in a world without bank intermediation. Another reason for preferring currency to money was the lack of a homogeneous series of the money supply for the whole period.

Equations (5.10) to (5.14) are identities explaining real NNP, the stock of government debt held by the private sector, private wealth and the money supply process. Equation (5.10) is the net national product identity. It implies that NNP adjusts instantaneously to an increase in demand. In a previous version of the model, a stochastic equation for NNP was used in which the latter was assumed to adjust with a lag to changes in demand and relative prices. However, the mean adjustment lag turned out to be very low implying less than a month in the adjustment of actual output to the partial equilibrium level. Thus it was decided to assume instantaneous adjustment. The residual item in the equation reflects the fact that imports and exports of services are excluded from the import and export functions, and discrepancies between national accounts and trade statistics.

Equations (5.11), (5.13), and (5.14) describe the money supply process and the balance-of-payments. Equation (5.11) is the government budget constraint which determines changes in the government debt held by the German private sector; Equation (5.13) is the balance sheet identity of the central bank determining the level of net international reserves, given the quantity of currency demanded and the behaviour of the authorities as regards the monetary financing of the government deficit. It should be noted that the model determines the Mark value of changes in international reserves. The allocation of a change in reserves between an exchange rate change and a change

in the dollar value of reserves is not determined in this model. In principle, it should be possible to model official interventions in the foreign exchange market and to determine what proportion of a change in the Mark value of international reserves is allocated between the exchange rate and the dollar value of international reserves. However, the time period covered by the estimated analysis included periods of fixed exchange rate, flexible exchanges rates, and managed floating. Therefore, it was decided to keep the exchange rate exogenous, given the difficulty in identifying a valid reaction function of the monetary authorities for the period under analysis.[6] The variable *BR* in Equation (5.13) is the difference between currency in circulation and the monetary base. It includes mostly deposits (reserves) held by commercial banks at the Reichs/Bundesbank and grows as the size of the banking industry increases. Equation (5.14) is the balance of payments identity which is assumed to determine changes in net foreign assets of the private sector.

Equation (5.12) defines real net wealth as the sum of the real stock of physical capital, the stock of cumulated nominal government budget deficits from 1876 to 1979 deflated by the price level, and the cumulated current account balance (in dollars), corrected for exchange rate changes and deflated by the German price level. *Rg* stands for the difference between the current account of the balance-of-payments and the trade balance. The effects of changes in the price level on the real value of wealth represent one of the main mechanisms through which the economy returns to the steady state path after a disturbance in this model. This definition of wealth implies that the banking sector is consolidated with the non-bank private sector. Finally, Equations (5.15) and (5.16) transform the second order differential Equations (5.2) and (5.3) into first order differential equations.

## 5.2 PARAMETER ESTIMATES AND STABILITY OF THE MODEL

Table 5.3 contains the estimates of the parameters of the model. A limited number of a priori restrictions were imposed upon the model: the elasticities of consumption with respect to wealth ($\beta_1$), of exports with respect to foreign income ($\beta_{15}$) and of currency demand with respect to real wealth ($\beta_{22}$) were constrained to one. These restrictions are consistent with the hypothesis that in the steady state

all real variables grow at the same rate. The share of labour in income $(1 - \beta_8)$ was constrained to 0.65 as suggested by preliminary estimates. All the estimated parameters have the right sign with the exception of the relative price elasticity in imports ($\beta_{14}$). Parameters $\beta_3$, $\lambda_2$ and $\beta_{19}$ are the only ones which are not significantly different from zero.

The estimated mean adjustment lags range from six months to four years. In interpreting the adjustment parameters and the mean adjustment lags one has to bear in mind that they are averages of the period, and that today some of the adjustment parameters might be higher, owing to the absence of regulations (for instance, exchanges controls, rationing) which prevailed during some years of the sample period. The adjustment parameters which are most relevant for the analysis of the effects of monetary and fiscal policy are $\alpha_4$ and $\alpha_9$. The former, which appears in the equation determining inflation, measures the speed of adjustment of actual to expected inflation. This parameter is relevant because the higher its value, the smaller the power of monetary policy in determining real activity: if it is close to zero, implying an adjustment lag close to infinity, then monetary policy is very powerful through the wealth effect. Alternatively, if $\alpha_4$ is very large, implying an almost instantaneous adjustment of actual inflation to expected inflation, then the strength of the real wealth effect is limited by the destruction of real wealth due to inflation. The estimate obtained for $\alpha_4$ implies a mean time lag of about 0.9 years for the average of the sample period. The second adjustment parameter, which appears in the equation determining the nominal interest rate measures how rapidly nominal interest rate adjusts to expected inflation in the short run. The estimates indicate that the nominal interest rate adjusted slowly during the sample period (i.e. $\alpha_9$ implies a mean adjustment lag of about six months). Hence, over the sample period, these estimates indicate that monetary policy was a powerful instrument in affecting real economic activity in the short run. The fact that the above adjustment parameters are not infinite is a necessary but not sufficient condition for monetary policy to be effective. Real interest elasticities in the components of domestic expenditure and the wealth elasticity in private consumption are, in addition, required to be significantly different from zero.

In general the mean adjustment lags in the real sector are quite low. Consumption adjusts in about two years to its partial equilibrium level. The mean adjustment lag of investment to its partial equilibrium level is about 1.5 years. This speed of adjustment is

*Table 5.3* Estimates of the parameters of the model of Table 5.2 (1880–1979)

| | | *Estimates* | *Asymptotic standard error* | *Mean adjustment lag (in years)* |
|---|---|---|---|---|
| *Adjustment parameters* | | | | |
| Consumption | $\alpha_1$ | 0.459 | 0.092 | 2.2 |
| Investment | $\alpha_2$ | 0.606 | 0.079 | 1.7 |
| Inflation | $\alpha_3$ | 0.408 | 0.038 | 2.5 |
| Inflation | $\alpha_4$ | 1.104 | 0.223 | 0.9 |
| Wages | $\alpha_5$ | 1.238, | 0.202 | 0.8 |
| Employment | $\alpha_6$ | 0.264 | 0.040 | 3.8 |
| Imports | $\alpha_7$ | 0.581 | 0.086 | 1.7 |
| Exports | $\alpha_8$ | 0.291 | 0.035 | 3.4 |
| Interest rate | $\alpha_9$ | 1.874 | 0.038 | 0.5 |
| Currency | $\alpha_{10}$ | 0.521 | 0.022 | 1.9 |
| *Structural parameters* | | | | |
| Consumption | $\beta_1$ | 1.000[a] | — | |
| | $\beta_2$ | 0.747 | 0.218 | |
| | $\beta_3$ | 0.03 | 0.086 | |
| Expectations of inflation | $\beta_4$ | 0.822 | 0.083 | |
| | $\beta_5$ | 0.128 | 0.073 | |
| | $\beta_6$ | 0.023 | 0.013 | |
| | $\beta_7$ | 1.106 | 0.040 | |
| Production function | $\beta_8$ | 0.350[a] | — | |
| Inflation | $\beta_9$ | 0.743 | 0.018 | |
| Wages | $\lambda_2$ | 0.015 | 0.011 | |
| | $\beta_{10}$ | 0.964 | 0.041 | |
| Employment | $\beta_{11}$ | 0.952 | 0.087 | |
| | $\lambda_3$ | 0.011 | 0.007 | |
| | $\beta_{12}$ | 0.847 | 0.218 | |
| Imports | $\beta_{13}$ | 1.546 | 0.088 | |
| | $\beta_{14}$ | −0.332 | 0.126 | |
| Exports | $\beta_{15}$ | 1.000[a] | — | |
| | $\beta_{16}$ | 1.011 | 0.008 | |
| Interest rate | $\beta_{17}$ | 0.189 | 0.018 | |
| Demand for currency | $\beta_{18}$ | 0.757 | 0.221 | |
| | $\beta_{19}$ | 0.112 | 0.196 | |
| | $\beta_{20}$ | 0.579 | 0.159 | |
| | $\beta_{21}$ | 0.421 | 0.166 | |
| | $\beta_{22}$ | 1.0[a] | — | |

[a] These parameters have been constrained during estimation.

*Table 5.3a* Estimates of parameters of dummy variables used in model of Table 5.2

| | | *Estimates* | *Asymptotic standard errors* |
|---|---|---|---|
| Inflation | $Q_{23}$ | 3.649 | 0.265 |
| | $Q_{24}$ | −2.148 | 0.224 |
| Exports | $Q_{AUT}$ | −0.518 | 0.099 |
| | $Q_{45}$ | −1.659 | 0.153 |
| | $Q_{46}$ | −1.047 | 0.143 |
| Demand for currency | $Q_{23}$ | −0.057 | 0.015 |

comparable to the one obtained for investment in models for other countries estimated with similar methods on post-Second World War data.[7] The adjustment parameter of private consumption implies instead a somewhat lower speed of adjustment than in other models. This may be due to the persistance of disequilibrium for private consumption during the wars and in the interwar periods largely due to rationing, price controls, and forced saving. The speed of adjustment in the market for currency is about two years, substantially lower than in the other models mentioned above – probably for the same reasons. Wages and civilian employment adjust respectively in about ten months and four years while exports and imports adjust in about three and a half and two years respectively. The slower adjustment of exports might be due to the large weight of capital goods in German exports for which the lag between orders and deliveries is much higher than for the typical German import good (mostly raw materials and consumer goods).

The estimates of the parameters, $\beta_4$, $\beta_5$, $\beta_6$ and $\beta_7$ provide a test of the quantity theory of money. The weighted sum um of $\beta_4$, $\beta_5$ and $\beta_6$ is not significantly different from one. The estimate of $\beta_7$ is higher than one as has to be expected if velocity of the monetary base has a downward trend.[8] Parameters $\beta_4$, $\beta_5$, $\beta_6$ and $\beta_7$ have been restricted across equations in the estimation of the model and appear in the consumption and investment functions, in the equations determining inflation, the interest rate, and the demand for currency.

The key elasticities in the transmission mechanism of monetary policy are the real interest rate elasticities of consumption and of investment. Both elasticities have the right sign, and are significantly

different from zero. The elasticity of consumption with respect to the real interest rate is 0.09 evaluated at sample means. The elasticity of demand of currency with respect to the foreign interest rate corrected for exchange rate changes ($\beta_{20}$) is quite high (about 0.17) implying a strong substitution between domestic currency and foreign assets, as found also in the model for the hyperinflation period in Chapter 2.

Another important set of parameters relates to the production and employment sectors. They are the share of capital in output ($\beta_8$) which has been constrained across equations to be equal to 0.35 and the parameters $\beta_{10}$, $\beta_{11}$, $\beta_{12}$ in Equations (5.4a) and (5.5a) which should be equal to one if the production function underlying the model is Cobb-Douglas. All of them are not very significantly different from one providing evidence that the production function in Germany is adequately represented by a Cobb-Douglas. The relative price elasticity in the export function ($\beta_{16}$) is equal to one and highly significant, while relative prices in the import function ($\beta_{14}$) show the wrong sign. The values of the parameters of dummy variables and their asymptotic standard errors are reported in Table 5.3a. Five dummy variables appear in the model.[9] All the years for which dummy variables have been used correspond to periods during which the German economy was subjected to large exogenous disturbances.

The model presented above is stable. The eigenvalues of the system and their standard errors are presented in Table 5.4. One eigenvalue is positive and approximately equal to the rate of growth of nominal variables due to the fact that the identities have been linearised around sample means. The complex conjugate eigenvalues have negative real parts. These correspond to two superimposed cycles, one of around 30 years and another very long cycle. The damping period of the 30-year cycle is relatively long, which means that the amplitude is almost constant.[10]

The root mean square errors for the *ex post* static and dynamic forecast of the linear model are presented in Table 5.5. It should be remembered that the variables are expressed in logarithms, and consequently the root-mean square error is the average error as a proportion at the actual level of the endogenous variable. For the *ex post* static forecast all variables, except two, present errors which are less than 10 per cent. Inflation presents the largest error. This is partly due to the inclusion of the hyperinflation in the sample period. The root mean square errors for the dynamic forecast are larger than in the static one. This is due to the fact that in each period the values of the lagged endogenous variables are not the observed values but

*Table 5.4* Eigenvalues of model of Table 5.2

| *Real part*[a] | *Imaginary* | *Asymptotic standard error* | *Period cycle (in years)* |
|---|---|---|---|
| −4.47 | | 0.32 | |
| −2.50 | | 0.31 | |
| −1.00 | | 39.30 | |
| −1.05 | | 13.13 | |
| −0.91 | | 0.19 | |
| −0.12 | | 0.02 | |
| −0.12 | | 0.03 | |
| +0.16 | | 0.03 | |
| −0.05 | | 0.03 | |
| −0.02 | | 0.001 | |
| −0.03 | | 0.003 | |
| −0.01 | | 0.005 | |
| −0.03 | ±0.213 | 0.004 | 0.03 |
| −0.01 | ±0.015 | 0.002 | 0.002 |

[a] The presence of one positive real root does not imply instability of the model, since the linearization of the model was made around sample means. The positive real root reflects the average growth rate of nominal variables in the model.

the ones which the model predicts. The error tends to be larger for the nominal variables.

The following main conclusions are derived from the estimates. First, it was found that one of the main channels, through which monetary and fiscal policy affect the level of economic activity, is the real financial interest rate. In the model the real financial interest significantly affects investments and consumption. This result is made possible by the fact that the nominal interest rate adjusts with a lag to changes in expectations of inflation thus causing deviations of the real financial interest rate from its equilibrium level. Estimates of the adjustment parameter in the Fisher equation indicate that, for the average of the sample period, monetary policy was a powerful instrument in affecting real economic activity in the short term. Another important channel of transmission of monetary policy is the wealth effect on consumption. Second, the assumption that the long-run effect of monetary policy is neutral is not rejected by the data. As the real financial interest rate converges towards the marginal product of capital and the actual inflation rate converges to the expected one the real effects of monetary policy tend to disappear. It

*Table 5.5* *Ex post* root-mean square errors of forecast of model of Table 5.2

| | *Error of single period forecast* | *Error of dynamic forecast* |
|---|---|---|
| Consumption | 1.7 | 13.0 |
| Investments | 0.2 | 4.5 |
| Inflation | 46.5 | 41.0 |
| Wages | 2.0 | 24.1 |
| Employment | 10.1 | 32.0 |
| Imports | 6.7 | 20.2 |
| Exports | 5.5 | 17.9 |
| Interest rate | 1.5 | 28.3 |
| Currency | 5.8 | 20.7 |
| NNP | 6.2 | 18.2 |
| Government bonds held outside the central bank | 4.1 | 58.0 |
| Wealth | 7.5 | 38.0 |
| International reserves | 15.4 | 89.1 |
| Net foreign assets | 8.8 | 91.0 |
| Stock of capital | 0.1 | 10.0 |
| Price level | 0.8 | 8.9 |

is also found that the sum of the parameters of the components of the monetary base in the equation determining expected inflation sum up to one as indicated by the quantity theory of money. Recalling that in the model the actual rate of inflation converges in the long-run towards the expected rate of inflation, it follows that the quantity theory of money holds only in the long-run.

## 5.3 SIMULATION OF THE MODEL TO EXPLAIN THE EFFECTS OF WAR DESTRUCTIONS ON POST-SECOND WORLD WAR ECONOMIC GROWTH

This section is concerned with isolating the effects of war destruction on economic growth in Germany after the Second World War. The time profile of real NNP and real NNP per capita and of their major determinants from 1880 to 1979 has been already described in Section 1.1 of Chapter 1 and is summarised in Tables 1.1 and 1.2. International comparisons of growth rates of real NNP per capita are contained in Table 1.8. From 1950 to 1979 real NNP per capita grew at an average geometric growth rate of 3.8 per cent per year. The

growth rate of real NNP per capita slowed down steadily from 4.8 per cent in the 1950s to 3.8 per cent in the 1960s and to 2.6 per cent from 1970 to 1979. After the First World War the growth rates of real NNP per capita were also high at 3.7 per cent on average in the 1920s and 3.8 per cent in the 1930s. The growth rates of real NNP per capita in the two decades following the two world wars were substantially higher than the rate of growth of 1.7 per cent per year recorded on average from 1880 to 1913 and of 2.2 per cent recorded from 1914 to 1979.

There is, therefore, the presumption that the strong acceleration in the growth rate of NNP per capita in the postwar periods with respect to the gold standard is in large part due to the negative growth rates of the war years. It appears that the destruction of the wars has given rise to long phases of higher than average growth rates in the postwar periods, bringing the stock of capital and NNP per capita after some time back to the level which would have prevailed in the absence of the wars. The growth accounting developed in Section 1.1 of Chapter 1 shows that the main factor causing the high rates of growth of the 1950s and the 1960s was the historically very high rate of capital accumulation. The destructions of capital due to the war led to a drop in the capital labour ratio and to a sharp rise in the marginal product of capital. These factors constituted the main driving force behind the high rate of capital accumulation.

The macroeconomic model was used to simulate the effects of war destructions and losses of territory on capital accumulation and growth. The base year of the simulation is 1936, which was a year of approximate prewar equilibrium for the German economy. All foreign variables are assumed to follow their historical path. As far as the exogenous domestic variables are concerned, all real variables are assumed to grow at a geometric rate of 2.5 per cent per year which is approximately the long-term growth rate of the German economy from 1880 to 1936. Real public expenditure on goods and services and real government revenues net of transfers are therefore assumed to grow at the same rate. Since, in 1936, the government deficit was about 2 per cent of NNP, the above assumption implies a slight increase in the absolute value of the deficit over time. Population is assumed to grow at 0.8 per cent per year which is equal to the average geometric growth rate of population from 1880 to 1936, if one assumes away the loss of population in 1919. Export prices of German goods are assumed to grow at the same rate as the consumer price index while import prices are assumed to grow at the same rate as the United States consumer price index corrected for exchange

*Table 5.6* Simulation: ratio of key exogenous variables in the simulation to actual ones, 1936–48

| | $g$[a] | $PO$[b] |
|---|---|---|
| 1936 | 1.00 | 1.00 |
| 1937 | 0.99 | 1.00 |
| 1938 | 0.73 | 1.00 |
| 1939 | 0.72 | 0.99 |
| 1940 | 0.49 | 0.99 |
| 1941 | 0.37 | 1.00 |
| 1942 | 0.30 | 1.00 |
| 1943 | 0.27 | 1.01 |
| 1944 | 0.26 | 1.03 |
| 1945 | 0.24 | 1.07 |
| 1946 | 1.15 | 1.50 |
| 1947 | 1.21 | 1.55 |
| 1948 | 3.59 | 1.58 |

[a] Real government expenditure on goods and services.
[b] Population.

rate changes. The exchange rate is assumed to behave according to purchasing power parity, while all other nominal variables are assumed to grow at the same rate as nominal NNP.

Table 5.6 contains the ratios of real government expenditures on goods and services and of population assumed in the simulation to their historical levels from 1936 to 1948. In 1945, real government expenditures assumed in the simulation fell to 24 per cent of the historical level. Due to the territorial losses and to the end of war expenditures actual government expenditures fell remarkably in 1946. As a consequence, real government expenditures assumed in the simulation rise to 115 per cent of the historical level in that year and following a fiscal reform rise further to 359 per cent of the historical level in 1948. Population growth assumed in the simulation is more or less in line with the historical path until 1942, when actual population begins to be affected by war casualties. As a consequence, population in the simulation rises to 7 per cent above the historical level in 1945. It rises further to 50 per cent above the historical level in 1946 due to territorial losses and continues to rise to 58 per cent above the historical level in 1948.

The results of the simulation for output and the capital stock per capita are reported in Table 5.7. Both variables are expressed as a ratio to the actual levels. In the simulation, real output per capita

*Table 5.7* Simulation: effects of war destructions on output and the capital stock, 1936–79[a]

| | *NNP/PO* | *K/PO* |
|---|---|---|
| 1936 | 100.0 | 100.0 |
| 1940 | 93.4 | 96.6 |
| 1945 | 115.5 | 141.8 |
| 1950 | 132.9 | 139.3 |
| 1955 | 117.9 | 120.2 |
| 1960 | 107.4 | 116.1 |
| 1965 | 100.2 | 106.6 |
| 1970 | 99.7 | 97.0 |
| 1975 | 90.8 | 93.4 |
| 1979 | 99.8 | 100.4 |

[a] Ratios of simulated levels of output and the stock of capital per capita to actual ones.

increases at an average rate of about 2.6 per cent per year from 1936 to 1979. The stock of capital per capita increases in the simulation at an annual rate of 3.4 per cent during the same period. These results imply that both output and the stock of capital per capita in the simulation reach again the actual level of these variables between 1965 and 1968. This outcome seems to validate the hypothesis that the actual high growth rates of output and the stock of capital per capita in the 1950s and early 1960s were a reflection of the destruction of the capital stock during the war and of the inflow of refugees. From 1965 to 1974, the actual growth rates of these variables returned to lower rates, similar to those obtained in the simulation, implying that the exogenous factors affecting growth generated by the war were disappearing, and that the German economy was returning to growth rates close to the long-term potential growth. After 1973, the rate of growth of NNP fell below the long-term potential growth rate, mainly because of the worsening of the terms of trade following the two oil crises, and possibly because of the disincentives introduced by the increase in the size of the government sector. This simulation indicates also that the estimated model is well-behaved and it represents therefore also an implicit test of its tracking ability. Although similar results have been obtained by simply extrapolating pre-war trends of NNP per capital,[11] there are several advantages in using a model of this type. First, it allows to analyze separately the effect on growth of the destruction of capital

from the effect of the inflow of refugees. Second, it can be used for the analysis of the cyclical behaviour of the German economy in the recovery from large exogenous shocks.

**Notes**

1. See also footnote b), Table 1.1
2. In 1923, the Ruhr was occupied by the French and Belgian armies; it was returned to Germany in 1925.
3. In this model the rest of the world is represented only by the United States. It would, in principle, be possible to gather long-term statistics of income, interest rates, and prices for the United Kingdom, France, and Italy. However, we do not think that this would substantially change the results of the model.
4. Currency is the relevant monetary concept on the demand side (equation 5.9), and the monetary based is the relevant concept on the supply side in equation (5.1b) (the quantity theory) and in equation (5.13).
5. Some growth in outside money occurs because of the different term structure of the assets and liabilities of commercial banks.
6. Putting it another way, in order to endogenise the exchange rate in a sample which includes both periods of fixed and flexible exchange rates, it would have been necessary to estimate a model which is non-linear in the logarithms of the variables.
7. See Bergstrom and Wymer (1978), Sommariva (1981) and Tullio (1981b).
8. The quantity theory states that:

   (1) $D \ln p = w_1 D \ln IR + w_2 D \ln MF + w_3 D \ln A - D \ln y + D \ln v$
   where $w_1 + w_2 + w_3 = 1$ and $v$ is the velocity of circulation of the monetary base. Since we have excluded the velocity of circulation from our equation the parameter of $D$ ln y has to be greater than one if velocity falls, because assuming that $v = v(y)$ then

   (2) $D \ln p = w_1 D \ln IR + w_2 D \ln MF + w_3 D \ln A - (1 + v_y) D \ln y$
   where $v_y$ is the absolute value of the elasticity of velocity of the monetary base (and not of currency) with respect to income.
9. The five dummy variables are: $Q_{23}$ for the peak of the hyperinflation which is equal to 1 in 1923 and 0 otherwise, $Q_{24}$ for the stabilisation of 1924, $Q_{AUT}$ which is equal to one for the years of autarky (1933–39), $Q_{45}$ and $Q_{46}$ for the disturbances related to the end of the war and to the division of Germany.
10. A twenty-year cycle, with constant amplitude, was also found by Bergstrom and Wymer (1976) for the UK.
11. See Borchardt (1982, 1985).

# Appendix 1 Sources of Data used for Econometric Models of Chapters 3, 4 and 5

This appendix contains a description of the sources of the monthly time series used to estimate the hyperinflation model of Chapter 3, of the quarterly time series used to estimate the model of Chapter 4 and of the annual time series used to estimate the 100-year model presented in Chapter 5. The symbols used in this appendix are the same as those used for the corresponding series in the three chapters. Capital letters refer to nominal variables and small letters to real variables, unless otherwise indicated. The data banks used to estimate the quarterly model of Chapter 4 and the 100-year model of Chapter 5 are presented in Appendix 2. The data bank of the hyperinflation model and the data used for the tests of Chapter 2 are not reproduced here because they are readily available from the indicated sources.

## MONTHLY TIME SERIES FOR HYPERINFLATION MODEL (CHAPTER 3): 1919–23

The data bank collected by the authors to estimate the hyperinflation model originally covered the period January 1919 to December 1923, although for estimation a smaller sample period was used. Owing to the transition of the war economy to a peace economy and the removal of price, wage and exchange controls in 1919, the model was estimated starting from January 1920. Three observations are lost due to averaging implicit in the estimation procedure used. The last months of the hyperinflation period were excluded for the purpose of estimation because of the collapse of the function of money as a medium of exchange and because of expectations of the monetary reform, which make the modelling difficult. The main source for the statistics on currency in circulation, prices and the exchange rate is Statistisches Reichsamt (1925).

### Endogenous variables

$S$ = Number of marks per US dollar in Berlin, spot rate, monthly average. *Source*: Statistisches Reichsamt (1925) p. 6.

$p$ = Wholesale price index in paper marks in Germany: Monthly average 1913 = 1.0 *Source*: Statistisches Reichsamt (1925) p. 16–17.

*BU* = Currency in circulation, paper money and coins, millions of paper marks. *Source*: Statistisches Reichsamt (1925) p. 46–47.

**Exogenous variables**

$p_{us}$ = US wholesale price index 1913 = 100. *Source*: Federal Reserve Board, *Federal Reserve Bulletin*, various issues.

*y* = German real output index, 1913 = 100, obtained by interpolating the annual index published by Graham (1930) using the real value of monthly imports of goods obtained from Bresciani-Turroni (1937).

QUARTERLY TIME SERIES FOR MODEL OF CHAPTER 4: 1924–32.

**Endogenous variables**

NNP = Nominal NNP in billions of Reichsmarks. *Sources*: Hoffmann (1965) and Institüt für Konjunkturforschung (1933). The annual real NNP was benchmarked using the quarterly index of industrial production. The resulting real series was multiplied by the quarterly index of consumer prices. This series is seasonally adjusted.

*IR* = International Reserves of the Reichsbank (Gold und Devisenbestand), in billions of RM. *Source*: Institut für Konjunkturforschung (1933) p. 149.

*DA* = Domestic counterpart of currency in circulation in billions of *RM*, obtained as difference between *BU* and *IR*.

*BU* = Currency in circulation, in billions of *RM*. *Source*: Institut für Konjunkturforschung (1933) p. 145.

**Exogenous variables**

*G* = Total nominal government expenditure of the Reich in billions of RM, seasonally adjusted. *Source*: Institüt für Konjunkturforschung, Konjunktur-Statistisches Handbuch (1934) p. 183.

$Y_{us}$ = US nominal GDP, in billions of *RM*, seasonally adjusted, estimated in the same way as German NNP and converted into *RM*. Source of annual GDP: US Department of Commerce (1979); Source of industrial production and quarterly prices: Federal Reserve, Federal Reserve Bulletin, various issues.

YEARLY TIME SERIES FOR 100-YEAR MACROECONOMIC MODEL (CHAPTER 5): 1880–1979

The main sources for this data bank are Hoffmann (1965) for the national accounts and Deutsche Bundesbank (1976) for the monetary statistics,

including prices and the exchange rate. Since, for the war periods and the hyperinflation period, monetary statistics are generally available, most of the problems were encountered in estimating the national accounts and trade statistics for these periods (1914 to 1924 and 1939 to 1949). The data were updated to 1979 (from 1960 or 1961 in the case of Hoffmann's data and from 1975 in the case of the Bundesbank's data) using official sources. The data estimated by the authors are published in Appendix 2 in parentheses in order to remind possible users that they have to be taken with great caution.

**Endogenous variables**

$c$ = real private consumption in billions of 1913 marks. *Source*: Hoffmann (1965) Table 190, p. 698–99, updated to 1979 on the basis of data published by the Statistisches Bundesamt. For the years 1914–18 percentage changes of real private consumption were estimated on the basis of percentage changes of the following series:

$$[wL + r(GD-MF) - \Delta(GD-MF)]/p$$

where $GD$ is central government debt, $\Delta$ stands for the first difference and the other symbols are explained below. The numerator of this expression is a proxy for personal income of households defined as income from labour plus interest payments on central government debt, corrected for acquisitions of new debt instruments. Taxation and debt issued by levels of government other than the central government are neglected. For the years 1919–23 percentage changes of $c$ were estimated more simply on the basis of percentage changes of $wL/p$. From 1939 to 1949 $c$ was estimated in a similar more simple way.

$K$ = real stock of capital including housing in billions of 1913 prices. *Source*: Hoffmann (1965) Table 39, p. 253–54, and Statistisches Bundesamt for the updating. For the years 1914 to 1923 $K$ was obtained as follows:

$$\hat{\dot{K}} = 0.456\,\dot{y}$$

where a dot indicates an annual rate of change, a hat stands for the desired change and $y$ is real NNP as estimated below. 0.456 is the ratio between the percentage change of $K$ from 1913 to 1924 (−11.4) and the percentage change of $y$ in the same period (−25.0). Assuming a two year adjustment period of the actual to the desired capital stock, the rate of change of the actual capital stock was obtained as follows:

$$\dot{K} = 0.50\,\hat{\dot{K}} + 0.50\,\dot{K}_{-1}$$

where $\dot{K}_{-1}$ is the rate of change of $K$ lagged one year. The cumulated error which results is reflected in the figure for 1923.

For the Second World War period (1939 to 1949) a more complicated method was used. Using a Cobb-Douglas production

function with technical progress and solving for the desired rate of change of the capital stock one obtains:

$$\hat{\dot{K}} = \frac{1}{\alpha}\dot{y} - \frac{1-\alpha}{\alpha}\dot{L} - \frac{\lambda}{\alpha}$$

where $\alpha$ is the share of capital and $\lambda$ is the degree of technical progress. As before a two-year adjustment lag of the actual to the desired capital stock was assumed, $\lambda$ was assumed to be equal to 1 per cent.

*p* = consumer price index, 1913 = 1.00. *Source*: Deutsche Bundesbank (1976) and updated using Statistisches Bundesamt. The only period not covered by this source are the years 1940–48. An index for the years 1940–46 was derived from Wolf (1947). This index shows moderate increases, due to a rigid system of price controls which prevented monetary and fiscal disturbances from materialising as an increase in the actual price level. This system of price control was continued until the monetary reform in 1948. For 1947 and 1949 the source is International Monetary Fund, International Financial Statistics (1950).

*w* = annual average labour earnings of self-employed, excluding the defence sector, in current Marks/Reichsmarks/Deutschmarks. *Source*: Hoffmann (1965) Table 119, pp. 493–95. For 1960 to 1979 the index of average gross earnings of workers in industry was used (Statistisches Bundesamt, Statistisches Jahrbuch für die Bundesrepublik Deutschland (1982) p. 467). For the period 1914 to 1923, Hoffmann's series was updated using the index of nominal wages of miners, from Statistisches Reichsamt (1925) p. 41, column 3. From 1939 to 1949 nominal annual earnings were estimated on the basis of the behaviour of the consumer price index.

*L* = civilian employment. *Source*: Hoffmann (1965) Table 20, pp. 204–06, updated using the official data of the Statistisches Bundesamt. For the period 1914 to 1918, 1913 civilian employment was reduced in line with the increase in the size of the armed forces. For the period 1919 to 1924 a Cobb-Douglas production function was used to estimate changes in desired employment as follows:

$$\hat{\dot{L}} = \frac{1}{1-\alpha}\dot{y} - \frac{\alpha}{1-\alpha}\dot{K} - \frac{\lambda}{1-\alpha}$$

where the symbols have been defined before. Actual employment was assumed to adjust to the desired one as follows:

$$\dot{L} = 0.80\,\hat{\dot{L}} + 0.20\,\dot{L}_{-1}$$

For the period 1939 to 1946, civilian employment was derived from Wolf (1947). For the years 1947 to 1949 the data has been obtained from the International Monetary Fund, International Financial Statistics (1950).

*I* = nominal imports of goods in millions of Marks/Reichsmarks/Deutschmarks. *Source*: Deutsche Bundesbank (1976) pp. 322, 323

and 339, updated with official statistics from the Statistisches Bundesamt.

From 1914 to 1918 there are estimates only for the total from August 1914 to end 1918 (Meerworth, 1924). Estimates of imports for the single years were derived by benchmarking imports to the index of industrial production. For the years 1919 to 1923 two sources were used: Bresciani-Turroni (1937) and the League of Nations trade statistics. For the Second World War and the early postwar period data are available until 1943 included, and from war end to 1948 (Deutsche Bundesbank (1976) p. 323 and Bank of International Settlements, Annual Report (1950). Real imports used in the model were obtained by dividing $I$ by the index of unit import values. Real imports for 1944 and 1945 have been benchmarked to real NNP.

$X$ = nominal exports of goods in millions of Marks/Reichsmarks/Deutschmarks. The sources are the same as for nominal imports of goods.

$r$ = nominal short-term private interest rate. *Source*: Deutsche Bundesbank (1976), p. 278 and 279, and Monatsberichte, various issues. For the period 1915 to 1922 the private short-term interest rate published by the Bundesbank has been substituted with a new series computed by assuming that the real interest rate (nominal interest rate corrected with the rate of change in $p$) was slightly negative from 1915 to 1917. For the following years the real interest rate was assumed to have become more negative. This assumption is founded on a careful reading of Bresciani-Turroni (1937) and on the behavior of interest sensitive components of expenditure. For 1924 the official discount rate was used (*Lombardsatz*). For the Second World War, the main source contains this interest rate until 1944. For 1945, the interest rate was kept at the same level as the previous year in nominal terms. For 1946 and 1947 the real interest rate was set equal to zero. For 1948 the official discount rate is published by the International Monetary Fund, International Financial Statistics (1950). From 1949 to 1959 the official discount rate (*Lombardsatz*) was used because the private rate was not available until 1959. From 1960 onwards the rate is again the private short-term interest rate.

$BU$ = currency in circulation outside banks in millions of Marks/Reichsmarks/Deutschmarks. *Source*: Deutsche Bundesbank (1976) pp. 14 and 28. For the period 1880 to the end of The Second World War the figure published on p. 14 of Deutsche Bundesbank (1976) includes currency held by banks. Cash reserves (*Barreserve*) of incorporated banks from p. 56 and of all banks from p. 74 of the same publication have therefore been subtracted from total currency in circulation to obtain an estimate of currency outside banks. For 1945, the figure relating to war end was used. The figure for 1946 has been obtained by interpolation. The 1947 figure is obtained by multiplying by 10 the published 1948 figure. Ten was approximately the factor by which most monetary magni-

tudes were scaled down during the June 1948 monetary reform.

$y$ = real net national product in billions of 1913 Marks. *Sources*: Hoffmann (1965) Table 249 pp. 827–28 and Statistiches Bundesamt, Statistisches Jahrbuch für die Bundesrepublik Deutschland, various issues. To construct estimates of gross domestic product for the period 1914–18 we took estimates of industrial production, production in agriculture, and in commercial services, which are available in the publications of the Statistisches Reichsamt, as our starting point. These three series were weighted with the importance of the corresponding sectors in domestic product of 1913. The growth rate of this aggregate was utilised in order to derive an estimate of gross domestic product for the war years. For the period 1919–24 the source was Graham (1930) who used the same method as above. For the period 1939–46, the source was Wolf (1947) and for 1947–48 NNP was estimated on the basis of the index of industrial production from Grotius (1949) and other information on agricultural production and services.

$BP$ = central government bonds held outside the central bank in millions of Marks/Reichsmarks/Deutschmarks obtained as residual from the government budget constraint:

$$BP = GD - MF$$

where $GD$ is the central government debt obtained from Deutsche Bundesbank (1976) pp. 313 and 314 and MF is defined below. $BP$ is not reproduced in Appendix 2 since all its components are already included.

$f$ = real stock of wealth of the German private sector in billions of 1913 Marks/Reichsmarks/Deutschmarks, computed according to Equation (5.12). In discrete time f has been computed as:

$$f_t = K_t + \frac{GD_t}{p_t} + \left[ \Sigma \left( \frac{CA}{S} \right) \right] \cdot \frac{S_t}{p_t}$$

where $GD$ is central government debt; the symbol $\Sigma$ indicates the cumulation operation from 1876 and $CA$ stands for the current account of the balance of payments on a national accounts basis. The last term is the amount of Germany's net foreign assets corrected for valuation changes arising from changes in the exchange rate. (see also Table 1.10 and note 25 of Chapter 1). $f$ is not reproduced in Appendix 2 since all its components are already included.

$IR$ = net international reserves held by the central bank in millions of Marks/Reichsmarks/Deutschmarks was obtained from Deutsche Bundesbank (1976): from 1880 to 1944, Table 2.01, p. 329 and from 1948 to 1974, Table 1.01, p. 29. From 1914 to 1923 the Bundesbank data are expressed in gold Marks. They have been converted into marks by multiplication with the exchange rate between the paper Mark and the gold Mark published by Bresciani-Turroni (1937). From 1975 to 1979 the series is updated from International Monetary Fund, International Financial Statis-

tics (1981). For 1945 and 1946, balance of payments statistics for the three zones published by the Bank of International Settlements, Annual Report (1949), show no changes in reserves, while for 1947 they show an increase of 293 million Marks.

*NF* = net foreign assets of Germany in millions of Marks/Reichsmarks/Deutschmarks, exclusive of valuation changes, determined as residual from the balance of payments identity (equation 5.14). This series is not reproduced in this Appendix, as all its components are already included.

**Exogenous variables**

*A* = claims of the central bank on the non-bank private sector in millions of Marks/Reichsmarks/Deutschmarks. *Source*: Deutsche Bundesbank (1976) Table 1.01, pp. 36–7 (Noten anderer Banken, Wechsel und Lombardforderungen) and Table 1.01, pp. 48–9 (Kredite an inländische Kreditinstitute and Kredite an inländische sonstige Unternehmen). From 1960 onwards the source is Deutsche Bundesbank Monatsberichte, various issues. For 1947, a figure is derived from Deutsche Bundesbank (1976) Table 1.01, p. 44. The figure for 1946 was linearly interpolated.

*CA* = current account balance of the balance of payments, in millions of Marks/Reichsmarks/Deutschmarks, national account definition. *Source*: Hoffmann (1965) Table 248 p. 825–26. From 1960 to 1979 the source is International Monetary Fund, International Financial Statistics, various issues. For the years 1914 to 1919 and 1939 to 1945 the current account was assumed to be equal to the trade account (*X-I*). From 1920 to 1923 *CA* was derived from Bresciani-Turroni (1937) and League of Nations, balance of trade statistics, various issues. For 1924, the current balance net of transfers was taken from Deutsche Bundesbank, Table 1.01, p. 322. From 1946 to 1948, the current account for the three western zones is published in the 1950 Annual Report of the Bank of International Settlements. For 1949 the current account net of transfers was taken from the Deutsche Bundesbank (1976) Table 10, p. 339.

*g* = real government expenditure on goods and services, in billions of 1913 Marks, national accounts definition. *Source*: Hoffmann (1965) Table 249, pp. 827–28, updated from Statistisches Bundesamt, Statistisches Jahrbuch für die Bundesrepublik Deutschland, various issues. For the period 1914 to 1924, central government expenditure from Bresciani-Turroni (1924, 1937) were used to estimate government expenditure on a national accounts basis (see also Chapter 3, Tables 3.1 and 3.3.) For the period 1939 to 1947, government expenditure statistics were derived from Wolf (1947). These figures refer to the fiscal year (1 April–31 March). They have been transformed into calendar year figures by taking three-quarters of the expenditure for the fiscal budget for each year plus a quarter of those of the previous year. For the fiscal years 1945–46 and 1946–47, government expenditure are available

for the different sectors in which Germany was divided. Government expenditure in the British, United States and French zones were aggregated. This series was deflated by the NNP deflator (Wolf, 1947) in order to obtain a series at constant prices. For 1948 and 1949 $g$ was estimated from different sources on the monetary reform of 1948.

$GD$ = central government debt, in millions of Marks/Reichsmarks/Deutschmarks. *Source*: Deutsche Bundesbank (1976) Table 1.01 p. 313, until 1944 and Table 1.02, p. 314 for the period 1950 to 1974. For the updating to 1979 the source was Deutsche Bundesbank, Monatsberichte, various issues. For the period 1880 to 1944 the debt relates to the end of the fiscal year ending in March. The March figures are attributed to the end of the previous year in Appendix 2. For 1945, changes in $MF$ from the beginning of the year to war end and the government deficit of the three zones reported by Wolf (1947) were used to estimate changes in the stock of public debt. For 1948 and 1949, $GD$ was obtained using estimates of the government budget deficit. The figure for 1947 is obtained by multiplying by 10 the 1948 figure. The figure for 1946 was interpolated.

$MF$ = claims of the central bank on the government sector, in millions of Marks/Reichsmarks/Deutschmarks. *Source*: Deutsche Bundesbank (1976) Table 1.01, p. 36–7 (Reichskassenscheine, Rentenbankscheine, Schatzwechsel und Wertpapiere). From 1948 to 1974, the source is Deutsche Bundesbank (1976) Table 1.01, pp. 48–9 (claims on the central government, the railway system and the postal system and other claims on the central and local governments). The updating to 1979 was made from the International Monetary Fund, International Financial Statistics, various issues. For the year 1945, the figure relating to war end was used. For 1946 and 1947, $MF$ was reduced in the same proportion as $BU$.

$p_i$, = index of unit values of imports of goods (1913 = 1.00). *Sources*: Hoffmann (1965) Table 153, pp. 612–15 and International Monetary Fund, International Financial Statistics, various issues. For the period 1914 to 1923 unit values of imports were obtained on the basis of movements of the unit export values of the US converted into Marks. For the years 1939 to 1949 unit values of imports were obtained on the basis of unit export values of the US, the UK, France, Japan, Italy and Sweden converted into Marks.

$PO$ = total population at mid-year, in millions. *Sources*: Hoffmann (1965) Table 1, pp. 173–74 and International Monetary Fund, International Financial Statistics, various issues. The figures for the period 1914–21 and 1937 to 1944 were obtained from Deutsche Bundesbank (1976) Table 1.02 pp. 6–7. For 1945, the figure relates to war end and has been estimated on the basis of estimates of war casualities in the first eight months of 1945.

$p_{us}$ = US consumer price index (1913 = 1.00). *Source*: US Department

of Commerce, (1979), and International Monetary Fund, International Financial Statistics, various issues.

$p_x$ = index of unit values of exports of goods (1913 = 1.00). *Sources*: Hoffmann (1965) Table 151, pp. 606–609 and International Monetary Fund, International Financial Statistics, various issues for updating. For the period 1914 to 1923 and from 1939 to 1949, unit export values were linked to movements of the wholesale price index. The wholesale price index is available from Deutsche Bundesbank (1976) until 1944. Wolf (1947) published a figure for 1946 and the International Monetary Fund, International Financial Statistics has figures for the period 1948 to 1950.

$p_{xs}$ = index of unit export values of US goods (1913 = 1.00). *Source*: US Department of Commerce (1979) and International Monetary Fund, International Financial Statistics, various issues.

$r_{us}$ = US long-term interest rate. *Source*: US Department of Commerce, (1979) and Homer (1977).

$S$ = Marks/Reichsmarks/Deutschmarks per US dollar. *Source*: Deutsche Bundesbank (1976) Table 1.01 p. 3 and 5 and Statistisches Reichsamt, Sonderheft No. 5 (1925) p. 6 and International Monetary Fund, International Financial Statistics, various issues.

$y_{us}$ = US real gross domestic product in billions of 1913 dollars. *Source*: US Department of Commerce (1979).

# Appendix 2 Data Banks for Quarterly Model of Chapter 4 (1924–32) and Yearly Model of Chapter 5 (1880–1979)

QUARTERLY TIME SERIES FOR MODEL OF CHAPTER 4 (1924–32);

**Endogenous variables**
(in billions of Reichsmarks.)

| | | *Nominal net national product*[a] *(NNP)* | *International Reserves (IR)* | *Currency in circulation (BU)* |
|---|---|---|---|---|
| 1924 | I | 10.16 | 0.46 | 2.82 |
| | II | 11.38 | 0.46 | 3.13 |
| | III | 13.18 | 0.58 | 3.71 |
| | IV | 15.50 | 1.01 | 4.27 |
| 1925 | I | 16.48 | 1.34 | 4.48 |
| | II | 16.52 | 1.42 | 4.77 |
| | III | 17.18 | 1.49 | 5.06 |
| | IV | 15.51 | 1.61 | 5.18 |
| 1926 | I | 15.89 | 1.97 | 5.05 |
| | II | 15.15 | 1.82 | 5.17 |
| | III | 16.24 | 2.12 | 5.46 |
| | IV | 18.60 | 2.35 | 5.80 |
| 1927 | I | 18.27 | 2.05 | 5.55 |
| | II | 19.73 | 1.87 | 5.73 |
| | III | 19.80 | 2.01 | 6.10 |
| | IV | 20.67 | 2.15 | 6.27 |
| 1928 | I | 21.12 | 2.12 | 6.17 |
| | II | 21.07 | 2.33 | 6.31 |
| | III | 20.94 | 2.58 | 6.51 |
| | IV | 18.81 | 2.88 | 6.59 |
| 1929 | I | 19.30 | 2.72 | 6.47 |
| | II | 21.19 | 2.27 | 6.44 |
| | III | 19.96 | 2.55 | 6.52 |
| | IV | 19.17 | 2.69 | 6.60 |

**Endogenous variables**
(in billions of Reichsmarks.)

| | | *Nominal net national product*[a] *(NNP)* | *International Reserves (IR)* | *Currency in circulation (BU)* |
|---|---|---|---|---|
| 1930 | I | 20.44 | 2.88 | 6.31 |
| | II | 18.38 | 3.08 | 6.27 |
| | III | 16.60 | 2.65 | 6.34 |
| | IV | 15.31 | 2.69 | 6.38 |
| 1931 | I | 17.66 | 2.51 | 6.05 |
| | II | 15.67 | 1.72 | 5.96 |
| | III | 13.86 | 1.44 | 6.30 |
| | IV | 12.23 | 1.15 | 6.37 |
| 1932 | I | 13.05 | 1.02 | 6.22 |
| | II | 12.22 | 0.96 | 6.03 |
| | III | 12.29 | 0.93 | 5.86 |
| | IV | 12.76 | 0.92 | 5.64 |

[a] Seasonally adjusted.

**Exogenous variables**
(in billions of Reichsmarks.)

| | | *Nominal expenditures of the Reich*[a] *(G)* | *US nominal GDP*[a] *($Y_{us}$)* |
|---|---|---|---|
| 1924 | I | 1.53 | 53.17 |
| | II | 1.85 | 54.84 |
| | III | 1.78 | 60.68 |
| | IV | 1.70 | 68.33 |
| 1925 | I | 1.85 | 66.55 |
| | II | 2.03 | 67.66 |
| | III | 1.93 | 67.73 |
| | IV | 1.87 | 75.37 |
| 1926 | I | 1.58 | 74.23 |
| | II | 2.06 | 74.90 |
| | III | 2.35 | 75.60 |
| | IV | 1.17 | 73.52 |

| | | *Nominal expenditures of the Reich*[a] *(G)* | *US nominal GDP*[a] *($Y_{us}$)* |
|---|---|---|---|
| 1927 | I | 1.94 | 75.42 |
| | II | 2.28 | 75.98 |
| | III | 2.33 | 70.23 |
| | IV | 2.61 | 67.91 |
| 1928 | I | 2.09 | 68.79 |
| | II | 2.43 | 69.68 |
| | III | 2.55 | 74.23 |
| | IV | 2.85 | 78.58 |
| 1929 | I | 3.06 | 82.04 |
| | II | 2.48 | 85.75 |
| | III | 2.69 | 82.22 |
| | IV | 2.72 | 68.47 |
| 1930 | I | 3.00 | 75.32 |
| | II | 2.94 | 69.25 |
| | III | 3.08 | 59.72 |
| | IV | 3.00 | 53.66 |
| 1931 | I | 2.71 | 57.71 |
| | II | 2.46 | 52.60 |
| | III | 1.94 | 45.83 |
| | IV | 2.58 | 44.18 |
| 1932 | I | 2.58 | 41.34 |
| | II | 1.97 | 35.97 |
| | III | 1.88 | 40.06 |
| | IV | 2.09 | 35.59 |

[a] Seasonally adjusted.

YEARLY TIME SERIES FOR 100-YEAR MACROECONOMIC MODEL: 1880–1979 (CHAPTER 5)

**National accounts**
(in billions of Marks/Reichmarks/Deutschmark, in 1913 prices.)

| | *Private consumption (c)* | *Stock of capital (K)* | *Government expenditure (g)* | *Imports (i)* | *Export (x)* | *NNP (y)* |
|---|---|---|---|---|---|---|
| 1879 | – | 92.00 | – | – | – | – |
| 1880 | 16.8 | 93.97 | 1.49 | 2.77 | 2.31 | 19.9 |
| 1881 | 17.3 | 96.17 | 1.51 | 2.98 | 2.37 | 20.6 |
| 1882 | 17.2 | 98.17 | 1.49 | 3.20 | 2.46 | 20.4 |
| 1883 | 18.4 | 100.69 | 1.47 | 3.38 | 2.57 | 21.9 |
| 1884 | 18.8 | 103.36 | 1.50 | 3.56 | 2.72 | 22.7 |
| 1885 | 19.4 | 106.16 | 1.51 | 3.48 | 2.66 | 23.5 |
| 1886 | 19.7 | 109.00 | 1.55 | 3.48 | 2.89 | 24.1 |
| 1887 | 20.0 | 111.98 | 1.64 | 3.77 | 3.02 | 24.6 |
| 1888 | 20.7 | 114.98 | 1.98 | 3.97 | 3.12 | 25.8 |
| 1889 | 21.3 | 118.57 | 2.01 | 4.59 | 2.94 | 26.5 |
| 1890 | 21.7 | 122.68 | 2.22 | 4.86 | 3.09 | 27.8 |
| 1891 | 22.2 | 125.54 | 2.05 | 5.11 | 3.15 | 26.8 |
| 1892 | 22.8 | 129.43 | 2.11 | 5.24 | 3.17 | 28.4 |
| 1893 | 24.5 | 133.54 | 2.22 | 5.23 | 3.28 | 30.6 |
| 1894 | 24.7 | 137.23 | 2.23 | 5.83 | 3.31 | 30.2 |
| 1895 | 26.1 | 141.18 | 2.26 | 5.77 | 3.73 | 32.1 |
| 1896 | 26.4 | 146.08 | 2.38 | 6.19 | 3.99 | 33.4 |
| 1897 | 27.1 | 151.39 | 2.52 | 6.42 | 4.04 | 34.7 |
| 1898 | 28.2 | 158.10 | 2.60 | 7.17 | 4.27 | 36.8 |
| 1899 | 28.8 | 164.07 | 2.72 | 7.21 | 4.42 | 36.9 |
| 1900 | 28.8 | 169.37 | 2.94 | 7.11 | 4.65 | 36.5 |
| 1901 | 29.2 | 173.86 | 3.03 | 7.10 | 4.64 | 36.2 |
| 1902 | 29.8 | 178.05 | 3.06 | 7.12 | 5.08 | 36.9 |
| 1903 | 31.0 | 183.83 | 3.14 | 7.65 | 5.40 | 40.1 |
| 1904 | 31.9 | 190.42 | 3.30 | 8.09 | 5.51 | 42.3 |
| 1905 | 32.4 | 197.21 | 3.58 | 8.42 | 5.99 | 43.4 |
| 1906 | 32.6 | 204.31 | 3.88 | 9.00 | 6.68 | 44.3 |
| 1907 | 34.2 | 212.02 | 4.02 | 9.30 | 6.94 | 46.2 |
| 1908 | 35.6 | 218.10 | 4.03 | 9.05 | 6.72 | 46.4 |
| 1909 | 35.9 | 224.72 | 4.28 | 9.56 | 7.22 | 47.5 |
| 1910 | 35.4 | 231.30 | 4.26 | 9.90 | 8.00 | 47.4 |
| 1911 | 36.7 | 239.18 | 4.30 | 10.41 | 8.55 | 49.7 |
| 1912 | 38.3 | 247.77 | 4.58 | 10.97 | 9.20 | 51.9 |
| 1913 | 38.2 | 255.94 | 5.13 | 11.20 | 10.20 | 52.4 |
| 1914 | (39.0) | (247.29) | (11.40) | (7.80) | (6.10) | (47.6) |

| | *Private consumption (c)* | *Stock of capital (K)* | *Government expenditure (g)* | *Imports (i)* | *Export (x)* | *NNP (y)* |
|---|---|---|---|---|---|---|
| 1915 | (33.6) | (239.31) | (18.8) | (3.90) | (1.90) | (42.9) |
| 1916 | (30.1) | (229.26) | (19.9) | (4.70) | (2.30) | (39.6) |
| 1917 | (27.3) | (222.81) | (20.9) | (5.40) | (2.30) | (35.4) |
| 1918 | (26.6) | (211.10) | (17.0) | (5.20) | (2.40) | (33.9) |
| 1919 | (33.9) | (197.60) | (14.7) | (5.60) | (1.60) | (28.3) |
| 1920 | (28.8) | (197.01) | (9.3) | (3.70) | (3.70) | (31.9) |
| 1921 | (33.1) | (202.07) | (6.7) | (5.70) | (4.50) | (35.7) |
| 1922 | (31.8) | (209.05) | (4.0) | (6.40) | (6.20) | (39.1) |
| 1923 | (25.8) | (200.86) | (11.4) | (4.80) | (5.30) | (29.7) |
| 1924 | (33.6) | 226.80 | (5.5) | (6.97) | (5.90) | (39.3) |
| 1925 | 35.7 | 232.19 | 5.80 | 8.56 | 6.89 | 46.9 |
| 1926 | 36.9 | 235.49 | 6.13 | 7.71 | 7.94 | 46.6 |
| 1927 | 41.9 | 242.57 | 6.38 | 11.28 | 8.05 | 53.1 |
| 1928 | 42.5 | 250.45 | 6.69 | 10.94 | 9.08 | 54.0 |
| 1929 | 42.2 | 253.90 | 6.57 | 10.63 | 10.01 | 51.7 |
| 1930 | 40.4 | 256.96 | 6.50 | 9.48 | 9.42 | 49.3 |
| 1931 | 39.0 | 255.43 | 6.32 | 7.79 | 8.46 | 43.9 |
| 1932 | 38.2 | 254.14 | 6.28 | 6.90 | 5.71 | 41.8 |
| 1933 | 39.6 | 252.05 | 7.72 | 6.89 | 5.21 | 47.4 |
| 1934 | 42.1 | 260.21 | 9.77 | 7.63 | 4.84 | 52.1 |
| 1935 | 42.3 | 266.13 | 17.37 | 6.82 | 5.28 | 58.7 |
| 1936 | 42.9 | 273.40 | 15.69 | 6.59 | 5.87 | (64.5) |
| 1937 | 45.4 | 284.60 | 16.25 | 7.58 | 6.66 | (71.9) |
| 1938 | 47.2 | 296.56 | 22.46 | 9.13 | 6.15 | (79.8) |
| 1939 | (48.8) | (307.60) | (31.59) | (7.87) | (6.07) | (83.6) |
| 1940 | (42.1) | (301.70) | (41.53) | (7.29) | (5.21) | (77.2) |
| 1941 | (39.4) | (295.71) | (48.96) | (9.80) | (7.10) | (76.2) |
| 1942 | (36.6) | (290.52) | (60.91) | (11.00) | (7.80) | (75.3) |
| 1943 | (34.1) | (277.91) | (69.80) | (9.80) | (8.30) | (73.3) |
| 1944 | (31.3) | (247.12) | (74.96) | (2.80) | (2.10) | (68.5) |
| 1945 | (28.3) | (188.51) | (43.06) | (1.90) | (2.40) | (41.7) |
| 1946 | (20.6) | (133.20) | (4.97) | (1.50) | (0.30) | (29.9) |
| 1947 | (21.8) | (134.75) | (4.43) | (1.90) | (0.50) | (33.7) |
| 1948 | (23.1) | (143.40) | (5.87) | (2.80) | (1.10) | (37.4) |
| 1949 | (25.5) | (151.43) | (6.89) | (3.80) | (1.90) | (38.5) |
| 1950 | 30.8 | 173.80 | 7.81 | 5.10 | 3.46 | 44.9 |
| 1951 | 31.9 | 181.30 | 8.28 | 5.23 | 4.91 | 48.3 |
| 1952 | 34.5 | 188.80 | 9.07 | 6.12 | 5.40 | 51.7 |
| 1953 | 37.7 | 196.20 | 9.07 | 6.94 | 6.29 | 54.7 |
| 1954 | 40.4 | 206.00 | 9.58 | 8.66 | 7.48 | 59.7 |
| 1955 | 43.7 | 218.80 | 9.77 | 10.70 | 8.73 | 64.8 |

**National accounts**
(in billions of Marks/Reichmarks/Deutschmark, in 1913 prices.)

| | *Private consumption (c)* | *Stock of capital (K)* | *Government expenditure (g)* | *Imports (i)* | *Export (x)* | *NNP (y)* |
|---|---|---|---|---|---|---|
| 1956 | 47.5 | 230.80 | 9.89 | 11.68 | 9.78 | 69.2 |
| 1957 | 50.3 | 242.70 | 10.31 | 13.26 | 10.93 | 71.8 |
| 1958 | 52.7 | 254.10 | 11.36 | 14.37 | 10.96 | 73.1 |
| 1959 | 56.2 | 267.50 | 12.56 | 16.69 | 12.22 | 78.5 |
| 1960 | 60.7 | 282.93 | 13.31 | 19.36 | 13.93 | 85.8 |
| 1961 | 64.5 | 299.22 | 14.15 | 20.77 | 14.74 | 90.1 |
| 1962 | 67.9 | 315.90 | 15.70 | 23.03 | 14.91 | 93.7 |
| 1963 | 70.3 | 332.66 | 16.76 | 24.51 | 16.38 | 97.0 |
| 1964 | 73.9 | 351.86 | 16.68 | 27.59 | 18.24 | 103.4 |
| 1965 | 78.8 | 372.63 | 17.47 | 32.20 | 19.82 | 109.2 |
| 1966 | 81.8 | 391.58 | 17.87 | 32.73 | 22.04 | 112.4 |
| 1967 | 82.5 | 408.98 | 18.44 | 31.93 | 24.05 | 112.1 |
| 1968 | 85.7 | 430.06 | 18.45 | 37.76 | 27.83 | 120.3 |
| 1969 | 92.3 | 454.04 | 19.34 | 44.57 | 31.27 | 130.2 |
| 1970 | 98.7 | 480.28 | 20.29 | 48.39 | 31.81 | 137.8 |
| 1971 | 104.1 | 506.14 | 21.76 | 52.36 | 33.22 | 141.9 |
| 1972 | 108.2 | 532.90 | 22.74 | 56.27 | 35.39 | 146.7 |
| 1973 | 110.9 | 559.52 | 23.99 | 59.16 | 40.44 | 154.2 |
| 1974 | 111.3 | 583.63 | 25.03 | 57.09 | 45.00 | 155.0 |
| 1975 | 114.7 | 606.73 | 26.15 | 57.44 | 39.84 | 150.1 |
| 1976 | 118.9 | 630.91 | 26.68 | 65.69 | 44.36 | 158.5 |
| 1977 | 122.3 | 656.07 | 26.89 | 68.10 | 46.76 | 162.6 |
| 1978 | 126.5 | 682.82 | 27.87 | 73.23 | 48.73 | 168.1 |
| 1979 | 129.9 | 711.69 | 28.67 | 79.93 | 52.23 | 175.4 |

**Monetary base**
(in millions of Marks/Reichmarks/Deutschmarks.)

| | *Currency in circulation* (BU) | *International reserves* (IR) | *Monetary financing of the government* (MF) | *Private sector financing* (A) |
|---|---|---|---|---|
| 1880 | 2714 | 218 | 61 | 513 |
| 1881 | 2635 | 199 | 59 | 575 |
| 1882 | 2634 | 251 | 39 | 573 |
| 1883 | 2692 | 246 | 49 | 557 |

| | *Currency in circulation* (BU) | *International reserves* (IR) | *Monetary financing of the government* (MF) | *Private sector financing* (A) |
|---|---|---|---|---|
| 1884 | 2722 | 232 | 63 | 667 |
| 1885 | 2622 | 350 | 68 | 557 |
| 1886 | 2734 | 407 | 79 | 676 |
| 1887 | 2669 | 427 | 24 | 658 |
| 1888 | 2678 | 454 | 34 | 620 |
| 1889 | 2834 | 483 | 45 | 853 |
| 1890 | 2807 | 480 | 54 | 773 |
| 1891 | 2755 | 619 | 18 | 724 |
| 1892 | 2865 | 539 | 31 | 734 |
| 1893 | 2896 | 502 | 27 | 762 |
| 1894 | 3004 | 722 | 24 | 711 |
| 1895 | 3296 | 579 | 36 | 991 |
| 1896 | 3288 | 540 | 22 | 998 |
| 1897 | 3323 | 583 | 54 | 953 |
| 1898 | 3510 | 541 | 59 | 1063 |
| 1899 | 3682 | 502 | 45 | 1234 |
| 1900 | 3786 | 581 | 102 | 1248 |
| 1901 | 3829 | 689 | 142 | 1170 |
| 1902 | 3975 | 611 | 207 | 1224 |
| 1903 | 4156 | 612 | 130 | 1359 |
| 1904 | 4381 | 764 | 206 | 1235 |
| 1905 | 4655 | 664 | 233 | 1420 |
| 1906 | 5067 | 565 | 314 | 1637 |
| 1907 | 5056 | 534 | 197 | 1865 |
| 1908 | 5122 | 922 | 453 | 1345 |
| 1909 | 5249 | 868 | 388 | 1539 |
| 1910 | 5320 | 907 | 209 | 1707 |
| 1911 | 5552 | 899 | 179 | 1920 |
| 1912 | 5927 | 885 | 124 | 2221 |
| 1913 | 5825 | 1378 | 450 | 1598 |
| 1914 | 7675 | 2344 | 3647 | 1226 |
| 1915 | 8920 | 3159 | 6558 | 601 |
| 1916 | 11056 | 3668 | 9377 | 750 |
| 1917 | 16684 | 3885 | 15612 | 394 |
| 1918 | 31032 | 5640 | 32580 | 267 |
| 1919 | 46968 | 25856 | 52440 | 505 |
| 1920 | 76044 | 104504 | 81226 | 3014 |
| 1921 | 122913 | 357420 | 139490 | 1073 |
| 1922 | 1294748 | 4658700 | 1423416 | 423019 |
| 1923 | 4.916E14 | 3.47E14 | 2.023E14 | 5.91E14 |
| 1924 | 3805 | 2068 | 223 | 2089 |

**Monetary base**
(in millions of Marks/Reichmarks/Deutschmarks.)

| | *Currency in circulation* (BU) | *International reserves* (IR) | *Monetary financing of the government* (MF) | *Private sector financing* (A) |
|---|---|---|---|---|
| 1925 | 4651 | 2230 | 364 | 1936 |
| 1926 | 5213 | 2795 | 99 | 1917 |
| 1927 | 5530 | 2337 | 117 | 3212 |
| 1928 | 6033 | 3257 | 221 | 2811 |
| 1929 | 5983 | 3095 | 417 | 2863 |
| 1930 | 5797 | 2980 | 316 | 2626 |
| 1931 | 6195 | 1292 | 264 | 4391 |
| 1932 | 5290 | 1059 | 413 | 2984 |
| 1933 | 5338 | 661 | 647 | 3364 |
| 1934 | 5538 | 223 | 832 | 4172 |
| 1935 | 5801 | 268 | 728 | 4587 |
| 1936 | 6320 | 185 | 621 | 5522 |
| 1937 | 6832 | 269 | 519 | 6073 |
| 1938 | 9612 | 279 | 993 | 8168 |
| 1939 | 13485 | 309 | 3791 | 8942 |
| 1940 | 15674 | 135 | 10975 | 5093 |
| 1941 | 20963 | 110 | 20156 | 2061 |
| 1942 | 25834 | 101 | 29042 | 807 |
| 1943 | 34567 | 95 | 40923 | 1011 |
| 1944 | 51325 | 84 | 62073 | 1995 |
| 1945 | (70535) | (84) | (70754) | (2173) |
| 1946 | (67193) | (84) | (67400) | (1478) |
| 1947 | (63850) | (337) | (64030) | (782) |
| 1948 | 6385 | 983 | 8228 | 1666 |
| 1949 | 7463 | 845 | 8954 | 3912 |
| 1950 | 8105 | 1079 | 9781 | 5689 |
| 1951 | 9310 | 2001 | 9413 | 6301 |
| 1952 | 10805 | 4971 | 8928 | 4611 |
| 1953 | 11956 | 8368 | 8803 | 3789 |
| 1954 | 12751 | 11499 | 8733 | 3755 |
| 1955 | 14040 | 13293 | 8894 | 5016 |
| 1956 | 14876 | 18315 | 8811 | 3315 |
| 1957 | 16461 | 24060 | 8993 | 1823 |
| 1958 | 17940 | 27028 | 9032 | 1067 |
| 1959 | 19384 | 25216 | 9211 | 1334 |
| 1960 | 20821 | 33342 | 9113 | 2042 |
| 1961 | 23191 | 32006 | 12831 | 2809 |
| 1962 | 24230 | 30963 | 13238 | 3591 |

| | *Currency in circulation* (BU) | *International reserves* (IR) | *Monetary financing of the government* (MF) | *Private sector financing* (A) |
|---|---|---|---|---|
| 1963 | 25501 | 33528 | 14200 | 3340 |
| 1964 | 27877 | 34281 | 13084 | 4690 |
| 1965 | 29647 | 32892 | 12418 | 7289 |
| 1966 | 30871 | 34702 | 12601 | 8064 |
| 1967 | 31507 | 35092 | 13553 | 6814 |
| 1968 | 32587 | 41928 | 11666 | 6719 |
| 1969 | 34689 | 28047 | 12332 | 18000 |
| 1970 | 36889 | 51726 | 11851 | 18992 |
| 1971 | 40292 | 62403 | 10947 | 18826 |
| 1972 | 45785 | 77396 | 9414 | 20186 |
| 1973 | 47429 | 92466 | 11852 | 11224 |
| 1974 | 51524 | 83449 | 10236 | 15524 |
| 1975 | 56480 | 86400 | 12310 | 8521 |
| 1976 | 60571 | 88500 | 11306 | 19517 |
| 1977 | 67505 | 90200 | 10704 | 19588 |
| 1978 | 76203 | 107200 | 11908 | 24252 |
| 1979 | 79877 | 107000 | 11547 | 36246 |

**Exchange rate and prices**

(in Marks/Reichmarks/Deutschmarks per US dollar.)

| | *Exchange rate* (S) | *Consumer price* (p) | *Unit values of exports* ($p_x$) | *Unit values of imports* ($p_i$) | *US consumer price* ($p_{us}$) |
|---|---|---|---|---|---|
| | | | *(1913 = 100)* | | |
| 1880 | 4.19 | 0.76 | 1.29 | 1.03 | 0.80 |
| 1881 | 4.19 | 0.77 | 1.30 | 1.00 | 0.83 |
| 1882 | 4.18 | 0.75 | 1.34 | 0.98 | 0.86 |
| 1883 | 4.18 | 0.75 | 1.29 | 0.96 | 0.81 |
| 1884 | 4.18 | 0.72 | 1.20 | 0.92 | 0.77 |
| 1885 | 4.19 | 0.70 | 1.09 | 0.86 | 0.75 |
| 1886 | 4.18 | 0.68 | 1.05 | 0.85 | 0.76 |
| 1887 | 4.19 | 0.68 | 1.06 | 0.85 | 0.76 |
| 1888 | 4.18 | 0.70 | 1.08 | 0.86 | 0.78 |
| 1889 | 4.19 | 0.73 | 1.11 | 0.89 | 0.78 |
| 1890 | 4.18 | 0.75 | 1.11 | 0.88 | 0.78 |
| 1891 | 4.18 | 0.77 | 1.06 | 0.86 | 0.76 |
| 1892 | 4.18 | 0.76 | 1.00 | 0.81 | 0.77 |

**Exchange rate and prices**

(in Marks/Reichmarks/Deutschmarks per US dollar.)

| | *Exchange rate* (*S*) | *Consumer price* (*p*) | *Unit values of exports* (*1913 = 100*) ($p_x$) | *Unit values of imports* (*1913 = 100*) ($p_i$) | *US consumer price* ($p_{us}$) |
|---|---|---|---|---|---|
| 1893 | 4.19 | 0.75 | 0.99 | 0.79 | 0.75 |
| 1894 | 4.18 | 0.74 | 0.92 | 0.74 | 0.73 |
| 1895 | 4.18 | 0.73 | 0.92 | 0.74 | 0.73 |
| 1896 | 4.18 | 0.72 | 0.94 | 0.74 | 0.74 |
| 1897 | 4.19 | 0.74 | 0.94 | 0.76 | 0.75 |
| 1898 | 4.21 | 0.76 | 0.94 | 0.76 | 0.75 |
| 1899 | 4.20 | 0.76 | 0.99 | 0.80 | 0.77 |
| 1900 | 4.20 | 0.77 | 1.02 | 0.85 | 0.80 |
| 1901 | 4.19 | 0.78 | 0.97 | 0.80 | 0.82 |
| 1902 | 4.19 | 0.78 | 0.95 | 0.82 | 0.84 |
| 1903 | 4.20 | 0.78 | 0.95 | 0.83 | 0.88 |
| 1904 | 4.19 | 0.79 | 0.96 | 0.85 | 0.87 |
| 1905 | 4.20 | 0.82 | 0.98 | 0.88 | 0.87 |
| 1906 | 4.21 | 0.87 | 0.97 | 0.94 | 0.90 |
| 1907 | 4.21 | 0.88 | 1.02 | 0.97 | 0.95 |
| 1908 | 4.19 | 0.88 | 0.96 | 0.89 | 0.91 |
| 1909 | 4.19 | 0.90 | 0.95 | 0.93 | 0.91 |
| 1910 | 4.20 | 0.92 | 0.96 | 0.94 | 0.96 |
| 1911 | 4.20 | 0.95 | 0.96 | 0.96 | 0.96 |
| 1912 | 4.20 | 1.00 | 0.99 | 1.00 | 1.02 |
| 1913 | 4.20 | 1.00 | 1.00 | 1.00 | 1.00 |
| 1914 | 4.28 | 1.00 | (1.05) | (1.00) | 1.01 |
| 1915 | 4.86 | 1.35 | (1.42) | (1.22) | 1.03 |
| 1916 | 5.52 | 1.80 | (1.52) | (1.78) | 1.11 |
| 1917 | 6.58 | 2.25 | (1.79) | (2.77) | 1.30 |
| 1918 | 6.01 | 3.10 | (2.17) | (2.95) | 1.52 |
| 1919 | 19.76 | 4.90 | (4.15) | (10.15) | 1.75 |
| 1920 | 63.06 | 10.44 | (14.86) | (34.91) | 2.03 |
| 1921 | 104.57 | 13.37 | (19.11) | (64.11) | 1.81 |
| 1922 | 1885.78 | 150.36 | (341.82) | (651.49) | 1.69 |
| 1923 | 5.349E11 | 1.59E11 | (1.66E11) | (1.986E11) | 1.72 |
| 1924 | 4.20 | 1.31 | 1.33 | 1.38 | 1.73 |
| 1925 | 4.19 | 1.42 | 1.39 | 1.40 | 1.77 |
| 1926 | 4.20 | 1.42 | 1.35 | 1.28 | 1.79 |
| 1927 | 4.21 | 1.48 | 1.38 | 1.25 | 1.75 |
| 1928 | 4.19 | 1.52 | 1.39 | 1.27 | 1.73 |
| 1929 | 4.20 | 1.54 | 1.36 | 1.29 | 1.73 |

| | *Exchange rate* (*S*) | *Consumer price* (*p*) | *Unit values of exports* (*1913 = 100*) ($p_x$) | *Unit values of imports* ($p_i$) | *US consumer price* ($p_{us}$) |
|---|---|---|---|---|---|
| 1930 | 4.19 | 1.48 | 1.29 | 1.12 | 1.69 |
| 1931 | 4.21 | 1.36 | 1.15 | 0.89 | 1.54 |
| 1932 | 4.21 | 1.21 | 1.02 | 0.69 | 1.38 |
| 1933 | 3.40 | 1.18 | 0.95 | 0.62 | 1.31 |
| 1934 | 2.51 | 1.21 | 0.88 | 0.61 | 1.35 |
| 1935 | 2.49 | 1.23 | 0.82 | 0.64 | 1.39 |
| 1936 | 2.48 | 1.25 | 0.83 | 0.66 | 1.40 |
| 1937 | 2.49 | 1.25 | 0.91 | 0.74 | 1.45 |
| 1938 | 2.49 | 1.26 | 0.95 | 0.68 | 1.43 |
| 1939 | 2.49 | 1.26 | (0.96) | (0.68) | 1.40 |
| 1940 | 2.50 | 1.30 | (0.99) | (0.69) | 1.42 |
| 1941 | 2.50 | 1.33 | (1.01) | (0.71) | 1.47 |
| 1942 | 2.50 | 1.37 | (1.03) | (0.79) | 1.65 |
| 1943 | 2.50 | 1.39 | (1.05) | (0.84) | 1.75 |
| 1944 | 2.50 | 1.41 | (1.06) | (0.85) | 1.78 |
| 1945 | 2.50 | 1.73 | (1.16) | (1.04) | 1.82 |
| 1946 | 2.50 | 1.78 | (1.26) | (1.07) | 1.97 |
| 1947 | 2.50 | 1.89 | (1.83) | (1.14) | 2.26 |
| 1948 | 3.33 | 2.03 | (2.55) | (1.91) | 2.43 |
| 1949 | 3.58 | 2.01 | (2.47) | (2.10) | 2.41 |
| 1950 | 4.20 | 1.89 | 2.41 | 2.23 | 2.43 |
| 1951 | 4.20 | 2.02 | 2.97 | 2.81 | 2.62 |
| 1952 | 4.20 | 2.06 | 3.13 | 2.65 | 2.68 |
| 1953 | 4.20 | 2.01 | 2.95 | 2.31 | 2.70 |
| 1954 | 4.20 | 2.02 | 2.95 | 2.23 | 2.71 |
| 1955 | 4.21 | 2.05 | 2.97 | 2.29 | 2.71 |
| 1956 | 4.20 | 2.10 | 3.16 | 2.40 | 2.75 |
| 1957 | 4.20 | 2.15 | 3.29 | 2.40 | 2.84 |
| 1958 | 4.19 | 2.19 | 3.38 | 2.23 | 2.92 |
| 1959 | 4.18 | 2.22 | 3.37 | 2.15 | 2.94 |
| 1960 | 4.17 | 2.25 | 3.44 | 2.21 | 2.99 |
| 1961 | 4.02 | 2.30 | 3.46 | 2.14 | 3.02 |
| 1962 | 4.00 | 2.37 | 3.55 | 2.15 | 3.05 |
| 1963 | 3.99 | 2.44 | 3.56 | 2.13 | 3.09 |
| 1964 | 3.97 | 2.50 | 3.56 | 2.13 | 3.13 |
| 1965 | 3.99 | 2.59 | 3.62 | 2.19 | 3.18 |
| 1966 | 4.00 | 2.68 | 3.66 | 2.22 | 3.28 |
| 1967 | 3.99 | 2.72 | 3.62 | 2.20 | 3.37 |
| 1968 | 3.99 | 2.75 | 3.58 | 2.15 | 3.51 |
| 1969 | 3.92 | 2.81 | 3.63 | 2.20 | 3.70 |

**Exchange rate and prices**

(in Marks/Reichmarks/Deutschmarks per US dollar.)

| | *Exchange rate* (*S*) | *Consumer price* (*p*) | *Unit values of exports* (*1913 = 100*) ($p_x$) | *Unit values of imports* ($p_i$) | *US consumer price* ($p_{us}$) |
|---|---|---|---|---|---|
| 1970 | 3.65 | 2.90 | 3.94 | 2.27 | 3.92 |
| 1971 | 3.48 | 3.05 | 4.09 | 2.29 | 4.09 |
| 1972 | 3.19 | 3.22 | 4.21 | 2.29 | 4.22 |
| 1973 | 2.66 | 3.44 | 4.41 | 2.46 | 4.49 |
| 1974 | 2.59 | 3.67 | 5.12 | 3.15 | 4.98 |
| 1975 | 2.46 | 3.89 | 5.56 | 3.21 | 5.43 |
| 1976 | 2.52 | 4.07 | 5.79 | 3.38 | 5.75 |
| 1977 | 2.32 | 4.22 | 5.85 | 3.45 | 6.12 |
| 1978 | 2.01 | 4.33 | 5.85 | 3.33 | 6.59 |
| 1979 | 1.83 | 4.51 | 6.02 | 3.66 | 7.33 |

**Wages, employment and population**

[a] Marks/Reichsmarks/Deutschmarks.
[b] In millions.

| | *Wages*[a] (*w*) | *Employment*[b] (*L*) | *Population*[b] (*PO*) |
|---|---|---|---|
| 1880 | 564 | 19.6 | 45.1 |
| 1881 | 574 | 19.7 | 45.4 |
| 1882 | 579 | 19.9 | 45.7 |
| 1883 | 586 | 20.2 | 46.0 |
| 1884 | 588 | 20.4 | 46.4 |
| 1885 | 593 | 20.6 | 46.7 |
| 1886 | 602 | 21.0 | 47.1 |
| 1887 | 613 | 21.3 | 47.6 |
| 1888 | 632 | 21.6 | 48.2 |
| 1889 | 650 | 22.1 | 48.7 |
| 1890 | 667 | 22.4 | 49.2 |
| 1891 | 681 | 22.5 | 49.8 |
| 1892 | 685 | 22.6 | 50.3 |
| 1893 | 687 | 22.7 | 50.8 |
| 1894 | 692 | 23.1 | 51.3 |
| 1895 | 701 | 23.4 | 52.0 |
| 1896 | 718 | 23.9 | 52.8 |

| | *Wages*[a] *(w)* | *Employment*[b] *(L)* | *Population*[b] *(PO)* |
|---|---|---|---|
| 1897 | 738 | 24.3 | 53.6 |
| 1898 | 763 | 24.7 | 54.4 |
| 1899 | 786 | 25.1 | 55.2 |
| 1900 | 809 | 25.6 | 56.0 |
| 1901 | 815 | 25.6 | 56.9 |
| 1902 | 819 | 25.9 | 57.8 |
| 1903 | 839 | 26.3 | 58.6 |
| 1904 | 860 | 26.8 | 59.5 |
| 1905 | 887 | 27.2 | 60.3 |
| 1906 | 927 | 27.7 | 61.2 |
| 1907 | 968 | 28.2 | 62.0 |
| 1908 | 674 | 28.4 | 62.9 |
| 1909 | 984 | 28.8 | 63.7 |
| 1910 | 1013 | 29.4 | 64.6 |
| 1911 | 1052 | 30.0 | 65.4 |
| 1912 | 1089 | 30.5 | 66.2 |
| 1913 | 1122 | 31.0 | 67.0 |
| 1914 | (1122) | (31.3) | 67.8 |
| 1915 | (1234) | (30.1) | 67.9 |
| 1916 | (1459) | (28.0) | 67.7 |
| 1917 | (1795) | (27.0) | 67.4 |
| 1918 | (2244) | (27.0) | 66.8 |
| 1919 | (3997) | (26.4) | 62.9 |
| 1920 | (6202) | (26.8) | 61.8 |
| 1921 | (9381) | (27.3) | 62.5 |
| 1922 | (48952) | (27.9) | 61.9 |
| 1923 | (7.73E16) | (27.6) | 62.3 |
| 1924 | (1600) | (28.9) | 62.7 |
| 1925 | 1682 | 31.0 | 63.2 |
| 1926 | 1753 | 29.9 | 63.6 |
| 1927 | 1903 | 31.9 | 64.0 |
| 1928 | 2074 | 32.5 | 64.4 |
| 1929 | 2200 | 32.3 | 64.7 |
| 1930 | 2216 | 30.5 | 65.1 |
| 1931 | 2030 | 28.1 | 65.4 |
| 1932 | 1749 | 26.1 | 65.7 |
| 1933 | 1696 | 26.7 | 66.0 |
| 1934 | 1735 | 29.9 | 66.4 |
| 1935 | 1769 | 29.9 | 66.9 |
| 1936 | 1802 | 32.0 | 67.3 |
| 1937 | 1850 | 32.6 | 67.8 |
| 1938 | 1904 | 33.8 | 68.6 |
| 1939 | (1923) | 34.6 | 69.3 |

**Wages, employment and population**

[a] Marks/Reichsmarks/Deutschmarks.
[b] In millions.

| | *Wages*[a] *(w)* | *Employment*[b] *(L)* | *Population*[b] *(PO)* |
|---|---|---|---|
| 1940 | (1894) | 30.7 | 69.8 |
| 1941 | (1938) | 29.6 | 70.2 |
| 1942 | (1996) | 28.3 | 70.8 |
| 1943 | (2025) | 27.4 | 70.4 |
| 1944 | (2054) | 26.2 | 69.9 |
| 1945 | (2520) | 25.7 | 67.6 |
| 1946 | (2593) | 17.9 | 43.3 |
| 1947 | (2753) | 18.3 | 44.7 |
| 1948 | (2958) | 18.8 | 45.7 |
| 1949 | (3019) | 20.0 | 46.5 |
| 1950 | 2966 | 20.5 | 47.1 |
| 1951 | 3380 | 21.2 | 47.5 |
| 1952 | 3686 | 21.5 | 47.7 |
| 1953 | 3915 | 22.0 | 48.2 |
| 1954 | 4101 | 22.6 | 48.7 |
| 1955 | 4373 | 23.6 | 49.2 |
| 1956 | 4754 | 24.2 | 49.8 |
| 1957 | 5029 | 24.7 | 50.5 |
| 1958 | 5358 | 25.0 | 51.1 |
| 1959 | 5632 | 25.2 | 51.7 |
| 1960 | 6171 | 25.6 | 55.4 |
| 1961 | 6800 | 26.0 | 56.2 |
| 1962 | 7609 | 26.1 | 56.8 |
| 1963 | 8178 | 26.1 | 57.4 |
| 1964 | 8837 | 26.1 | 58.0 |
| 1965 | 9706 | 26.3 | 58.6 |
| 1966 | 10365 | 26.2 | 59.2 |
| 1967 | 10695 | 25.3 | 59.3 |
| 1968 | 11144 | 25.4 | 59.5 |
| 1969 | 12163 | 25.7 | 60.1 |
| 1970 | 13960 | 26.0 | 60.7 |
| 1971 | 15488 | 26.1 | 61.3 |
| 1972 | 16866 | 26.0 | 61.7 |
| 1973 | 18604 | 26.1 | 62.0 |
| 1974 | 20521 | 25.6 | 62.1 |
| 1975 | 22019 | 24.7 | 61.8 |
| 1976 | 23420 | 24.5 | 61.5 |
| 1977 | 25088 | 24.5 | 61.4 |
| 1978 | 26429 | 24.6 | 61.3 |
| 1979 | 27949 | 25.0 | 61.3 |

**Central government debt and short term interest rate**

[a] In millions of Marks/Reichsmarks/Deutschmarks
[b] per cent per year

| | *Central government debt*[a] *(GD)* | *private short-term interest rate*[b] *(r)* |
|---|---|---|
| 1880 | 308 | 3.04 |
| 1881 | 336 | 3.50 |
| 1882 | 349 | 3.89 |
| 1883 | 395 | 3.08 |
| 1884 | 445 | 2.90 |
| 1885 | 484 | 2.85 |
| 1886 | 540 | 2.16 |
| 1887 | 721 | 2.30 |
| 1888 | 884 | 2.11 |
| 1889 | 1118 | 2.63 |
| 1890 | 1318 | 3.78 |
| 1891 | 1686 | 3.02 |
| 1892 | 1741 | 1.80 |
| 1893 | 1916 | 3.17 |
| 1894 | 2081 | 1.74 |
| 1895 | 2125 | 2.01 |
| 1896 | 2141 | 3.04 |
| 1897 | 2208 | 3.08 |
| 1898 | 2223 | 3.55 |
| 1899 | 2309 | 4.65 |
| 1900 | 2503 | 4.41 |
| 1901 | 2826 | 3.06 |
| 1902 | 2995 | 2.19 |
| 1903 | 3227 | 3.01 |
| 1904 | 3523 | 3.14 |
| 1905 | 3818 | 2.85 |
| 1906 | 4127 | 4.04 |
| 1907 | 4352 | 5.12 |
| 1908 | 4847 | 3.52 |
| 1909 | 5140 | 2.87 |
| 1910 | 4910 | 3.54 |
| 1911 | 4904 | 3.54 |
| 1912 | 4807 | 4.22 |
| 1913 | 5202 | 4.98 |
| 1914 | 16715 | 2.84 |
| 1915 | 39496 | (28.00) |
| 1916 | 68877 | (26.80) |

**Central government debt and short term interest rate**

[a] In millions of Marks/Reichsmarks/Deutschmarks
[b] per cent per year

| | *Central government debt*[a] *(GD)* | *private short-term interest rate*[b] *(r)* |
|---|---|---|
| 1917 | 104945 | (20.30) |
| 1918 | 156092 | (29.10) |
| 1919 | 199728 | (40.80) |
| 1920 | 263543 | (65.60) |
| 1921 | 352204 | (19.70) |
| 1922 | 6675048 | (222.00) |
| 1923 | 1.96E15 | (2067.9) |
| 1924 | 2703 | (12.00) |
| 1925 | 7141 | 7.62 |
| 1926 | 7300 | 4.92 |
| 1927 | 7131 | 5.49 |
| 1928 | 8229 | 6.53 |
| 1929 | 9630 | 6.87 |
| 1930 | 11342 | 4.43 |
| 1931 | 11434 | 6.78 |
| 1932 | 11690 | 4.95 |
| 1933 | 11793 | 3.88 |
| 1934 | 12452 | 3.77 |
| 1935 | 14372 | 3.15 |
| 1936 | 16058 | 2.96 |
| 1937 | 19098 | 2.91 |
| 1938 | 30676 | 2.88 |
| 1939 | 47889 | 2.77 |
| 1940 | 85935 | 2.36 |
| 1941 | 137629 | 2.18 |
| 1942 | 195554 | 2.13 |
| 1943 | 273354 | 2.13 |
| 1944 | 379800 | 2.13 |
| 1945 | (387334) | (2.13) |
| 1946 | (222717) | (2.80) |
| 1947 | (58100) | (5.90) |
| 1948 | (5810) | (5.00) |
| 1949 | (6550) | 5.47 |
| 1950 | 7290 | 5.36 |
| 1951 | 8220 | 7.00 |

| | *Central government debt*[a] *(GD)* | *private short-term interest rate*[b] *(r)* |
|---|---|---|
| 1952 | 8897 | 6.23 |
| 1953 | 16726 | 4.73 |
| 1954 | 17894 | 4.19 |
| 1955 | 17908 | 4.20 |
| 1956 | 17706 | 5.77 |
| 1957 | 19985 | 5.37 |
| 1958 | 20464 | 4.27 |
| 1959 | 21528 | 4.03 |
| 1960 | 23149 | 5.98 |
| 1961 | 26469 | 2.81 |
| 1962 | 27673 | 2.69 |
| 1963 | 30534 | 2.86 |
| 1964 | 32028 | 2.90 |
| 1965 | 33703 | 3.60 |
| 1966 | 36338 | 4.79 |
| 1967 | 44467 | 3.32 |
| 1968 | 48439 | 2.80 |
| 1969 | 47122 | 4.46 |
| 1970 | 49689 | 7.11 |
| 1971 | 51511 | 5.26 |
| 1972 | 55299 | 3.51 |
| 1973 | 61356 | 6.66 |
| 1974 | 72138 | 7.88 |
| 1975 | 108500 | 4.40 |
| 1976 | 128450 | 3.90 |
| 1977 | 150150 | 4.10 |
| 1978 | 177520 | 3.40 |
| 1979 | 202630 | 5.90 |

## Current account

(in millions of Marks/Reichsmarks/Deutschmarks.)

| | *Current account deficit. (CA)* | *Export of goods. (X)* | *Import of goods. (I)* |
|---|---|---|---|
| 1880 | 288 | 2976 | 2844 |
| 1881 | 357 | 3095 | 2990 |
| 1882 | 455 | 3280 | 3134 |

**Current account**

(in millions of Marks/Reichsmarks/Deutschmarks.)

| | *Current account deficit. (CA)* | *Export of goods. (X)* | *Import of goods. (I)* |
|---|---|---|---|
| 1883 | 263 | 3324 | 3248 |
| 1884 | 489 | 3256 | 3261 |
| 1885 | 507 | 2912 | 2976 |
| 1886 | 486 | 3041 | 2941 |
| 1887 | 431 | 3193 | 3186 |
| 1888 | 686 | 3356 | 3429 |
| 1889 | 590 | 3257 | 4088 |
| 1890 | 430 | 3410 | 4273 |
| 1891 | 334 | 3340 | 4404 |
| 1892 | 185 | 3150 | 4228 |
| 1893 | 361 | 3245 | 4134 |
| 1894 | 641 | 3052 | 4285 |
| 1895 | 337 | 3424 | 4246 |
| 1896 | 590 | 3754 | 4558 |
| 1897 | 666 | 3786 | 4865 |
| 1898 | 815 | 4011 | 5440 |
| 1899 | 374 | 4368 | 5784 |
| 1900 | 411 | 4752 | 6043 |
| 1901 | 418 | 4512 | 5710 |
| 1902 | 494 | 4813 | 5806 |
| 1903 | 444 | 5131 | 6321 |
| 1904 | 639 | 5316 | 6854 |
| 1905 | 1305 | 5842 | 7436 |
| 1906 | 518 | 6479 | 8439 |
| 1907 | 156 | 7095 | 9001 |
| 1908 | 557 | 6481 | 8078 |
| 1909 | 417 | 6859 | 8861 |
| 1910 | 752 | 7645 | 9310 |
| 1911 | 643 | 8224 | 10007 |
| 1912 | 453 | 9100 | 11018 |
| 1913 | 939 | 10198 | 11206 |
| 1914 | (–1477) | (6432) | (7909) |
| 1915 | (–2482) | (2689) | (5171) |
| 1916 | (–3162) | (3426) | (6588) |
| 1917 | (–3834) | (4154) | (7988) |
| 1918 | (–4866) | (5271) | (10137) |
| 1919 | (–22519) | (10057) | (32576) |

| | *Current account deficit. (CA)* | *Export of goods. (X)* | *Import of goods. (I)* |
|---|---|---|---|
| 1920 | (–22598) | (69703) | (99077) |
| 1921 | (–122797) | (119268) | (144917) |
| 1922 | (–355267) | (3052332) | (3633139) |
| 1923 | (–2.57E14) | (8.81E14) | (1.01E15) |
| 1924 | –1383 | (7810) | 9626 |
| 1925 | –1988 | 9545 | 11990 |
| 1926 | 1152 | 10677 | 9884 |
| 1927 | –2660 | 11118 | 14078 |
| 1928 | –1202 | 12627 | 13939 |
| 1929 | –132 | 13632 | 13676 |
| 1930 | 1096 | 12175 | 10617 |
| 1931 | 2028 | 9733 | 6955 |
| 1932 | 417 | 5834 | 4782 |
| 1933 | 281 | 4957 | 4291 |
| 1934 | –534 | 4240 | 4613 |
| 1935 | –107 | 4335 | 4343 |
| 1936 | 400 | 4871 | 4330 |
| 1937 | 290 | 6069 | 5617 |
| 1938 | –340 | 5863 | 6208 |
| 1939 | 410 | 5771 | 5361 |
| 1940 | (–54) | 4976 | 5030 |
| 1941 | (97) | 7040 | 6943 |
| 1942 | (–793) | 7895 | 8689 |
| 1943 | (330) | 8588 | 8258 |
| 1944 | (–175) | (2205) | (2380) |
| 1945 | (–296) | (1680) | (1976) |
| 1946 | (–985) | (400) | 1385 |
| 1947 | –1235 | 800 | 2063 |
| 1948 | –2737 | 2151 | 5223 |
| 1949 | –3665 | 4136 | 7846 |
| 1950 | –1170 | 8362 | 11334 |
| 1951 | 2270 | 14557 | 14726 |
| 1952 | 3420 | 16909 | 16203 |
| 1953 | 5460 | 18526 | 16010 |
| 1954 | 5290 | 22035 | 19337 |
| 1955 | 4180 | 25717 | 24472 |
| 1956 | 6610 | 30861 | 27964 |
| 1957 | 8730 | 35968 | 31885 |
| 1958 | 8840 | 36998 | 32044 |
| 1959 | 8460 | 41184 | 35823 |

**Current account.**

(in millions of Marks/Reichsmarks/Deutschmarks.)

| | *Current account deficit. (CA)* | *Export of goods. (X)* | *Import of goods. (I)* |
|---|---|---|---|
| 1960 | 7900 | 47946 | 42723 |
| 1961 | 7100 | 50978 | 44363 |
| 1962 | 4300 | 52975 | 49498 |
| 1963 | 5600 | 58309 | 52277 |
| 1964 | 5900 | 64920 | 58839 |
| 1965 | 300 | 71651 | 70448 |
| 1966 | 7400 | 80628 | 72670 |
| 1967 | 17300 | 87045 | 70183 |
| 1968 | 19800 | 99551 | 81179 |
| 1969 | 17600 | 113557 | 97973 |
| 1970 | 14300 | 125276 | 109606 |
| 1971 | 15500 | 136000 | 120119 |
| 1972 | 18400 | 149022 | 128744 |
| 1973 | 28800 | 178396 | 145417 |
| 1974 | 43400 | 230578 | 179732 |
| 1975 | 29000 | 221590 | 184312 |
| 1976 | 28600 | 256641 | 222172 |
| 1977 | 29500 | 273614 | 235178 |
| 1978 | 37300 | 284907 | 243706 |
| 1979 | 12400 | 314622 | 291160 |

**US variables**

[a] In billions of 1913 dollars.
[b] Per cent per year.

| | *Real gross domestic product*[a] $(y_{us})$ | *Long-term interest rate*[b] $(r_{us})$ | *Unit values of exports (1913 = 1)* $(p_{xs})$ |
|---|---|---|---|
| 1880 | 31.4 | 5.60 | 1.02 |
| 1881 | 33.8 | 5.19 | 1.04 |
| 1882 | 34.6 | 5.24 | 1.07 |
| 1883 | 35.7 | 5.23 | 1.01 |
| 1884 | 36.9 | 5.15 | 0.98 |

| | *Real gross domestic product*[a] ($y_{us}$) | *Long-term interest rate*[b] ($r_{us}$) | *Unit values of exports (1913 = 1)* ($p_{xs}$) |
|---|---|---|---|
| 1885 | 38.3 | 4.89 | 0.91 |
| 1886 | 39.0 | 4.55 | 0.86 |
| 1887 | 39.8 | 4.65 | 0.86 |
| 1888 | 41.2 | 4.59 | 0.90 |
| 1889 | 49.1 | 4.43 | 0.86 |
| 1890 | 52.7 | 4.55 | 0.85 |
| 1891 | 55.1 | 4.71 | 0.88 |
| 1892 | 60.4 | 4.53 | 0.82 |
| 1893 | 57.5 | 4.65 | 0.80 |
| 1894 | 55.9 | 4.41 | 0.71 |
| 1895 | 62.6 | 4.27 | 0.72 |
| 1896 | 61.3 | 4.34 | 0.71 |
| 1897 | 67.1 | 4.11 | 0.69 |
| 1898 | 68.6 | 4.03 | 0.68 |
| 1899 | 74.8 | 3.85 | 0.72 |
| 1900 | 76.9 | 3.89 | 0.81 |
| 1901 | 85.7 | 3.83 | 0.79 |
| 1902 | 86.5 | 3.84 | 0.81 |
| 1903 | 90.8 | 4.03 | 0.87 |
| 1904 | 89.7 | 3.98 | 0.87 |
| 1905 | 96.3 | 3.89 | 0.84 |
| 1906 | 107.5 | 4.00 | 0.90 |
| 1907 | 109.2 | 4.27 | 0.95 |
| 1908 | 100.2 | 4.22 | 0.90 |
| 1909 | 116.8 | 4.07 | 0.94 |
| 1910 | 120.1 | 4.18 | 1.02 |
| 1911 | 123.2 | 4.19 | 0.94 |
| 1912 | 130.2 | 4.23 | 0.96 |
| 1913 | 131.4 | 4.44 | 1.00 |
| 1914 | 125.6 | 4.44 | 0.98 |
| 1915 | 124.5 | 4.62 | 1.05 |
| 1916 | 134.3 | 4.49 | 1.36 |
| 1917 | 135.2 | 4.79 | 1.77 |
| 1918 | 151.8 | 5.23 | 2.06 |
| 1919 | 146.4 | 5.49 | 2.16 |
| 1920 | 140.0 | 6.12 | 2.33 |
| 1921 | 127.8 | 5.97 | 2.58 |
| 1922 | 148.0 | 5.10 | 1.45 |
| 1923 | 165.9 | 5.12 | 1.56 |

**US variables**

[a] In billions of 1913 dollars.
[b] Per cent per year.

| | *Real gross domestic product*[a] ($y_{us}$) | *Long-term interest rate*[b] ($r_{us}$) | *Unit values of exports (1913 = 1)* ($p_{xs}$) |
|---|---|---|---|
| 1924 | 165.5 | 5.00 | 1.53 |
| 1925 | 179.4 | 4.88 | 1.54 |
| 1926 | 190.0 | 4.73 | 1.42 |
| 1927 | 189.8 | 4.57 | 1.33 |
| 1928 | 190.9 | 4.55 | 1.36 |
| 1929 | 203.6 | 4.73 | 1.34 |
| 1930 | 183.5 | 4.55 | 1.20 |
| 1931 | 169.3 | 4.58 | 0.93 |
| 1932 | 144.2 | 5.01 | 0.79 |
| 1933 | 141.5 | 4.49 | 0.83 |
| 1934 | 154.3 | 4.00 | 0.97 |
| 1935 | 169.5 | 3.60 | 1.00 |
| 1936 | 193.0 | 3.24 | 1.02 |
| 1937 | 203.2 | 3.26 | 1.08 |
| 1938 | 192.9 | 3.19 | 1.00 |
| 1939 | 209.4 | 3.01 | 0.99 |
| 1940 | 227.2 | 2.84 | 1.05 |
| 1941 | 263.7 | 2.77 | 1.13 |
| 1942 | 297.8 | 2.83 | 1.37 |
| 1943 | 337.1 | 2.73 | 1.51 |
| 1944 | 361.3 | 2.72 | 1.73 |
| 1945 | 355.2 | 2.62 | 1.73 |
| 1946 | 312.6 | 2.53 | 1.64 |
| 1947 | 309.9 | 2.61 | 1.95 |
| 1948 | 323.7 | 2.82 | 2.07 |
| 1949 | 324.1 | 2.66 | 1.93 |
| 1950 | 355.3 | 2.62 | 1.87 |
| 1951 | 383.4 | 2.86 | 2.13 |
| 1952 | 395.1 | 2.96 | 2.13 |
| 1953 | 412.8 | 3.20 | 2.12 |
| 1954 | 407.0 | 2.90 | 2.08 |
| 1955 | 438.0 | 3.06 | 2.12 |
| 1956 | 446.1 | 3.36 | 2.19 |
| 1957 | 452.5 | 3.89 | 2.27 |

| | *Real gross domestic product*[a] ($y_{us}$) | *Long-term interest rate*[b] ($r_{us}$) | *Unit values of exports (1913 = 1)* ($p_{xs}$) |
|---|---|---|---|
| 1958 | 447.3 | 3.79 | 2.25 |
| 1959 | 475.9 | 4.38 | 2.25 |
| 1960 | 487.7 | 4.41 | 2.26 |
| 1961 | 497.2 | 4.35 | 2.31 |
| 1962 | 529.8 | 4.33 | 2.29 |
| 1963 | 551.0 | 4.26 | 2.29 |
| 1964 | 581.1 | 4.40 | 2.31 |
| 1965 | 617.8 | 4.49 | 2.39 |
| 1966 | 658.1 | 5.13 | 2.46 |
| 1967 | 675.2 | 5.31 | 2.51 |
| 1968 | 706.6 | 6.18 | 2.54 |
| 1969 | 725.6 | 7.03 | 2.63 |
| 1970 | 722.5 | 8.04 | 2.77 |
| 1971 | 744.1 | 7.39 | 2.87 |
| 1972 | 786.8 | 7.21 | 2.95 |
| 1973 | 829.8 | 7.44 | 3.44 |
| 1974 | 818.2 | 8.57 | 4.37 |
| 1975 | 807.8 | 8.83 | 4.89 |
| 1976 | 855.3 | 8.43 | 5.07 |
| 1977 | 900.6 | 8.02 | 5.27 |
| 1978 | 940.1 | 8.73 | 5.64 |
| 1979 | 961.9 | 9.63 | 6.59 |

# Appendix 3 The Conflict between the Reichsbank and Hitler in Early 1939

In January 1939, a conflict arose between the Reichsbank, whose President was Hylmar Schacht, and the political leadership of the country over the excessive growth of government expenditure and its short-term financing. A letter signed by all the members of the Board of the Reichsbank was sent to Hitler on 7 January 1939. Our translation of the letter is reproduced here as follows:

Berlin, January 7th 1939

The President of the
Board of Governors

*Confidential matter of the Reichsbank*

To the Führer and Reichskanzler
*BERLIN*

The Reichsbank has been pointing out for some time the dangers for monetary stability arising from excesses in short term credit and public expenditures. As of the end of 1938 the financial situation of the country has reached a *state of danger*, which makes it our duty to ask for the introduction of measures to bring the threatening inflation under control.

Monetary stability is threatened by the policy of unconstrained public sector expenditure. The unlimited *growth in central government expenditures* undermines any attempt to achieve an orderly state, brings the state finances to the edge of collapse, despite increases in tax revenues, and consequently weakens the central bank and monetary stability. There are no ingenious or well-conceived recipes or financial and monetary techniques, no measures of control, which could be effective enough to stop the devastating effects on monetary stability of such expenditure policy. *No monetary authority is in a position to maintain monetary stability in the presence of such an inflationary public expenditure policy.*

During the major operations in the Ostmark and in the Sudetenland, government expenditures necessarily increased. However after the end of these actions there appears to be no evidence of restraints in expenditures, and on the contrary there is every indication that a *further increase in expenditures* is planned. It is now our duty to point out the consequences of these policies for monetary stability.

Although it is not our duty to indicate to what extent an unchecked expenditure policy can be reconciled with the development of output and

saving of the German economy or with the social needs of the population, it is our responsibility to make it clear that a further recourse to the Reichsbank either directly or by means of other forms of intervention in the money market is not justifiable from the point of view of a responsible monetary policy. The undersigned board of governors of the Reichsbank is aware that so far it has willingly cooperated to achieve the 'great goals'. However a stop is now due. An increase in the production of goods cannot be brought about by an increase in money. With the increase in money one brings about an increase in prices and wages, but not in output, particularly in view of the full or overfull employment conditions of the German economy.

We are convinced that the negative consequences for monetary stability of the policy of the last 10 months can be avoided and that the inflation problem can be solved with a most rigid containment of public expenditures. The Führer and Reichskanzler himself, has repeatedly condemned inflation. We therefore request that the following measures be taken:

1. The central government and all other public bodies should not be allowed to spend or to take committments or guarantees without coverage from tax revenues or long-term capital which can be raised by bond issues without disturbing long-term capital markets.
2. In order to carry out effectively the above measures, the Minister of Finance should obtain the full financial control of all public expenditures.
3. The price and wage controls should be made more effective. The loopholes which have arisen should be eliminated.
4. The recourse to the money and capital markets should be submitted to the sole approval of the Reichsbank.

The board of Governors of the Reichsbank.
*Signed* by Hylmar Schacht and all other members of the Board.

In the years 1933 to 1937 Schacht, President of the Board of Directors of the Reichsbank, had supported the expansionary public expenditure policies in view of the high unemployment rate and the very low capacity utilization of the German economy. However, with the attainment of full employment around 1938, Schacht started to dissociate himself from the highly expansionary policies of the German government, which contradicted the objective of monetary stability. This document indicates also that moderate elements, who had initially supported the Nazi regime, dissociated themselves from it at the time of the strong increase in military expenditure and of the most aggressive phase of German foreign policy, which eventually led the German nation to the disaster. The harsh tone of the letter reflects in our view the opposition of the Board of Directors of the Reichsbank to the overall policies of the regime. On the day after the sending of the letter the whole board was compelled to resign.

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