

Currency Competition and Foreign Exchange Markets

The Dollar, the Yen and the Euro

Currency Competition and Foreign Exchange markets by Philipp Hartmann is a major new theoretical and empirical study of international currencies, which focuses on the role which the euro (the future single European currency) will play, along with the US dollar and the Japanese yen, in the international monetary and financial system.

In contrast with much of the existing literature, which approaches the subject from a macroeconomic perspective, Hartmann develops theoretical and empirical models which use game theory, time series and panel econometrics, and link financial market micro-structure analysis with transaction cost economics. The results of *Currency Competition and Foreign Exchange Markets* are presented with reference to political, historical and institutional considerations, and provide accessible answers for policy-makers, business people and scholars world-wide. The sections on spread estimation and multiple vehicles with inter-dealer price and entry competition will be of particular use for finance professionals.

is an economist at the European Central Bank in Frankfurt. He formerly worked in the Financial Markets Group at the London School of Economics. He is widely regarded as one of the leading young economists in Europe, and his work has been featured on BBC Radio 4 (UK) and in publications including *Le Figaro* (France), *The Wall Street Journal* and the *Frankfurter Allgemeine Zeitung – Blick durch die Wirtschaft* (Germany). His previous writings include the monograph *Financial Regulation: Why, How and Where Now?* (with Professor Charles Goodhart *et al.*) and numerous articles published in leading academic and policy journals.

Currency Competition and Foreign Exchange Markets

The Dollar, the Yen and the Euro

Philipp Hartmann



CAMBRIDGE
UNIVERSITY PRESS

The Pitt Building, Trumpington Street, Cambridge CB2 1RP, United Kingdom

The Edinburgh Building, Cambridge, CB2 2RU, United Kingdom

<http://www.cup.cam.ac.uk>

40 West 20th Street, New York, NY 10011-4211, USA <http://www.cup.org>

10 Stamford Road, Oakleigh, Melbourne 3166, Australia

© Philipp Hartmann 1998

This book is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published 1998

Printed in the United Kingdom at the University Press, Cambridge

Typeset in 10/12pt Times []

A catalogue record for this book is available from the British Library

Library of Congress Cataloguing in Publication data

Hartmann, Philipp.

Currency competition and foreign exchange markets : the dollar, the yen and the future international role of the Euro / Philipp Hartmann.

p. cm.

Includes bibliographical references.

ISBN 0 521 63273 0 (hbk.)

1. European currency unit. 2. Euro-dollar market. 3. Currency question.

4. Monetary unions – European Union countries. I. Title.

HG925.H367 1998

332.4'56–dc21 98–36046 CIP

ISBN 0 521 63273 0 hardback

Contents

<i>List of figures</i>	<i>page</i> vii
<i>List of tables</i>	viii
<i>Preface and acknowledgements</i>	xi
1 Introduction	1
1.1 Importance of currency internationalization and European Monetary Union	2
1.2 Pivotal role of forex markets	5
1.3 Overview of the book	7
2 National and international money: a survey	11
2.1 Functions of international money	12
2.2 Theories of international money	19
2.3 A brief history of international money	29
3 A theory of vehicle currencies	40
3.1 Introduction	40
3.2 Transaction costs in the forex market	42
3.3 Structures of currency exchange	48
3.4 Conclusions	64
Appendix: multiple vehicles with inter-dealer price and entry competition	66
4 Currency competition between the euro, the dollar and the yen	76
4.1 Introduction	76
4.2 The emergence of the Deutsche mark as a forex vehicle currency and the 'simple arithmetics' of EMU	80
4.3 EMU and forex markets	89
4.4 EMU and foreign trade invoicing	97
4.5 EMU and official reserve holdings	114
4.6 EMU, international investment and the evolution of European financial markets	117
4.7 Conclusions	129

5	Trading volumes and transaction costs: from the short run to the long run	132
5.1	Introduction	132
5.2	Spread theory refined	134
5.3	A survey of spread estimations	137
5.4	Spreads and volumes in the short run: a time-series approach	145
5.5	Spreads and volumes in the long run: a panel-data approach	152
5.6	Conclusions	162
6	General conclusions	164
6.1	International monetary and financial policies	165
6.2	Theory of international money	167
6.3	Forex market micro-structure analysis	168
	<i>Bibliography</i>	170
	<i>Index</i>	189

Figures

2.1	‘Forex barter’ in the interbank market	<i>page</i> 16
2.2	‘Full monetization’ of the forex market through a single forex vehicle (the US dollar)	17
3.1	Determination of the short-run wholesale exchange rate	46
3.2	Small forex market with two vehicle currencies	60
3.3	Krugman’s (1984) ‘bipolar structure of exchange’	61
3.4	Strictly bipolar forex market	61
3.5	Strictly tripolar forex market	62
3A.1	Example 1 – full monetization with a single vehicle currency (‘monopoly money’)	72
3A.2	Example 2 – strictly bipolar (‘non-hierarchical’) exchange structure	73
3A.3	Example 3 – weakly bipolar (‘hierarchical’) exchange structure	74
4.1	Structure of exchange in the interbank forex market from the 1960s to the mid-1980s	81
4.2	Current (weakly bipolar) exchange structure in the spot interbank forex market	85
4.3	Hypothetical new (bipolar) equilibrium exchange structure in the spot interbank forex market after EMU	94

Tables

1.1	Turnover comparison of different markets, 1995	<i>page</i> 6
2.1	Functions of international money	14
2.2	Estimated shares of trade invoicing in world trade, 1980–92	36
4.1	The EU, the USA and Japan in the world economy, 1991–6	78
4.2	Regional roles of dollar and mark in spot forex trading, 1992	83
4.3	Level and currency composition of spot forex trading volume before and after EMU, 1995 data	91
4.4	Estimated trade invoicing in major currencies before and after EMU, 1992 data	101
4.5	Scenarios of euro invoicing after EMU	103
4.6	Development of manufactured goods trade among industrial countries (excluding intra-EU trade), 1980–93	106
4.7	Development of industrial countries' trade with developing countries, 1980–93	106
4.8	Development of developing and transition countries' intra-regional trade as compared to that of world trade, 1980–93	107
4.9	Development of industrial countries' trade with Asia (excluding Middle East), 1980–93	109
4.10	Development of industrial countries' trade with South and Central American developing countries, 1980–93	109
4.11	Development of industrial countries' trade with Central and Eastern Europe (including countries of the former USSR), 1980–93	110
4.12	Global reserve currency composition before and after EMU, 1995 data	115
5.1	The eight largest forex markets, April 1992	139
5.2	ARIMA(9,1,1) model estimation for log volumes	147
5.3	GARCH(1,1) estimation for log returns	147
5.4	Spread model estimations with decomposed volumes	150

5.5	Panel estimations of the relationship between spreads, volumes and volatilities	157
5.6	Analysis of covariance for spread estimations	159
5.7	Panel estimations of the relationship between spreads, ticks and volatilities	161

Preface and acknowledgements

When I started working on international currencies in 1992 the Maastricht Treaty, establishing a concrete timetable for the completion of European Economic and Monetary Union (EMU), had just been signed. Many citizens, economists, journalists and politicians, in particular in the United States but also in Europe, remained sceptical whether such an ambitious project would ever go ahead, and most people pondered what the internal consequences for Europe would be and whether EMU was really such a good idea. In this situation, only a limited number of people, most of them within or close to the European Commission, found it worthwhile to think about 'great ideas', such as the external role of the single currency and its future competition with the US dollar. Fascinated by the idea of 'getting under the skin' of the workings of the world monetary and financial system, I began to wonder whether I could tackle this issue with modern economic analysis.

It was at that time that I met Richard Portes, who was one of the few academics recognizing the political determination in Europe to bring EMU into being and who was prepared to make 'the great leap forward' necessary to think about the implications for the international monetary order. He encouraged me to start a long-horizon theoretical and empirical research programme on the determinants of international currencies in general, which could alleviate the lack of rigorous analysis in this field and also satisfy a great deal of demand once the introduction of the single currency was imminent. The time has now come; when this book is available in bookstores the introduction of the euro will only be a couple of months away. The book is the synthesis of my work in this area over the last couple of years: however speculative the predictions in the applied parts may sound to some readers, I hope that it helps reduce the uncertainty and confusion about what the likely consequences of EMU will be for the international monetary and financial system.

The first person I would like to thank is Richard Portes, who – since Summer 1992 in Paris – followed my work in this area closely and did not spare suggestions, criticism and support for my projects. Most of the

work was done while I was on the staff of DELTA (Ecole Normale Supérieure, Paris) and of the London School of Economics' Financial Markets Group (FMG). I would like to express my gratitude to Roger Guesnerie and François Bourguignon, and David Webb and Charles Goodhart as well as to my other colleagues from DELTA and the FMG for the stimulating research environments they provided. Financial support by the EU Commission's Human Capital and Mobility Programme and by the UK's Economic and Social Research Council (ESRC) is gratefully acknowledged.

Among the other researchers who have expressed an interest in the various projects contained in this book I would like to mention explicitly Christian de Boissieu (Université Paris I, Panthéon-Sorbonne), Bernard Dumas (HEC), Jürgen von Hagen (Bonn University), Torsten Hens (Bielefeld University) and Charles Wyplosz (University of Geneva), who with their suggestions and criticism have helped improve substantially some of the more technical aspects. I have also greatly benefited from discussions with Roel Beetsma and Peter Schotman at Limburg University; Stanley Black at the University of North Carolina; Marc Flandreau at OFCE; Rüdiger Frey at ETH, Zurich; Paul de Grauwe at Leuven University; Dominique Guillaume at Oxford University; Nobuhiro Kiyotaki at the University of Minnesota; Michael Leahy and Shang-Jin Wei at Harvard University; Ward Brown, Charles Goodhart, Asbjørn Hansen and Richard Payne at LSE; Guillermo Larraín, Thierry Magnac, Mathilde Maurel, Georges de Ménil, Nathalie Picard, Gilles St Paul and Bertrand Villeneuve at DELTA; Alvaro Almeida, Peter Clarke, Peter Quirk, George Tavlas and Jens Weidmann at the IMF; Michel Dacorogna, Rakhil Davé, Ueli Müller and Richard Olsen at Olsen & Associates; Ann Fremault-Vila and Dirk Schoenmaker at the Bank of England. Another indispensable input were the discussions I had with market economists and traders, in particular Francis Breedon of Lehman Brothers, Jean-Christophe Doittau of Compagnie Bancaire, Michael Feeney of Sumitomo and Dirk Wegener of Citibank.

Some sections of chapter 4 were first presented at the Centre for European Policy Studies' (CEPS) working party on 'The Passage to the Euro' (May 1996); I am grateful to the Chairman, Helmut Schlesinger, and the two Rapporteurs, Daniel Gros and Karel Lannoo, for having given me this opportunity and to all the working party members for a lively debate on this occasion. Parts of the book have also been presented at academic conferences and seminars too numerous to list in this Preface.

For the empirical parts of the book I had to gather a substantial amount of very specific data. Without the extraordinary cooperation of

Olsen & Associates and a large number of central banks this would never have been possible. It is therefore a pleasure to mention the hospitality of Olsen & Associates in Zurich, where I spent one month in the research group. In particular, Rakhal Davé assisted me generously in the use of Olsen & Associates' high-frequency foreign exchange data bases. Thanks go also to Ashwin Rattan of Cambridge University Press, who has taken so much care of the manuscript. Last but not least, my readers and I owe a lot to the anonymous subway driver who found my notebook and diskette with the complete manuscript of the book.

The manuscript was finalized while I was on the staff of the London School of Economics' Financial Markets Group. Any views expressed are solely my own.

London, September 1997

1 Introduction

The world today is dominated by the US dollar ... This structural imbalance in the international monetary system is a factor of instability. I see advantages in not living in a dollar-dominated world.

(Yves-Thibault de Silguy, 1997)

The international role of the euro is the hidden agenda of Europe's long-planned adoption of a single currency.

(Charles Wyplosz, 1997)

This book studies the phenomenon of international currencies, from both a theoretical and an empirical perspective, and applies the results in order to give an answer to the question: 'what role will the euro, the future single European currency, play in the international monetary and financial system *when competing with the US dollar and the Japanese yen* after its introduction, scheduled for January 1999?' An 'international currency' is a currency which fulfils one or several of the classical money functions – medium of exchange, store of value and unit of account – for non-nationals or non-residents of the issuing country, be they private or public agents. 'International currency competition' refers to the process determining to what extent various national currencies are employed by non-residents. With respect to the euro, the issuing 'country' is the sum of all European Union (EU) countries joining European Monetary Union (EMU). 'Euro internationalization' refers only to the acceptance of the single European currency by non-EMU-area residents, since there will not be any genuinely competing alternative currency within the EMU zone.

The intention of my project is twofold: on the one hand, I hope to make an academic contribution to an area which, in my view, has been considerably under-researched. Two out of six chapters (chapters 3 and 5) are analytical, using the quantitative theoretical and empirical tools of modern economics and finance – game theory, time series and panel econometrics – to throw some light on the key mechanisms at work determining which national currencies achieve an important international role. In contrast to most of the previous analytical academic literature,

which usually takes a macroeconomic perspective, my approach links financial market – in particular foreign exchange (forex) market – micro-structure analysis with transaction cost economics. In chapters 2 and 4 I apply the analytical results and provide an additional empirical, historical and institutional dimension in order to answer more practical and policy-relevant questions of international currency use. Now that EMU is imminent, there is tremendous demand by government officials and business men and women to know the impact the euro will have on the international monetary and financial system. For the purpose of motivating what follows in the main body of the book I proceed in reverse order, starting with the policy questions.

1.1 Importance of currency internationalization and European Monetary Union

The extent with which national currencies in general and the euro in particular are used in the international sphere after 1999 is of major importance, for both the global community and for the specific issuing country. The more important is a country's national currency for cross-border or completely foreign transactions the stronger the impact of exogenous domestic shocks as well as the monetary and exchange rate policies of that country on other countries. The issuer of a large international currency will therefore have to be a major player in international policy coordination: in other words, a large international currency gives a country a lot of political power in international monetary relations, with substantial geopolitical consequences. In modern history a dominant international currency has often been the expression of, or even one of the driving forces behind, political and/or economic world leadership, as was the case for the British pound during the nineteenth century and for the US dollar after the Second World War.

Beyond the political sphere the internationalization of a currency has substantial consequences for internationally active businesses, which are the transmitters of this internationalization. Transnational corporations, for example, may find it more cost-effective to base their internal accounting on the dominant international currency instead of their home currency at headquarters. Banks and non-bank financial institutions offering financial services internationally will face increased demand for products in internationalized currencies, requiring them to develop expertise and operations in the respective financial markets (be they domestic or off-shore ('euro') markets). Of course, this increased demand will also feed back into domestic financial markets of the country issuing an international currency, enhancing their size and liquidity. In case of a

virtual regime shift – say, from one dominant international currency to another or from a one-currency to a two-currency system – private payments and settlements systems will have to be adjusted to the new monetary order. Similarly, the pricing practices and hedging needs of international traders of homogeneous primary goods, which are usually priced and settled in the dominant international currency, may change substantially.

It can also be argued that banks and other financial institutions have an advantage in dealing with products denominated in their home currency, be it through more experience with domestic macroeconomic policies, the legal and regulatory environment, better knowledge of the functioning and organization of the local securities and banking markets, long-standing relationships with an important domestic end-investor base, or easier access to the domestic payments and settlements systems. In this sense, banks from a country issuing a dominant international currency start with an advantage *vis-à-vis* their foreign competitors. While it might be objected that these competitive advantages should not play an important role among the truly global players operating in practically all important financial centres, the evidence is in favour of home currency advantage.¹

Since the Second World War the US dollar has been the dominant international currency, a situation ratified rather than caused by the Bretton Woods system of fixed exchange rates – built around it. A gradual diversification out of dollar into mainly Deutsche mark and Japanese yen since the unravelling of the post-war monetary order in the early 1970s came to a halt since the early 1990s and, in any case, never seriously threatened the dollar's dominance (see chapter 2). EMU is certainly the most important event in the international monetary and financial system since the end of the Bretton Woods system in the early 1970s (Bergsten, 1997). Depending on the number of countries qualifying for the European currency union the size of the domestic monetary habitat of the new common European currency, the euro, will become comparable to that of the dollar and larger than that of the yen or that of the mark, the most important European currency at present (see chapter 4).

Will this 'shock' to the international monetary system cause further diversification out of the dollar? Will the euro become as important as the size of Europe in the world economy suggests and challenge the current dollar dominance, maybe even replace the US currency as the world leader? Any of these scenarios has important implications for world

¹ For example, McCauley and White (1997) show that bookrunners in the primary eurobond markets have dominant market shares in issues denominated in their home currency.

monetary and financial affairs, for both the European common policy institutions as well as for the distribution of power on a global level.

With respect to the European level a quick and far-reaching internationalization of the euro has implications for the domestic monetary policy approach chosen. Large foreign short-term euro holdings are likely to render European money aggregates more unstable and therefore a pure monetary targeting strategy (as opposed to, say, an inflation targeting strategy) more difficult.² Moreover, strong euro internationalization will reinforce the case for a structure of EU-internal monetary institutions which allows Europe to speak with one voice to the outside world for the purposes of world monetary policy and exchange rate coordination. The Maastricht Treaty says in article 109 that the EU EcoFin Council can decide unanimously on formal fixed exchange rate agreements or give by qualified majority 'general orientations for exchange rate policies', whereas the European Central Bank (ECB) is in charge of the remaining exchange rate decisions. In fact, the EU summit in Mondorf-les-Bains in September 1997 seems to have confirmed that in normal times the operational responsibility for exchange rate policies would be with the ECB. It remains to be seen how a comparatively large group of national finance ministers, such as represented in the EU EcoFin Council, can effectively decide on formulating coherent policies in times of misalignment or crisis and coordinate them with the ECB.

On the world level, US influence on international monetary affairs will decline and EU influence increase, further strengthening the case for tightening of EMU-internal institutions. When a common EMU-external policy of European monetary institutions is fully accomplished, the composition of cooperative bodies such as the G-7 (currently comprising the USA, Canada and Japan on the one hand, and Germany, France, Italy and the UK on the other), and the refinancing and governance structures of the major international organisations, in particular that of the International Monetary Fund (IMF), will have to be reformed in order to reflect the new balance of power.³ Other issues concerning the impact of EMU on the international monetary system, relate to reforms

² Internationalization is not the only factor which can make monetary aggregates less reliable intermediate targets for monetary policy. Another major factor which plays a role is financial market development and, in particular, financial innovations resulting in more volatile money demand behaviour. Of course, these two factors are not independent: deep, broad and sophisticated financial markets make a currency more attractive for international traders and investors and internationalization itself will produce competitive pressures and incentives accelerating domestic financial market development.

³ See Alogoskoufis and Portes (1991) and Bergsten and Henning (1996) on these issues. The present share of the USA in total IMF quotas is about 18 per cent, while the cumulative share of all fifteen EU countries amounts to about 30 per cent (Henning, 1997).

of IMF macroeconomic policy surveillance (EMU-wide surveillance versus single-country surveillance), to potential access of EMU countries to IMF liquidity assistance and to the redefinition of currency weights for the Special Drawing Right (SDR), the IMF's artificial basket currency.⁴

The international competitive edge which the European banking industry could gain through euro internationalization and EMU-internal consolidation is likely to lead to more truly global financial players and fiercer international competition, raising the question: how will the related potential systemic risks be matched by financial regulators and supervisors? Although a large part of regulation for the foreseeable future is likely to remain fundamentally national, even within Europe more pressure will build up to improve international coordination in banking supervision and financial crisis management.⁵

1.2 Pivotal role of forex markets

Several parts of this book focus on forex markets and media of exchange in currency trading, which I denote as *vehicle currencies in the forex market*. Although there are also some purely academic reasons, this choice has been mainly made because of the key role forex markets play in the international monetary and financial system in general and in the internationalization of currencies in particular. First, for any (non-forex) international transaction, at least one of the parties involved has to enter the forex market at some point to either purchase or sell foreign currency balances. Conditions in this market thus considerably influence the denomination of the underlying transaction.⁶

Second, since the abolition of capital controls among industrial countries, forex markets are among the freest and most competitive markets in the world. Charles Goodhart (1997) has argued strongly that, on the national level, governments at most times in the past effectively determined which money their citizens had to use, with no (or very little) scope for true currency competition. The phenomenon of forex market vehicle currencies is an excellent example, maybe even the only example, of the truly spontaneous emergence of money on a large scale in modern times.

⁴ Many of these issues are discussed in Polak (1997) and Thygesen (1997). The future of the SDR has even been the focus of a separate book (see Mussa *et al.*, 1996).

⁵ This also raises the question whether European regulators will increasingly come to the Basle Committee on Banking Supervision (the G-10 coordinating body for banking regulatory affairs) speaking with a single voice (McCauley and White, 1997).

⁶ While these conditions depend on fundamental trade and investment flows, the market micro-structure analysis below shows that exchange structures, trading volumes, volatilities and so on in forex markets can develop considerable 'autonomy' from these fundamentals.

Table 1.1 *Turnover comparison of different markets, 1995 (bn USD)*

	Global USD spot forex trading	Global US treasury securities trading ^a	US stock market trading ^b	Real-world GDP ^c	World merchandise trade ^d
Total volume per business day	351	125	24	130	20

Notes: ^a 1994 data, all maturities.

^b On all recognized exchanges and NASDAQ.

^c At purchasing-power-parity (PPP) exchange rates, assuming 255 business days per year.

^d At market exchange rates, assuming 255 business days per year.

Sources: BIS (1996); Fleming (1997); IMF (1997b); OECD (1997); WTO (1996).

Last, but not least, the forex market is particularly important because of its huge size. As reported in table 1.1, total spot US dollar forex turnover alone is almost three times the size of total US Treasury securities trading (for all maturities) world-wide or global GDP. Even total US stock market trading and the overall volume of world trade are negligible compared to forex trading. For all these reasons, I fully agree with Peter Kenen (1995, p. 110) that ‘the international role of the ECU [euro] will be affected crucially by the impact of EMU on the foreign exchange market’.

Another motivation for the emphasis on forex markets in the analytical chapters of this book has to do with the substantial interest which the micro-structure of these markets has recently attracted in the academic profession. It is all the more surprising, then, that until now the forex micro-structure literature has completely ignored the phenomenon of vehicle currencies and the quite peculiar structure of open and closed interbank currency markets. For example, the 300-page volume, *The Microstructure of Foreign Exchange Markets* (Frankel *et al.*, 1996) does not make a single reference to the dollar’s or the mark’s special roles as vehicle currencies.⁷ One of the aims of this book, in chapter 3, is therefore to fill the gap and explain this phenomenon, in the hope that this might – in addition to the present applications to the internationalization of currencies – stimulate more research working out further implications, such as for information transmission through forex prices and volatilities, for example, or for optimal official intervention strategies.

⁷ The same applies to the booming forex high-frequency data literature (see for example the survey by Goodhart and O’Hara, 1998) – with a single notable exception (de Jong *et al.*, 1996).

However, the relevance of the results go beyond the areas of currency trading and forex vehicle currencies. The hypothesis of a negative relationship between the use of a medium of exchange (its turnover or trading volume) and the transaction costs encountered by its users is at the very basis of the theory of money, but has hardly ever been rigorously tested. It can be traced at least as far back as to the writings of Karl Menger (1892) and it still plays a prominent role in modern search models of monetary exchange (Kiyotaki and Wright, 1989). These *network externalities* or economies of scale in the use of exchange media, are at the heart of a certain tendency towards centralization to a single or only a few monies. It has led to the interpretation of a medium of exchange as a public good (Tobin, 1980).⁸ While the volume–transaction–cost relationship is hard to test in relation to fiat government money and goods exchange, the observability of bid–ask spreads – as a measure of transaction costs – and newly available data on trading volumes in the foreign exchange markets permit such a test. Forex market data therefore provide a unique opportunity to test for network externalities in monetary exchange in general, which is exploited in chapter 5, dealing with the empirical spread–volume relationship.

1.3 Overview of the book

The book is organized in six chapters. Following this Introduction, chapter 2 surveys the available literature about international currencies. The starting point is a restatement of the classical money functions in an international context. The following survey of the theoretical literature reveals that – without exception – existing theories of international currency can explain only a small part of the functions of international money. One of the most neglected international monetary functions appears to be that of a forex vehicle currency. This and other medium of exchange functions are characterized by the presence of network externalities, which imply forces driving towards concentration to one or a few dominant international currencies. In contrast, investment currency theory predicts that optimal international portfolio choice will be geared towards reaping the benefits of diversification. Currency competition may thus imply a friction between the store of value and medium of exchange functions, providing a new explanation for biases in international investment.

In a brief historical survey of international currencies since the Middle

⁸ For differences between money and traditional public goods, however, see de Grauwe (1989).

Ages, I then argue that – in accordance with network effects and vehicle-currency theories – there has in most times been a hierarchy of several competing international ‘key’ currencies with one clearly dominating all the others in practically all dimensions. Moreover, the available historical evidence suggests that transitions from one dominant international currency to another have been slow: earlier this century, for example, the dollar needed at least thirty years to overtake sterling. The switch to a floating exchange rate environment in 1973 led to a gradual diversification out of the dollar into the Deutsche mark and the Japanese yen, which came to a halt at the beginning of the 1990s, without seriously challenging the US currency’s post-war leadership.

In response to the gap in the theoretical literature, chapter 3 develops a theory of forex vehicle currencies which is based on micro-structure theory and exchange costs. First steps in this direction were taken by Black (1991). Chapter 3 builds on this paper, but goes beyond it in many respects. A forex-dealer model, integrating inventory and order processing costs, is used to derive the (long-run) relationship between transaction costs (bid–ask spreads), expected trading volume and expected exchange rate volatility. Inter-dealer and inter-market competition will cause a currency with high (predictable) turnover and low volatility to emerge as a forex vehicle. However, it is also shown that generally high volatility can completely demonetize the forex market (the ‘barter’ situation).

The theory explains the scope for multiple equilibria with respect to a single vehicle currency and the possible coexistence of multiple vehicle currencies in a forex market equilibrium. Some equilibria with multiple vehicle currencies exhibit a hierarchical structure, as has been observed so frequently in the history of international currencies. It is also demonstrated that the network externality in the use of media of exchange in the forex market can, in some cases, be negative (exchange cost increasing) instead of positive, at least in theory. Transitions from one dominant vehicle currency to another can be both gradual or dramatic, but – within the theoretical structure developed – multiple vehicle exchange structures need not be more unstable than single vehicle structures. An appendix extends the analysis to a Bertrand game of inter-dealer, inter-market price competition.

The multiplicity of forex vehicles is particularly relevant with regard to the recent emergence of the Deutsche mark as a second vehicle currency in addition to the US dollar (chapter 2, section 2.3). Chapter 4, in a first step, explains the mark’s emergence and describes the current exchange structure in the global forex market. It appears that the mark benefited from the volatility-reduction effect of the European Monetary System

(EMS) and volume-enlargement effects through financial liberalization and EMU convergence trading. However, the German currency's new role is strictly limited to trading among European currencies and the dollar remains dominant on the global level.

The rest of the chapter discusses the impact of EMU on international currency use in general and the potential future role of the euro in particular. Forex trading, international trade denomination, official reserve holdings and private investments in the euro, dollar and yen are studied in depth. On all these levels, a distinction is made between initial 'arithmetic' effects and dynamic follow-up effects. The former effects – the 'simple arithmetics' of EMU – originate from the removal of intra-European flows and stocks from the 'international' sphere. The latter effects are driven by EMU-internal and EMU-external size effects as well as changes in price level/exchange rate volatilities and international financial market return correlations.

The 'arithmetic' effects push the starting level of the euro well below the current aggregate share of EU currencies in international trade and investment. However, the size jump in the 'domestic monetary habitat' and to a somewhat lesser extent in external relations will lead to a gradual extension of the euro's role. Decelerating forces in this dynamic process will be network externalities and inertia favouring the incumbent dominant currency, the US dollar. Accelerating forces may include the ability of modern financial markets to adjust more quickly than earlier in history. Whether these latter forces can develop will depend on the speed and the extent with which intra-EMU financial markets integrate further.⁹ A study of the evolution of world trade flows suggests that the euro will expand its role more quickly in regions closer to the EU. The future of the Japanese yen, which is likely to fall behind the euro, will depend to a large extent on the new monetary and financial system which emerges in Asia as soon as banking and currency crises in the region are resolved.

As pointed out above, a recurrent feature in the theories of (national and) international media of exchange, surveyed in chapter 2, is the assumption or derivation of a positive externality or economies of scale in use. More use of an international medium of exchange makes it even more attractive for further use (see, for example, chapter 3; Krugman, 1980; Chrystal, 1984; Matsuyama *et al.*, 1993; Rey, 1997). In chapter 5 of the book a natural test for this is performed in two very different ways. This test involves the estimation of the impact of trading volumes in the

⁹ Portes *et al.* (1997) argue that these forces alone could raise the euro to the level of sharing world power with the US dollar, or even beyond.

forex market on transaction costs, as measured by bid–ask spreads, and thus goes deeper into the testing of forex market micro-structure theory. If the network-externality hypothesis is true, increasing volumes in a currency market should decrease transaction costs, at least in the long run. (If this were not the case, a vehicle currency would incorporate a certain tendency to auto-destroy its role, because vehicle transactions increase trading volume.) One major challenge for these estimations is the general lack of volume data, due to the fragmented (over-the-counter or OTC) character of forex trading.

Chapter 5 first surveys spread theory and empirics, highlighting the quality of different measures for forex trading volumes. It then goes on to integrate high-frequency exchange rate data and different measures of trading volume (including Reuters ‘ticks’) into two new datasets, one an eight-year long daily time-series for dollar/yen and the other a short panel over many currency pairs. The former dataset is used to estimate the *short-run* relationship between trading volumes and transaction costs, further developing an idea by Bessembinder (1994), who suggests that predictable trading volumes in the forex market should decrease transaction costs, while unpredictable volumes should increase them. Building on these results, I then apply a random-effects specification to the monthly panel data in order to test for the *long-run* relationship between volumes and spreads. Taken together, the results of chapter 5 provide strong evidence in favour of a negative long-run effect of trading volumes on transaction costs and, therefore, also in favour of the presence of positive network externalities and economies of scale in the use of international currencies. Reuters ticks are successfully applied as proxies for unpredictable and predictable turnovers.

The final chapter 6 assembles the main results from the different parts of the book and draws some general conclusions for international monetary and financial policies as well as for desirable future research efforts in the areas of currency internationalization and forex market micro-structure analysis.