Wiley Finance Series

Agricultural Agric

From Crops to Land, Water and Infrastructure

HÉLYETTE GEMAN



Agricultural Finance

For other titles in the Wiley Finance series please see www.wiley.com/finance

Agricultural Finance

From Crops to Land, Water and Infrastructure

Hélyette Geman

WILEY

This edition first published 2015 © 2015 Hélyette Geman

Registered office

John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, United Kingdom

For details of our global editorial offices, for customer services and for information about how to apply for permission to reuse the copyright material in this book please see our website at www.wiley.com.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, except as permitted by the UK Copyright, Designs and Patents Act 1988, without the prior permission of the publisher.

Wiley publishes in a variety of print and electronic formats and by print-on-demand. Some material included with standard print versions of this book may not be included in e-books or in print-on-demand. If this book refers to media such as a CD or DVD that is not included in the version you purchased, you may download this material at http://booksupport.wiley.com. For more information about Wiley products, visit www.wiley.com.

Designations used by companies to distinguish their products are often claimed as trademarks. All brand names and product names used in this book are trade names, service marks, trademarks or registered trademarks of their respective owners. The publisher is not associated with any product or vendor mentioned in this book.

Limit of Liability/Disclaimer of Warranty: While the publisher and author have used their best efforts in preparing this book, they make no representations or warranties with respect to the accuracy or completeness of the contents of this book and specifically disclaim any implied warranties of merchantability or fitness for a particular purpose. It is sold on the understanding that the publisher is not engaged in rendering professional services and neither the publisher nor the author shall be liable for damages arising herefrom. If professional advice or other expert assistance is required, the services of a competent professional should be sought.

Library of Congress Cataloging-in-Publication Data

Geman, Hélyette.

Agricultural finance : from crops to land, water and infrastructure/Hélyette Geman. pages cm. – (The Wiley finance series) Includes bibliographical references and index.
ISBN 978-1-118-82738-3 (hardback)
1. Commodity exchanges. 2. Agricultural prices. 3. Agricultural industries. 4. Investments. I. Title.

HG6046.G457 2015 338.1'3-dc23

2014036004

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

ISBN 978-1-118-82738-3 (hbk)ISBN 978-1-118-82737-6 (ebk)ISBN 978-1-118-82736-9 (ebk)ISBN 978-1-118-82735-2 (ebk)

Cover Design: Wiley Cover Image top: ©istock.com/jenjen42 Cover Image bottom: ©istock.com/77studio

Set in 10/12pt Times by Laserwords Private Limited, Chennai, India Printed in Great Britain by TJ International Ltd, Padstow, Cornwall, UK To Arnaud, Laure and Nathanaël To the memory of my sister

Table of Contents

Ac	knowledgments	xiii
Ab	out the Author	XV
Pre	amble	xvii
1	Physical and Financial Agricultural Markets	1
	1.1 Agriculture and the Beginning of Human Sedentarization	1
	1.1.1 Some recent numbers	2
	1.1.2 The growing role of Africa	2 2 3
	1.2 The Outlook of Agricultural Commodities Markets	
	1.2.1 Recent mergers and acquisitions	3
	1.2.2 'Trading places': from the ABCD to the NOW	4
	1.2.3 The physical markets	9
	1.2.4 The global flows of commodities	10
	1.2.5 Back to the future: a new age for barter	11
	1.2.6 The sources of information in agricultural commodity markets	12
	1.3 History of Commodity Futures and Spot Markets	12
	1.3.1 The actors in financial markets	12
	1.3.2 The actors in agricultural commodity exchanges	13
	1.3.3 The growth of Futures markets exchanges and the recent mergers	14
	1.3.4 Futures markets and price volatility	15
	1.3.5 The role of indexes in the creation of efficient commodity spot markets	16
	1.3.6 Commodities and numéraire	17
	1.4 Shipping and Freight	17
	1.4.1 International trade	18
	1.4.2 Price formation in freight markets	18
2	Agricultural Commodity Spot Markets	25
	2.1 Introduction	25
	2.2 Price Formation in Agricultural Commodity Markets	25
	2.3 Volatility in Agricultural Markets	27
	2.3.1 Volatility of the price level versus return in agricultural	
	commodity markets	32

	2.3.2 Which factors drive volatility?2.3.3 Conclusion	36 38
3	tures Exchanges – Future and Forward Prices – Theory of	
	orage – The Forward Curve	39
	Major Commodity Exchanges	39
	P. Forward Contracts	41
	Futures Contracts	43
	3.3.1 Definition	43
	3.3.2 Exchange of Futures for physicals (EFP)	44
	Relationship between Forward and Futures Prices	45
	Example of a Future Spread	47
	5 Inventory and Theory of Storage	47
	3.6.1 Spot and Futures prices volatilities	49
	3.6.2 Development of the theory of storage: inventory	51
	and prices The Benefits of Forward Curves	51
	3.7.1 Trading strategies around forward curves	52 52
	3.7.2 Example of a seasonality-based Futures spread	53
	3.7.3 From linear to convex payoffs	54
	Stochastic Modeling of the Forward Curve	55
4	ain Vanilla Options on Commodity Spot and Forward Prices. The	
	chelier–Black–Scholes Formula, the Merton Formula, the Black Formula	59
	Introduction	59
	2 Classical Strategies involving European Calls and Puts	62
	4.2.1 Straddle	62
	4.2.2 Strangle	62
	4.2.3 Call spread or vertical call spread	63
	4.2.4 Butterfly spread	64
	Put-Call Parity for a Non-dividend Paying Stock	64
	Valuation of European Calls: the Bachelier–Black–Scholes Formula and the Greeks	66
	4.4.1 Consequences of the Black–Scholes formula	70
	4.4.2 The Greeks	70
	5 The Merton (1973) Formula for Dividend-paying Stocks	75
	6 Options on Commodity Spot Prices	77
	⁷ Options on Commodity Futures: the Black (1976) Formula	78
	3 Monte-Carlo Simulations for Option Pricing	79
	4.8.1 The founding result	79
	4.8.2 Monte-Carlo methods for plain vanilla options on non-dividend	
	paying stocks	80
	4.8.3 Monte-Carlo methods for plain vanilla options on the spot commodity	
	Implied Volatility, Smile, and Skew in Equity Option Markets	83
4	Volatility Smile in Agricultural Commodity Markets	86
	4.10.1 Where is the liquidity in agricultural commodity option markets?	86
	4.10.2 Extracting the implied volatility from options on commodity Futures	86

	Table of Contents	ix	
5	5 Commodity Swaps, Swaptions, Accumulators, Forward-Start,		
	and Asian Options	89	
	5.1 Swaps and Swaptions	89	
	5.2 Accumulators	92	
	5.3 Forward-Start Options (or Calendar Spread Options on the Spot Price)	93	
	5.4 Asian Options as Key Instruments in Commodity Markets	95	
	5.4.1 Approximation of the arithmetic average by a geometric average5.4.2 Approximation of the distribution of the arithmetic average	96	
	by a log-normal distribution	97	
	5.4.3 Monte-Carlo simulations for Asian options valuation	98	
	5.4.4 Exact results (Geman and Yor, 1993)	100	
	5.5 Trading the Shape of the Forward Curve through Floating-strike Asian Options	102	
6	Exchange, Spread, and Quanto Options in Commodity Markets	103	
	6.1 Exchange Options	103	
	6.2 Commodity Spread Options and Their Importance in Commodity Markets	105	
	6.3 Commodity Quanto Options	109	
7	Grain Cereals: Corn, Wheat, Soybean, Rice, and Sorghum	113	
	7.1 Introduction	113	
	7.2 Corn	113	
	7.3 Wheat	118	
	7.3.1 Wheat trading	119	
	7.3.2 Global wheat	119	
	7.3.3 The wheat supply chain	120	
	7.4 Soybeans 7.5 Rice	123 126	
	7.6 Sorghum	120	
	7.0 Sorghum	129	
8	Sugar, Cocoa, Coffee, and Tea	133	
	8.1 Sugar	133	
	8.1.1 Links of sugar with other commodities	134	
	8.1.2 Sugar trading	135	
	8.1.3 The European Union	136	
	8.1.4 Special relations of the EU with other countries	136	
	8.1.5 The United States	136	
	8.1.6 Special relations of the USA with other countries	137	
	8.1.7 Brazil	137	
	8.1.8 China	138	
	8.1.9 India 8.1.10 Thailand	138 139	
	8.1.10 Inanana 8.1.11 Australia	139	
	8.1.12 Guatemala and Cuba	139	
	8.1.12 Sugar cane in Mauritius	139	
	8.2 Cocoa	140	
	8.3 Coffee	146	
	8.4 Tea	149	

9	Cotton, Timber and Wood, Pulp and Paper, Wool	153
	9.1 Cotton	153
	9.2 Lumber and Wood	156
	9.3 Pulp and Paper	158
	9.3.1 Pulp NBSK and BHKP indexes	159
	9.3.2 Pulp US NBSK index	160
	9.3.3 Pulp BHKP China	160
	9.3.4 Pulp NBSK China	161
	9.3.5 When bank notes go plastic	161
	9.4 Wool and Cashmere	162
	9.4.1 Cashmere	163
	9.4.2 From the Kashmir Goat to high quality yarns	164
10	Orange Juice, Livestock, Dairy, and Fishery	165
	10.1 Orange Juice	165
	10.2 Livestock	166
	10.2.1 Livestock markets	167
	10.2.2 Cattle	168
	10.2.3 Hogs	169
	10.2.4 Pork bellies	169
	10.2.5 The US live cattle contract specifications	170
	10.2.6 Australia	171
	10.2.7 The USA	171
	10.3 Dairy	172
	10.4 Fish Markets	173
	10.5 Poultry and Eggs	174
11	Rubber, Palm Oil, and Biofuels	177
	11.1 Rubber	177
	11.2 Palm Oil	180
	11.2.1 The oil palm and palm oil	181
	11.2.2 Markets	182
	11.3 Ethanol, Biofuels, and Biomass	183
12	Land, Water, and Fertilizers	187
	12.1 Land Types, Yields, and Erosion	187
	12.1.1 Yield-at-risk	187
	12.1.2 Land competition	188
	12.1.3 Farmland in the USA	188
	12.2 Fertilizers	189
	12.2.1 Fertilizer markets	191
	12.2.2 Fertilizer Index, corn, and wheat price trajectories over	
	the period 1991 to 2011	193
	12.2.3 Fertilizer producing companies and share price returns	
	over the period 2004 to 2011	193

		Table of Contents	xi
		12.2.4 A factor model for the share returns of fertilizer firms	198
	12.3	Water and its crucial Role in the World Economy	207
		12.3.1 The case of Australia, China, and Saudi Arabia	208
		12.3.2 The case of Brazil	208
		12.3.3 Competition for electricity, water, and land	209
	12.4	Projections for the Future of Agriculture	209
		12.4.1 Farm insurance	210
		12.4.2 Estimating long-term agricultural supply	210
		12.4.3 Market concentration	211
		12.4.4 Spare capacity	211
	12.5	Subsidies and Export Bans	211
		12.5.1 Subsidies	212
		12.5.2 Export bans	212
	12.6	Market-oriented Farming	212
		12.6.1 Open wheat market takes root in Canada	213
		12.6.2 Kansas City wheat Futures trading coming to an end after	
		157 years	213
		12.6.3 China food needs	214
13	Infra	astructure and Farming Management in the Digital Age	217
	13.1	Introduction	217
	13.2	Agricultural Infrastructure	218
		13.2.1 Total factor productivity	218
		13.2.2 Climate change	219
		13.2.3 Irrigation and increased productivity	219
		13.2.4 Trends in irrigation	219
		13.2.5 Storage	220
		13.2.6 Grain elevators	220
		13.2.7 Soybean crushers	220
		13.2.8 The Brave New World of Monsanto	221
		13.2.9 Infrastructure in sub-Saharan Africa	221
		13.2.10 Gabon: after black gold, green gold?	221
		13.2.11 Agricultural Transformation Agenda (ATA) in Nigeria	222
		13.2.12 Digital age on the farm: prescriptive planting	222
		13.2.13 Sugar biofactory for ethanol in Brazil	224
		13.2.14 After ethanol, railway, and natural gas	224
		13.2.15 From iron ore mining to cattle farming in Australia	225
		13.2.16 Robots for cow milking	225
		13.2.17 Containers for agricultural commodities	226
		13.2.18 Singapore as a hub for refrigeration containers	226
		13.2.19 The trip of the banana	226
		13.2.20 Energy, water, and infrastructure for DAP and agriculture	225
	10.0	in Saudi Arabia	227
		Country Risk: the Example of Ukraine in 2014	227
		Analyzing the Risks Involved in an International Wheat Tender Offer	228
	13.5	Weather Risk and Weather Derivatives	229

14	Inve	sting in Agricultural Commodities, Land, and Physical Assets	233
	14.1	Purchase of Commodity Futures	233
	14.2	Purchase of Commodity Options and Structured Products	235
	14.3	Commodity Index Investing	236
		14.3.1 Some prominent commodity indexes	236
		14.3.2 How commodity indices are constructed	238
		14.3.3 Commodity-linked bonds	239
	14.4	Investing in Commodity-related Equities	239
	14.5	Investing in Land	240
		14.5.1 The US case	241
		14.5.2 The world case	241
	14.6	Acquisition of Infrastructure and Physical Assets	242
		14.6.1 Valuation of a transformation plant using a real	
		options approach	242
		14.6.2 DCF approach to the valuation of a transformation plant	243
		14.6.3 Valuation of a silo (or an aquifer, or any storage facility)	245
	14.7	Conclusion	247
Glo	ssary		248
References			252
Ind	ex		257

Acknowledgments

First, I would like to extend my very warm thanks to my PhD students Bo Liu for his remarkably intelligent and merciless proofreading of the book – all remaining typos or repetitions are my sole responsibility – and Pedro Vergel and Tara Velez for their talent in building a number of price trajectories and forward curves. I would also like to thank Hugo Forget and Patrick Slama for their help in editing.

Second, I want to express my gratitude to my friends Hilary Till, from Premia Capital Management, and George Martin, from Wood Creek Capital Management, for the great discussions and reports exchanges we had over the years, some of them being reflected in this book.

Lastly, I am grateful to Javier Blas, editor at the Financial Times and other journalists at the FT, the Wall Street Journal, the Economist, the Business Times (Singapore), and other newspapers for their prompt and beautiful coverage of a number of new developments in the world of agricultural commodities; they allowed me to corroborate my own findings. I tried to trace and pay tribute to the first publication, sometimes a World Bank, USDA or another official organization valuable report.

On a side note, I wish to mention that I chose the article 'he' throughout the book for ease of use and did not intend to place the male gender above any other gender.