Institution: University of Liverpool

Unit of Assessment: 10 – Mathematical Sciences

Title of case study: Market first insurance product establishes start-up Stable Group Ltd to provide financial security to food and farming businesses

Period when the underpinning research was undertaken: May 2015 – July 2020

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	**Role(s) (e.g. job title):**	**Period(s) employed by submitting HEI:**
Dr Hirbod Assa	Lecturer in Actuarial and Financial Mathematics	September 2013 - December 2020
Dr Athanasios Pantelous	Reader in Stochastic Modelling & Control Theory	May 2009 - April 2019
Dr Nikolaos Karagiannis	Postdoctoral Research Associate	September 2014 – February 2015

Period when the claimed impact occurred: May 2015 – December 2020

Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact
First-of-its-kind 'index price' insurance designed by Liverpool mathematicians is heralded by Sky News, Reuters and the current Environment Secretary as a market first. The new product has created commercial and economic benefits in the insurance, food and farming sectors in the UK, Netherlands and the US. The Liverpool pricing algorithms, developed to establish start-up business Stable Group Ltd, have enabled the company to attract market authorisation and venture capital investment, create jobs and generate sales revenue. This insurance is providing food and farming businesses with protection from volatile market prices for the first time: • First ever price insurance approved by global underwriters Lloyd's of London. • Backed by USD6,000,000 (03-2019) venture capital. • 21 jobs created in London, Amsterdam and Chicago. • Turnover of GBP1,200,000, protecting GBP22,000,000 of risk to food security.

2. Underpinning research

2.1. The problem of price volatility

Price volatility is one of the biggest risks for the global food and farming industry. Farming income is inherently volatile due to natural disasters such as floods, political shocks such as Brexit and demand/supply (negative) shocks such as the Covid-19 outbreak. Prices can swing by as much as 30% each year. Existing risk management tools such as derivatives and options are complex, risky and expensive. This makes them inaccessible to nearly all small and medium size farms.

2.2. A new solution – index insurance

Dr Assa is a lecturer in the Institute of Financial and Actuarial Mathematics, Department of Mathematical Sciences at the University of Liverpool. The novelty in this body of work on index insurances by Dr Assa is in creating a brand new risk management platform as a legitimate replacement of derivatives for managing volatile prices. Index-based insurance - where payouts are linked to some 'index' rather than actual losses - is an accessible solution for farmers. Firstly

there is no claims process and users cannot lose more than they invest; insurances are heavily regulated and cannot be used for speculation - users can only insure what they have; and finally they remove the risk of 'moral hazard' (deliberate exposure to risk) as they are based on independent indexes. By taking this different perspective, Dr Assa introduced and developed insurances on index prices for the first time. He found that insurances on index prices (compared with derivatives) needed the development of completely new financial mathematical frameworks in order to estimate volatility and price the risk. This is due to a lack of suitable data (implied, realised volatility methods) and issues with underestimation (empirical volatility methods) in applying traditional techniques. The novel mathematical framework Dr Assa constructed was an equilibrium solution to estimate volatility in order to price the risk.

2.3. Developing index insurance

Between 2014 and 2019 Dr Assa developed these new insurance methodologies on index prices and applied them to problems in agriculture **[3.1, 3.2,** and particularly **3.3]**. These publications form the fundamentals of the agricultural index price insurances used by Stable Group Ltd. The research outlines a complete framework, from theoretical feasibility to priced insurances. Due to the novelty of these products, **[3.3]** investigates the attractiveness of such new markets from both insurer and insured perspectives. During this time, Dr Assa also collaborated with Liverpool mathematicians Dr Athanasios Pantelous and Dr Nikolaos Karagiannis, and Prof Turvey of Cornell University (USA) on a novel 'over the counter' insurance contract on catastrophe risk **[3.4]**. Specifically, Dr Assa designed and priced a risk bond related to agricultural catastrophes (AgriCATs), transferring the risk of an agriculture-related catastrophe to a hedge-fund rather than the insurers themselves.

2.4. New index insurance for industry

This body of research demonstrated how optimal insurance contracts on agricultural price indexes can be designed and how risk capital investment can make agricultural insurance financially viable, creating a pathway to designing and pricing index insurance contracts in the real-world. By 2016 Dr Assa and his PhD student Simon Wang were obtaining results for the Stable team directly, solving the problem of systemic (undistributed) risk in agriculture markets; for example if the price of milk falls in Yorkshire, it also falls in Somerset **[3.3]**. They applied machine learning to over seventy years of UK government index prices, to price the risk of a price fall and dynamically allocate capital across 12 different commodities (products) to distribute risk. Payouts are made based on the difference between insured price levels and independent price indexes set by third parties such as the Agriculture and Horticulture Development Board (AHDB). This model was applicable to price risk in the UK in the first instance, founding an insurance platform that would act like a mixed farm by spreading risk across many commodities.

This research was supported by a grant from the Montreal Institute of Structured Finance and Derivatives (Canada).

3. References to the research

3.1. Assa, H. (2015) A financial engineering approach to pricing agricultural insurances. Agricultural Finance Review, Vol. 75 Issue: 1, pp.63-76. doi:10.1108/AFR-12-2014-0041

3.2. Assa, H. (2016) Financial engineering in pricing agricultural derivatives based on demand and volatility. Agricultural Finance Review, Vol. 76. Issue: 1, pp.42-53. doi:10.1108/AFR-11-2015-0053

3.3. Assa, H. and Wang, S. (2020) Price index insurances in the agriculture markets. North American Actuarial Journal, published online July 13, 2020. doi:10.1080/10920277.2020.1755315

3.4. Karagiannis, N, Assa, H, Pantelous AA and Turvey CG. (2016) Modelling and pricing of catastrophe risk bonds with a temperature-based agricultural application, Quantitative Finance, Vol 16, Issue: 12, pp.1949-1959. doi:10.1080/14697688.2016.1211791

4. Details of the impact

Heralded by Reuters **[5.1a]** and Sky News **[5.1b]** in 2019 as a market first, new index price insurance developed by mathematicians at the University of Liverpool is benefitting insurance, farming and food businesses: "*Farmers can now for the first time insure their produce against price volatility as easily as insuring their homes*" (Reuters) **[5.1a]**. One farmer reports that market price swings can mean GBP300,000 of lost income **[5.2]**. Losses can be even greater during major demand/supply shocks such as the GBP13,000,000 (01-05-2020) loss to UK dairy farms in just one month during the Covid-19 pandemic. Existing risk management tools (designed for financiers) are inaccessible to most farmers due to high cost, risk and complexity. Technology start-up Stable Group Ltd uses algorithms developed by Dr Assa and his group **[3.3]**, providing unparalleled financial security to over 140 food and farming businesses for the first time **[5.3]**. **This is the first product to provide widely available protection from fluctuating prices and is the only price insurance to be backed by underwriters Lloyd's of London in its 330 year history [5.3, 5.4]**.

4.1. Food security – policyholders

Using insurance pricing models developed at Liverpool, Stable is stabilising cash flow for producers and buyers of agricultural products. At June 2020, Stable had covered a total of GBP22,000,000 risk for 140 food and farming businesses **[5.3]**. This is the maximum amount payable to policyholders against insurance policies sold. The protection makes businesses more credit worthy, protects profits and empowers them to invest in the future. A Norfolk farmer explains how Stable's "*innovative way of doing things*" is "*a definite advantage*" and is "*much easier to manage*" than the futures (derivatives) market **[5.2]**. In its first year of trading, Stable paid 40% of its total sales revenue directly back to farmers in automated payouts **[5.3]**. For example, one arable farmer received net benefits (payouts) totalling GBP32,000 **[5.3]**. In addition to protecting farmers from falling prices, Stable is also protecting a growing pipeline of food purchasing businesses from the rising costs of vital ingredients. One drinks producer has protected itself against EUR1,500,000 (06-2020) of price risk associated with fresh apples **[5.3]**.

4.2. New start-up business

Richard Counsell, a farmer and technology entrepreneur, now CEO of Stable Group Ltd, came across Dr Assa's research in 2015, with particular interest in **[3.4]**. Throughout 2016 the pair scoped the concept of index-based price insurance for the agricultural sector. By 2017 Counsell formally contracted Dr Assa and the University of Liverpool to design an insurance platform that would act like a mixed farm, spreading risk across many commodities (products) **[5.3]**. Dr Assa's group developed algorithms that could read and analyse price data, and a machine-learning engine that analysed trillions of prices and dates to forecast trends and look for diversification opportunities **[3.3]**. Stable CEO Mr Counsell explains: "…*you built new mathematical frameworks to estimate volatility and price risk that continue to underpin our company's entire concept and insurance methodology…Your work provided a ground breaking new insurance solution to tackle a global problem and established Stable as the only provider of index price*

insurance in the world…The algorithms you developed for us enabled the company to attract investors and underwriters in order to begin trading. Ours was the first ever price insurance to be approved by global underwriters at Lloyd's of London, proving market feasibility of the new platform" **[5.3]**.

Following three years of R&D with Dr Assa, Stable launched publicly in March 2019 with Liverpool's alumnus Dr Simon Wang as a Director **[5.5]**. From the original twelve indexes that Dr Assa developed to establish the concept, Stable now has more than 3,000 indexes in over 40 countries, all developed using the same pioneering mathematical framework for estimating volatility and pricing risk **[5.3]**. Total sales at June 2020 were GBP1,200,000 **[5.3]**. Stable has 21 employees (headcount) consisting of highly skilled data scientists, analysts and actuaries across their London headquarters and Amsterdam and Chicago sales offices. Dr Assa remains their Scientific Advisor **[5.3, 5.6a]**.

4.3. Insurance sector
External investment in Stable demonstrates sector confidence in and market feasibility of Dr Assa's index price algorithms, as well as a new business opportunity for these partners.

Underwriters: All insurance policies priced using the Liverpool algorithms and issued by Stable are underwritten by global underwriters at Lloyd's of London **[5.4]**. This means that Stable does not have to fund payouts itself. Lloyd's Coverholder status applies in 50 different countries. Coverholders are a major source of business for Lloyd's and Stable has brought new business to this marketplace, being the only price insurance to be backed in Lloyd's 330 year history **[5.3, 5.4]**.

Investors: Major international investors Anthemis, Syngenta and Ascot backed Stable in March 2019 with USD6,000,000 (03-2019) venture capital **[5.1b, 5.3]**. This is equity-based funding that investors can sell once the business becomes profitable. The investment put Stable in the top 10 London startups for raising the most capital that month **[5.7]**. Investor Anthemis says "*Stable is bringing a fresh perspective to food security…As investors, we are pleased to back Richard and his team as they tackle this multi-trillion-dollar opportunity.*" **[5.8]**.

Introducers: Stable sells policies directly to larger businesses, otherwise their insurance is sold through one of 12 trusted sales partners or 'introducers' **[5.3]**. Introducers are organisations trusted by the farming industry (such as member organisations), who benefit financially through onward sales. One introducer explains: "*Stable's simple solution is one that our farmers have been requesting for years. We're incredibly excited…to help our members protect their income and invest in the future of this vital industry'* **[5.3]**.

Stable has received 10 industry awards and honours **[5.9]**. Stable's CEO explains "*This commercial success wouldn't have been possible without your* [Dr Assa's] *expertise and pricing algorithms"* **[5.3]**. Speaking at Stable's launch in March 2019, a former Farming Minister (currently Secretary of State for Environment, Food and Rural Affairs) describes the platform as "*… a remarkable idea, and by neutralising risk* [for farmers] *it has identified a way forward*" **[5.6b]**.

5. Sources to corroborate the impact

5.1. Examples of widespread media coverage of the launch of the new Stable insurance platform in 2019, heralding it as a market first. **a)** Hunt, N. (11 April, 2019). Farmers dip toes into global crop insurance platform. Reuters. *Last accessed 17th December 2020.* **b)** Interview with Stable CEO, R. Counsell. (25 March 2019). Ian King Live. Sky News. Television. 3m 59s. *Last*

accessed 17th December 2020. Explains how the Stable platform is different to existing solutions - by avoiding speculation and focussing on farmers with real risks (throughout). Also references USD6,000,000 (03-2019) venture capital raised (15-18s). Clip available as an .mp4 file from the University of Liverpool.

5.2. Interview with arable farmer in Norfolk about the benefits of using Stable insurance: Anglia Farmer, January 2020. Price insurance takes risk out of commodity markets. *Last accessed 17th December 2020.*

5.3. Letter from Stable CEO detailing business performance, new jobs created, investment funding raised and how the commercial success is critically underpinned by the research of Dr Assa's group.

5.4. Stable Coverholder status with global underwriters Lloyd's of London, demonstrating market authorisation. *Archived 17th December 2020.*

5.5. Stable Group Ltd listed with Companies House showing the business is operational and Liverpool alumnus Dr Wang as Company Director. *Last accessed 17th December 2020.*

5.6. Website of Stable Group Ltd. *Last accessed 17th December 2020.* **a)** Dr Assa listed as Scientific Adviser. **b)** Stable launches price risk management tool with former Farming Minister (now Secretary of State for Environment, Food and Rural Affairs). 6th March 2019.

5.7. Stable named as one of the Top ten London startups to raise the most capital (2 April 2019) by London TechWatch. *Last accessed 17th December 2020.*

5.8. Published testimonial from investor Anthemis demonstrating sector confidence in the Stable platform. Anthemis insights. Foxe Blader, R. Why we invested: Stable. (13 March 2019). *Last accessed 17th December 2020.*

5.9. List of Stable's 10 industry awards and honours with web links and screenshots (includes [5.7]).