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PRIZE-WINNING ESSAYS OF THE STUDENT ECONOMIC REVIEW 2019/2020

BEST OVERALL ESSAY: DERMOT MCALEESE MEDAL

THE EVOLUTION OF OFFSHORE WEALTH AMONG VISEGRAD GROUP RESIDENTS, 2001-2015

KATE DEVANE AND MICHAELA FRICOVA

BEST APPLIED ECONOMICS ESSAY:

NEURAL NETWORKS AS AN OPTION PRICING METHOD

BRENDAN DOWLING

BEST FRESHMAN ESSAY PRIZE:

EVALUATING THE U.S POLICY TRADITION ON PREDATORY PRICING

OWEN GRAHAM O'REGAN

Editors and General Managers of the Student Economic Review, 1987-2020

Year	Editor	General Manager
1987 (Vol. I)	John Fingleton	Paddy Waldron
1988 (Vol. II)	Kevin Carey	Finbar McDonnell
1989 (Vol. III)	Johnathan Wright	Joe Denehy
1990 (Vol. IV)	Philip Lane	C. J. O'Neill
1991 (Vol. V)	Paul O'Connell	Billy Stamp
1992 (Vol. VI)	Alan White	Addo C. Barrows III
1993 (Vol. VII)	Gareth Davis	David Butler
1994 (Vol. VIII)	Alan Dunne	Donagh Lynch
1995 (Vol. IX)	Fergal Shortall	Myles H. Clarke
1996 (Vol. X)	Geoffrey Gill	Suzanne O'Neill
1997 (Vol. XI)	Sarah Rowell	Carol Newman
1998 (Vol. XII)	Richard Doyle	Charlotte Hess
1999 (Vol. XIII)	Michael Mc Mahon	Niamh McDonagh
2000 (Vol. XIV)	Ana Carrie	Collette Murphy
2001 (Vol. XV)	Ronan Lyons	Charles Larkin
2002 (Vol. XVI)	Ivan McAdam	Janine Boyd O'Carroll
2003 (Vol. XVII)	Rowena Gray	Elaine Doyle
2004 (Vol. XVIII)	Denis Tkatchenko	Tara McInhoe
2005 (Vol. XIX)	Cormac O'Dea	Paul Sammon
2006 (Vol. XX)	Deirdre Reilly	Melinda Simonffy
2007 (Vol. XXI)	Niamh Crilly	Charlie Nolan
2008 (Vol. XXII)	Nathalie Ennis	Kieran Curtis
2009 (Vol. XXIII)	Jean Acheson	James Walsh
2010 (Vol. XXIV)	Jason Somerville	Amandine Lobelle
2011 (Vol. XXV)	Robert Farhat	Áine Ni Shúilleabháin

Year	Editor	General Manager
2012 (Vol. XXVI)	Tony O'Connor	Debbie Blair
2013 (Vol. XXVII)	Brian Higgins	Marielle Grigsby-Rocca
2014 (Vol. XXVIII)	Féidhlim Mc Gowan	Cián Mc Leod
2015 (Vol. XXIX)	Gearóid Gibbs	Michael Mahony
2016 (Vol. XXX)	Gillian O'Connell	Kate Hayes
2017 (Vol. XXXI)	Míde Ní Ghríofa	Alexandru Radu Puiu
2018 (Vol. XXXII)	Keelan Beirne	Aditya Garg
2019 (Vol. XXXIII)	John (Charlie) Walsh	Luisa Mostarda
2020 (Vol. XXXIV)	Harry Humes	Kevin Loftus

GUEST SPEAKERS AT THE LAUNCH OF THE STUDENT ECONOMIC REVIEW, 1990-2020

Year	Speaker	Organisation
1990 (Vol. IV)	Richard Lipsey	Simon Fraser University
1991 (Vol. V)	Charles Goodhart	London School of Economics
1992 (Vol. VI)	Peter Sinclair	Brasenose College, Oxford
1993 (Vol. VII)	David Greenway	Nottingham University
1994 (Vol. VIII)	Hamish Mc Rae	The Iindependent, London
1995 (Vol. IX)	John Sutton	London School of Economics
1996 (Vol. X)	John Martin	OECD
1997 (Vol. XI)	Alan Tait	IMF
1998 (Vol. XII)	David O'Sullivan	European Commission
1999 (Vol. XIII)	Paula Donovan	World Bank
2000 (Vol. XIV)	Dermot McCarthy	Department of an Taoiseach
2001 (Vol. XV)	Donal Donovan	IMF
2002 (Vol. XVI)	Margaret Doyle	The Economist
2003 (Vol. XVII)	Tomy Healy	Irish Stock Exchange
2004 (Vol. XVIII)	Gerry Foley	ITV PLC.
2005 (Vol. XIX)	John Fingleton	Competition Authority
2006 (Vol. XX)	Marius Brülhart	HEC University of Lausanne
2007 (Vol. XXI)	Cliff Taylor	Sunday Business Post
2008 (Vol. XXII)	Alan Barrett	ESRI
2009 (Vol. XXIII)	Patricia Callan	Small Firms Association
2010 (Vol. XXIV)	Jane Williams	Forfás

2011 (Vol. XXV)	Tom O'Mahony	Department of Transport
2012 (Vol. XXVI)	Kyran Mc Stay	Key Capital Limited
2013 (Vol. XXVII)	Alan Gray	Indecon Economic Group
2014 (Vol. XXVIII)	Anke Heydenreich	Attestor Capital LLP
2015 (Vol. XXIX)	Declan Sheehan	JP Morgan
2016 (Vol. XXX)	Various Speakers	Past Committee Members
2017 (Vol. XXXI)	Kevin O'Rourke	All Souls College, Oxford
2018 (Vol. XXXII)	Liam Delaney	U.C.D.
2019 (Vol. XXXIII)	Carmel Crimmins	Reuters
2019 (Vol. XXXIII)	Seán Barrett	Dáil Éireann
2020 (Vol. XXXIV)	Eithne Fitzgerald	Former Minister of State

Student Economics Review Debates, 1996-2020

Year	Opposition	Topic	Victor
1996	U.C.D.	Third Level Fees	Trinity
1998	U.C.D.	EMU Without Britain	Trinity
1999	Oxford	The Euro: The Way Forward	Oxford
2002	Oxford	Boston or Berlin?	Trinity
2003	Cambridge	The Euro is a Success	Cambridge
2004	U.C.D.	Free Trade and Development	U.C.D.
2005	Oxford	Third World Debt	Trinity
2006	Cambridge	Common Agricultural Policy	Trinity
2007	Oxford	Environmental Resposibility	Trinity
2007	Yale	Boston or Berlin?	Trinity
2008	Harvard	Mass Emigration and Labour	Trinity
2008	Cambridge	Britain's Place in Europe	Cambridge
2009	Yale	Boston or Berlin?	Yale
2009	Oxford	Bank Nationalisation	Trinity
2010	Cambridge	Should Ireland have Joined the Euro?	Trinity
2010	Harvard	The Decline of US Economic Dominance	Harvard
2011	Oxford	Ireland Owes a Debt of Gratitude to Britain	Oxford
2011	Yale	It's all America's Fault	Trinity
2012	Cambridge	Ireland Should Rejoin the Sterling	Trinity
2012	Harvard	The US State Does Not Care for its Sick	Harvard
2013	Oxford	Deserting the Euro	Trinity

2013	Yale	Tax is Theft	Trinity
2014	Cambridge	United States of Europe?	Cambridge
2014	Harvard	US Education System	Trinity
2015	Oxford	100% Inheritance Tax	Trinity
2015	Yale	Opening the Mexican Border	Yale
2016	Cambridge	Will the EU Benefit from Brexit?	Cambridge
2016	Harvard	Should we be Afraid of Cheap Oil?	Harvard
2017	Oxford	The EU is Unsustainable	Oxford
2017	Yale	Globalisation is Doomed	Yale
2018	Cambridge	Britain Should Pay Reparation to Former Colonies	Cambridge
2018	Harvard	The American Dream is Dead	Trinity
2018	Oxford	This House would unite Ireland post-Brexit	Yale
2019	Yale	Protectionism is Failing America	Cambridge
2019	Cambridge	Open All Borders	Cambridge

ENDORSEMENTS

"The Student Economic Review gives many students their first opportunity to publish a piece of academic written work. It thus supports and promotes the rigorous analysis, excellence in learning and persuasion that are essential building blocks for future careers and broader intellectual contribution. The collected contributions, now reaching into a third decade, constitute an elegant contribution to scholarship and erudition of which Trinity College can be proud."

John Fingleton
DPhil Oxford and former Chief Executive Officer of Fair Trading London
Editor, SER 1987

"My involvement in the SER was an important defining point in my undergraduate experience at Trinity. It introduced me to the world of academia, the role and importance of academic publishing and the range of questions and depth of research possibilities in the discipline of economics. It has stood the test of time and grows stronger every year attracting the highest calibre of students."

Carol Newman
PhD TCD, Associate Professor TCD
General Manager, SER 1997

"Ever since leafing through a copy of the SER in my JF year, my ambition to become involved in this prestigious student society could not be curbed. Leading the committee through the year from the first workshop to the launch was an experience dotted along the way with enduring memories. From a three-day discussion about which tablecloth should be used for the workshop, to finally holding a copy of the review at the launch evening. I'm sure our friendships will last as long as the memory of my scrupulous organisation!"

Cián McLeod
Strategic Operations Specialist, Google Ireland
General Manager, SER 2014

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STUDENT ECONOMIC REVIEW WELCOMES

Welcome from the General Manager

Founded in 1987, the Student Economic Review is an entirely student-focused academic journal that features articles written by undergraduates of Trinity College, Dublin. With a reputation for academic excellence, the Review provides a platform to showcase the exceptional work being undertaken by the University's Economics students who seek to explore and challenge conventional economic wisdom and to apply economic theories in new ways and to new areas. Now, more than ever, this critical thinking and dynamic analysis, that together produce innovative solutions to novel challenges, are in high demand.

Every year the Review has featured many outstanding essays and today former committee members and contributors are leading figures and innovators in the fields of business, finance, research and academia globally. The journal hosts many highly anticipated events, such as debates against prestigious universities like Oxford and Harvard, as well as guest lectures from leaders and experts in all areas of economics. While some events were unfortunately cancelled in light of the COVID-19 Coronavirus outbreak, the breadth and depth of those held and planned is a testament to the diversity of economic thought on Trinity's campus.

The Review enables contributors to critically dissect and evaluate the efficacy of traditional economic beliefs. This provides them with a means through which they can propose modern adaptations to economic models that can be used to solve today's most pressing issues. The Review in recent years has published articles as far-ranging as trade protectionism in the United States and the history of gender inequality in economics. Through theoretical application of new and established theories, Trinity's Economics graduates will ensure the prosperous development of the subject into the future.

This year, the Review's mission takes a three-pronged approach. Firstly, it strives to cultivate an environment where economic discussions are reasoned, rational and rigorously debated by undergraduates. Moreover, the journal hopes to promote the value of economics on campus and in society more generally. Finally, the publication seeks to highlight the

many advantages to studying this esteemed subject, and its applicability to many career areas. The dynamism and flexibility in their study of economics show how contributors to the Review will face the new opportunities and threats that this post-pandemic world offers us.

The work of this year's Review would not have been possible without the remarkable efforts our Committee, all of whom have given tirelessly of themselves to this great cause. Each editor and manager dedicated themselves wholeheartedly to the Review, both before, during and after the onset of the pandemic. The efficiency of their adaptability to the unfolding situation will stand them in great stead as they embark on their future careers. I wish to personally thank them all for their vital support. Moreover, the entire Committee is greatly indebted to the Patrons of the Review, lead by Dr Ronan Lyons, for the generosity and steadfast support and guidance throughout its production.

To the readers of this year's Review, I have only one final message: let this publication inspire hope that there will, in the not so distant future, be a better tomorrow.

Kevin Loftus
General Manager, SER Vol. XXXIV

Letter from the Editor

After many months of hard work, it is with immense pleasure that I welcome all readers to the 34th Edition of the Student Economic Review. Throughout some incredibly tumultuous times in the world of economics, including the burst of the dot com bubble, the rise of new economic superpowers and the Great Recession, the Student Economic Review has continued to publish some of the finest undergraduate research in the field. Now, in these continually chaotic and unpredictable times, innovative and rigorous research remains as important as it always has been. Although publication in the SER is likely a first taste of the world of published economic research, many past submissions have been just the beginning of long and prolific careers in academia. Past committee members and submitting undergraduates have become leaders in the field of economics, and it is upon this history of ambition and success that we have continued building the esteemed reputation of the SER. The publication has gone from strength to strength since its inception in 1987, and I sincerely hope that it continues upon this upward trajectory.

In writing this letter of welcome, I recollect a conversation with former President of the SER, Professor John O'Hagan, as we walked across Front Square on a rather wintry November evening. Professor O'Hagan, who had been President since the Review began in 1987, spoke with such high regard for it as a publication, expressing great pride in how it has evolved since the first edition was published over three decades ago. This conversation with Professor O'Hagan was testament to the fact that the importance of the SER extends beyond merely the committee or those who submit their work for consideration. Indeed, it is a publication of considerable significance to all those who are involved in it, either in a direct or indirect capacity. It is for this reason, amongst others, that it has been an honour and a pleasure to serve as the Editor of the SER this year, and despite the hard work it involved, I am rather wistful at having to relinquish my position when the Review is published.

The task at hand for myself and my colleagues on the Editorial Board over the past number of months was to select those essays which we believe represent the finest in undergraduate economic research. We sought research which demonstrated an exceptional understanding of economics, whether it employs rigorous econometric modelling or dives

into the history of economic thought, and which is also thought-provoking, engaging, and demonstrates a clear relevance to the times in which we live. The sheer volume of submissions received was phenomenal, and has ensured that the quality of work in this year's Review is first-rate. However, this has also meant that, regretfully, a number of excellent papers have been excluded. To meet the criteria for publication, the chosen essays displayed not only a robust understanding of economic theory, but also originality of thought and the ability to write lucidly. Published works in this year's Review have been divided into eight sections, of which I will now give a brief overview.

We open with the Economic Policy section, which itself opens with what we considered to be the standout essay of this year's Review. Kate Devane and Michaela Fricova offer an erudite investigation into the evolution of offshore wealth in the Visegrad Group, which we have recognised as the Best Overall Essay of the 34th Edition of the Student Economic Review owing to its clarity, originality and adept utilisation of both economic theory and econometric analysis. The Economic Policy section continues with a thoroughly interesting work by Niall Maher which explores the impact of privatisation on the Chinese economy, and is concluded with Conor O'Malley's excellent analysis of the divergence between academic consensus and political reality on the issue of free trade.

The second section is Behavioural Economics, which, unfortunately, seemed to be less popular than has been the case in recent years. The tetrad of Liam Brown, Rowan Hamilton, Yannik Obelöer & John Walsh evaluate the impact of default frames in determining willingness to pay to offset carbon emissions, noting that this, amongst other behavioural "nudges", is a simple but effective way to lessen the distance between us and a carbon-neutral future.

Our third section is European Economics, with contributions from Kate Devane and Cian Devine Prendergast. Devane's paper analyses the impact that membership of the Eurozone has had on the economy of Italy, whilst Prendergast tackles the issue of introducing a bloc-wide unemployment insurance programme in the European Union. Both offer an interesting look into the inner workings of EU policy and explore the future prospects of the European Union and its member states.

Development Economics forms the fourth section of this year's Review. Within this section, Yannik Obelöer econometrically examines wheth-

er the level of freedom within an Official Development Aid recipient country impacts the level of aid received. His work is followed by that of Cillian Bissett, who offers a deep dive into the ever-expanding field of microcredit.

Fifth, we have the ever-popular Economic History section. This section opens with somewhat of an "originality assessment" of Adam Smith's Division of Labour by Ciarán Mulqueen, looking at ancient and modern influences on Smith's thought. Mulqueen is followed by a meticulously researched critique of neoclassical economic thought by Sarah McGuinness, whose focus on the role of economic discourse in battling climate change is both insightful and refreshing.

The sixth section is concerned with Urban Economics, and includes a wonderful assessment of the efficacy of the Central Bank of Ireland's "Mortgage Measures" by Conor Murphy and Philip Pollock. The authors adeptly employ dynamic panel-data regression techniques to determine whether or not these measures have successfully prevented or contained another Irish property bubble. It was noted during the process of selecting papers for publishing that Dr. Ronan Lyons has gone from being Editor of the Student Economic Review in 2001 to being cited in it in 2020!

Our penultimate section is Industrial Economics & Competition Policy, which hosts two papers. The first is "Evaluating the US Policy Tradition on Predatory Pricing" by Owen Graham-O'Regan, which seamlessly interweaves both economic and legal theory to produce a compelling argument for the requirement for much improved anticompetition policy in the United States. For this superb analysis, we awarded this paper the title of "Best Freshman Essay" of the 34th Edition of the Student Economic Review. Graham-O'Regan's paper is followed by a thoroughly engaging submission from Kai Fischer, who investigates the optimal means of punishing collusion in a market.

The final section of this year's Review is Economics of Financial Markets, which also happens to be the biggest section, predominantly owing to the large volume of research papers submitted within this field. The section begins with Brendan Dowling's excellent "Neural Networks as an Option Pricing Method", an incisive examination into the use of machine learning for derivative pricing within financial markets. Dowling's paper beautifully amalgamates financial economic theory, mathematics, statistical modelling and knowledge of machine learning, earning

his paper recognition as the "Best Applied Essay" of this year's Review. Up next is a paper by former SER Editor Charlie Walsh and his co-author Andrew O'Riordan, who argue that investors are myopic in their assessments of the cost of climate change by employing an impressive event study analysis. Shauna Fitzmaurice & Róise McSorley also delve into the impact of news events on financial markets by analysing the impact of the two high-profile crashes of Boeing's 737 Max aircraft on the stock price of the company. Michaela Fricova and Jonathan McKeown examine another increasingly relevant component of financial markets: cryptocurrencies. They look at potential bubbles in the market for Ether, the world's second most popular cryptocurrency. Last but by no means least, to round off the 2020 Edition of the Student Economic Review Vivien Ehle and Charlotte Cooper investigate how fluctuations in the USD/RMB exchange rate affect China's debt assets, with a special focus on the value changes that have occurred after the devaluation of the Chinese renminbi.

The above is but an incredibly brief outline of the papers in this year's Review -- I would highly recommend reading them all in great depth to appreciate their excellence! It was incredibly refreshing to see an enormous amount of original research this year, and in particular, I was impressed with the high levels of engagement with pressing economic issues of our time such as climate change, cryptocurrencies and machine learning.

At this juncture, I would like to express my immense gratitude to all those who were involved in the production of another fantastic edition of the SER. Firstly, to the other members of the 2020 SER Committee I extend my sincere appreciation -- they have been a pleasure to work alongside throughout the year and ought to be commended for their industriousness, diligence and tenacity. In particular, I would like to give thanks to my fellow members of the Editorial Board, Nicole O'Sullivan and Eoin O'Donnell, who were hugely helpful in selecting and editing those submissions which were to be published in this year's Review. I have no doubt that I am not alone in also wishing to especially thank Kevin Loftus, our General Manager, who inspired us all with his organisation, work ethic and indefatigable enthusiasm throughout the year.

Secondly, I also must give thanks to all of those who submitted their work for consideration. The publication simply would not exist without submissions, and thus continued engagement with the SER from

undergraduates in the Economics Department is vital. I am glad to say that this year the Review was once again in receipt of a huge volume of submissions from students across all years, with the standard exceptionally high as per usual.

Finally, both myself and the rest of the Committee owe a great debt of gratitude to the Economics Department, particularly to the Patrons of the SER: Dr. Ronan Lyons, Dr. Tara Mitchell, Dr. Michael Wycherley and Dr. Alejandra Ramos. We are all extremely thankful for your continued commitment to the SER and the indispensable guidance you gave throughout the year, and deeply appreciate the time you invested in both us and the publication. I also give my personal thanks to the Patrons for allowing me the wonderful opportunity to be the Editor of the Review this year, a position in which I have learned an incredible amount and which I will value eternally.

With all being said, I would like to extend a very warm welcome to the 2020 Edition of the Student Economic Review. I truly believe that the works published in this year's journal are as insightful, thought-provoking and innovative as those of the past, epitomising the boundless talent that the undergraduates of Trinity's Economics Department possess. Without any further delay, I invite you to begin reading them. I hope you enjoy reading them as much as I did, and that their content will excite and inspire you as they did me. The ideas contained within these pages might someday change your life, or indeed the world, for the better.

Harry Humes
Editor, Student Economic Review Volume XXXIV

Guest Speaker's Welcome

Now more than ever our world needs intellectual curiosity, expertise, and a focus on research into issues with the potential to make a difference to people's lives.

The COVID-19 pandemic has had a devastating impact on human health and loss of life; has brought about huge changes in everyday life and social interactions during lockdown and continuing social distancing; and has halted much of economic activity in its tracks. So alongside the medics and research scientists, the economics profession has a huge role to play in guiding how we manage the crisis and its consequences, and how we rebuild national economies and the global economy following this shock to the system.

The work of universities has been hard hit by the switch to remote teaching and research, and the challenge to a funding model that relies heavily on the income of overseas students. So producing and publishing this Review in the shadow of the pandemic is a great effort.

It is hugely encouraging to see the quality of work of tomorrow's young economists in the depth and range of topics covered in the eighteen pieces selected for Trinity College's 2020 Student Economic Review. These address topics as diverse as climate change, economic development in China, the pricing of derivatives, and microcredit. This rich collection looks at issues across the world, and at issues at home like Ireland's macroprudential policy. The ambition, curiosity and application of economic research techniques shown in these papers is a good augury for their authors' future careers.

We need more than ever a generation of economists who are engaged with the world's problems, are data-driven, and can offer new insights. The world economy has sustained a major shock, while underneath the old problems of climate change and environmental degradation, poverty and inequality, institutional and market failures remain to be addressed. The global pandemic has focused attention on the importance of quality healthcare and basic public health measures like access to clean water, and on the value of a well-functioning social safety net.

The globalised economy has experienced a setback as borders were closed, and countries have queried their reliance on foreign suppliers for essentials like personal protective equipment or ventilators. EU solidar-

ity has been shaky over the early weeks of the pandemic. All of these developments have built upon an already growing tide of economic nationalism that ranges from Budapest to Brexit to Trump's America.

Out of the chaos of the Second World War came the Bretton Woods institutions, and the Marshall Plan to rebuild a shattered Europe. The 2008 financial crisis, eventually, brought about new mechanisms to manage Europe's monetary union of sovereign member states. Will new institutions or economic tools be needed in the aftermath of the COVID-19 shock?

As governments and international bodies move to rebuild the world economy, we should undoubtedly try to do that in a greener and more sustainable way: for example, making aid and investment contingent on an environmentally sustainable approach. Economic instruments and pricing signals are important to achieve a rebalancing – the price of carbon needs to reflect the full social and environmental costs imposed.

Some industries around the world will take a bigger hit – tourism and air travel will be particularly slow to return to their pre-crisis levels. Countries that are heavily dependent on tourism like Greece and Spain will suffer, and in Ireland, we will feel the effects along the Wild Atlantic Way, and in other tourist hot-spots. Sound economic guidance will be required on how best to deal with the consequences in terms of fewer jobs, higher levels of personal, business and national debts, and the creation of alternative enterprises. Our societies will need to draw on a range of economic specialisms from macro-and micro-economics to monetary economics, public finance, labour market and behavioural economics, and more.

The coronavirus crisis has highlighted both strengths and weaknesses in social and institutional arrangements. European governments with their social safety nets have been nimble in responding to sudden losses of income, and providing the short-term financial security to businesses and families that have allowed quarantining of most business activity to become a reality. At the same time, the crisis has exposed weaknesses in surge capacity in hospitals, in access to and distribution of personal protective equipment, and most notably of a congregated model of elder care in nursing homes. The model of low-paid, precariously-employed staff, often migrants, living in overcrowded conditions, providing essential services from nursing home care to meat processing, has emerged in many countries as a particular vulnerability. Inequality and

poverty have exacerbated risks for many vulnerable groups.
Here in Ireland, the challenges that formed the substance of the February 2020 election campaign – housing market failure, the health service, climate change, childcare, and how to fund pensions, care and hospitalisation for a growing and ageing population – have come into starker relief, at a time when public finances are likely to be severely constrained going into the future.

It is vital that the economics profession in Ireland engages with the economic and social challenges we face, and that a diversity of voices and skills are brought to the task. Our universities need to complement the work undertaken by the ESRI, the Central Bank, and the Irish Government Economic Evaluation Service in undertaking applied economic research, and in opening up new areas of inquiry. There has been a proud tradition in this regard, with figures like the late Professors Louden Ryan and Brendan Walsh providing intellectual heft, research, and public engagement in informing policy. We depend on new generations of students and young academics to follow in their footsteps.

One of the former luminaries of the Student Economic Review, the European Central Bank's Chief Economist Philip Lane, has a pivotal role in managing the EU economy back to health after the COVID-19 shock. I hope that all those involved in the 2020 Student Economic Review will also go on to make their mark in the world of economics and public policy.

Eithne Fitzgerald

Former Minister of State, TD, Labour Party politician and Economist

SER Debates 2019/20

Since their introduction into the SER programme in 1996, debates have been an integral part of the Review's interaction with the student body and wider college community. Student speakers are chosen for their knowledge of the subject matter, as well as their ability to provide a convincing argument to engage the entire audience. Thus, the debates often provide a multidisciplinary companion to the papers presented in the Review. Due to unprecedented global events, the SER was only able to hold one debate this academic year: Trinity vs. Cambridge, in conjunction with the University Philosophical Society. Thanks are due to the committee members of both the Student Economic Review and the University Philosophical Society, as well as our faculty patrons, guest judges and chair, for ensuring the great success of this event.

Trinity vs. Cambridge
Thursday, October 31st, 2019

The Cambridge speakers arrived in Dublin on what was both Halloween night and the eve of a no-deal Brexit (which was, of course, later postponed), giving extra weight to the motion before the House: "This House Would Open All Borders". The Cambridge team, speaking in opposition, consisted of Andrew Tang, James Combe, and Misha Tseitliani, whilst the Trinity team featured Nicole O'Sullivan, Hugh O'Laoide and Caoimhin Hamill. All six speakers in the debate had significant international debating experience and had represented their respective institutions at multiple competitions.

The debate was chaired by Ian Kehoe, author, broadcaster and founder of TheCurrency.ie, and judged by Edel McGinley (Migrant Rights Centre Ireland) and Harry Morris (TCD Economics Graduate, 2018) with Cormac O'Grada (Emeritus Professor of Economics, UCD) acting as chair of the judges.

Nicole O'Sullivan, captain of the Trinity team, spoke first. O'Sullivan defined what exactly the idea of "opening all borders" would entail, and why it would be possible despite being outside of the current popular imagination. She told the audience of both the social and economic barriers that borders erect between the various nations of

the world. She furthered her argument by giving the examples of tariffs and trade barriers as being economically inefficient, and continued the economic case for open borders by highlighting that immigration often correlates with economic growth.

Andrew Tang of Cambridge spoke second, and gave arguments relating to why opening all borders was impossible in the current world, with the potential instability created by this change outweighing any hoped-for economic benefits. Caoimhin Hamill was the second speaker for Trinity, and rebutted Tang's material whilst simultaneously bolstering O'Sullivan's argument. He added a philosophical dimension to the debate, arguing that borders and the barriers and opportunities they create are immoral, given that where you are born in the world is wholly aleatory. Thus, because of this, no advantage should be given to nationals of a certain country.

James Coombe spoke second for Cambridge and provided additional economic reasoning to Tang's initial arguments, suggesting that there would be a significant "brain drain" from developing countries in a borderless world, thus resulting in even greater inequity than exists in a world with borders.

Hugh O'Laoide and Misha Tseitliani concluded the debate with whip speeches for Trinity and Cambridge respectively. They summarised the best arguments presented by their side and weighed up the claims given by the opposition. Both speakers effortlessly wove in humour with argument generation and rebuttal. With the debate concluded, the judges retired and the chair, Ian Kehoe, addressed the crowd.

Kehoe spoke nostalgically of his own time in Trinity, which consisted of attending debating competitions, playing tennis, and hanging around the GMB and the Arts Building -- all this in spite of the fact that he was a DCU student. Kehoe thanked the teams for their speeches and performance and gave his own insights on the motion, making particular note of the future of borders in light of the Brexit decision.

The adjudicators then returned and O'Grada gave a short address on his perception of the debate and the economic ideas presented. Cambridge's Andrew Tang was awarded Best Speaker, but Trinity was declared the winner of this thrilling competition!

Trinity vs. Harvard
Cancelled

This Hilary term, the SER Committee and faculty had to make the difficult decision to cancel the second SER debate as a precautionary measure to limit the spread of COVID-19. Set to represent Trinity were Amelia Melanson as captain, with Ronan Boyce and Hugh O'Laoide as team members. The debate was to be chaired by Robert Shortt, RTE's Chief Economics Correspondent. The motion before the house was to be, "This House Welcomes the Rise of Automation".

Despite not being able to hold the debate, discussion of both motions this term, as well as economics more generally, remain of utmost importance due to the impending recession and varying state responses to the coronavirus crisis.

My thanks goes to all the speakers and guests of the debates, my fellow SER Committee members, and faculty members Tara Mitchell, Alejandra Ramos, Ronan Lyons, Michael Wycherley, and Gaia Narcisco for their advice and support throughout this year's SER programme.

Lucille McKnight
Debates Manager, SER Vol. XXXIV

SER Workshops 2019/20

Workshops have been a staple feature of the Student Economic Review's annual programme for the past number of years, and are instrumental in increasing student engagement with the journal. The workshops are designed to increase the interest of fellow students in independent research, particularly economic research. They allow for the exchange of knowledge between students across different years within Trinity. They also explore themes and topics relevant to postgraduate careers. In Michaelmas Term two workshops were hosted by the SER.

Writing & Research Workshop with SER and TWR
5 November 2019

Through this collaborative event with the Trinity Women's Review we sought to promote interdisciplinary research within Trinity's undergraduate population. The workshop was given by PhD candidates in Economics, Political Science, Law and English. Invited guests discussed the primary areas of interest of their research, and explained the various ways of conducting research within their fields. Two of the guest speakers specialised in quantitative research, whilst the other two specialised in qualitative, thus offering the audience a broad array of insights into research methods.

This year's SER committee hopes collaborative events between various student publications in Trinity will continue into the future, as they foster exchange of knowledge and widen the scope of potential readers and contributors to the Review.

SER Foundation Scholarship Workshop
26 November 2019

Every year the SER committee provides students wishing to take the Foundation Scholarship examinations with a workshop and Q&A session delivered by students in third or fourth year who were elected as Scholars in recent years.

In November, three Economics Scholars elected in 2019 kindly

agreed to discuss their personal experiences with studying for the Foundation Scholarship exams. The advice covered preparation for exams in the fields of Economics, Business, Philosophy and Political Science. They shared technical and more personal advice on studying for different papers with a large audience of Senior Freshman students who intended to sit the Schol exams in January.

Overall, the workshops hosted this year proved to be a great success, and undoubtedly contributed to the high quality of research which was published in this year's edition of the SER.

Casper Kurpan
Workshops & Launch Manager, SER Vol. XXXIV

The evolution of offshore-wealth among Visegrad Group residents, 2001-2015

Kate Devane, Senior Sophister
Michaela Fricova, Senior Sophister

The 34th Edition of the Student Economic Review begins with an erudite investigation into the evolution of offshore wealth in Hungary, Poland, the Czech Republic and Slovakia – collectively referred to as the Visegrad Group – by Kate Devane and Michaela Fricova. This stellar research makes fantastic use of econometric tools to examine the factors that determine variability in offshore wealth in the Visegrad countries in the period 2001-2015. The paper finds a significant increase in the mean amount of offshore wealth from 2001-2015, even after adjusting for GDP growth. Unemployment rate, public indebtedness, personal income taxation, the rule of law and natural resources are shown to be significant determinants in the evolution of offshore wealth, whilst higher offshore holdings are discovered among Visegrad Group residents during periods of good governance. In contrast, political stability and the GDP growth variables are demonstrated to have very little explanatory power. Finally, a structural break in the magnitude of offshore wealth holdings for the Czech Republic and Hungary is identified in the years following the 2008-2009 economic downturn. This paper is well-researched and driven by quantitative data, which is adeptly interpreted and analysed. Moreover, the work is brimming with clarity, a difficult task in itself given the complexity of the econometric analysis performed.

Above all, the work is original, epitomising the propensity for novel and innovative research amongst Trinity's undergraduates. For these reasons, we have decided to recognise this paper as the Best Overall Essay of the Student Economic Review XXXIV.

I. Introduction

"The billions attracted by tax havens do harm to sending and receiving nations alike' (Shaxson, 2019)"

The use of offshore tax havens deprives domestic economies of tax revenue, draining developing countries in particular of a valuable source of public funds (Henry, 2012). In aggregate, governments lose between $500 billion and $600 billion annually to tax havens in the form of lost corporate tax revenue (Crivelli, de Mooij & Keen, 2016; Cobham & Janský, 2018). Hungary comes in third place among EU nations in terms of these losses: it could collect an additional 23% of tax revenue was it not for the extensive use of offshore havens. Poland and the Czech Republic could collect a further 10% and 6% respectively (Torslov, Wier & Zucman, 2017). The potential impact of offshore wealth on inequality measures is particularly salient in the context of Eastern Europe. Four decades of communist rule in Czechoslovakia, Poland and Hungary had a pronounced effect on the distribution of wealth and income. From 1990-2000, the Gini coefficient estimates rose by an average of 10 basis points across the Visegrad Group [V4]. There is evidence that wealth inequality in the V4 has continued to rise up until and following the crisis: in Poland, for example, the concentration of assets amongst the wealthiest households increased by 4% in the period 2014-2018 (Krukowska, 2017). A similar upward trend in inequality has been observed in the Czech Republic.

Private wealth has come to comprise an increasingly important share of national wealth in Eastern Europe since the 1990s (Zuk et al., 2018). Residents of the V4 countries have in recent years been consistently linked to offshore entities (ICIJ Offshore Leaks Database, 2019), including former Slovakian prime minister Robert Fico (Liptáková, 2016). Pawl Piskorski, the Mayor of Warsaw (1999-2002), came under scrutiny in 2005 when it emerged that his assets exceeded those he declared as an MEP (2004-2009). In 2013 Piskorski attempted to open a Panamanian bank account on his own behalf (ICIJ Offshore Leaks Database, 2019). Having observed the increasing wealth inequality together with the scandals surrounding Panama Papers in recent years, we hypothesize a significant rise in offshore wealth among the residents of V4 countries.

Much of the research on the evolution of offshore wealth has been concerned with well-developed countries in Europe – primarily Scandinavia (Alstadsæter, Johannesen & Zucman, 2018) and France (Garbinti, Goupille-Lebret & Piketty, 2016). Studies have also been conducted to investigate the relationship between wealth inequality and offshore wealth. However, no study has provided a comprehensive time series analysis of offshore wealth in the V4. The Visegrad countries offer an interesting case study. They comprise four open economies that are similar in many ways - geographically, culturally, and historically (International Visegrad Fund, 2019) - but exhibit heterogeneity in terms of political stability and economic growth[1] . We, therefore, present the first study on the evolution of offshore wealth in the post-communist countries of the Visegrad group.

1 "Individual Visegrad countries are dealing with heterogeneous problems" (Helšusová, 2003); see also Figures 2 and 3.

Country-by-country estimates of offshore wealth by Alstadsæter, Johannesen and Zucman (2018) identify a number of significant factors that determine the national size of offshore wealth: a) proximity to Switzerland; b) political and economic instability; c) presence of natural resources (particularly oil); and d) taxation legislation. According to Andersen et al. (2016), exogenous income shocks can lead to significant increases in hidden wealth at the country level; these effects can, however, be mitigated when the country exhibits strong political stability[2].

This leads us to hypothesize:

H1: There was a significant increase in the overall magnitude of offshore wealth as a proportion of GDP in the V4 countries over the time period 2001 to 2015.

H2: The evolution of the political stability and economic stability indicators in each of the V4 countries is significant in explaining the size of offshore wealth as a proportion of GDP.

Countries with a history of severe and persistent financial crises such as Argentina and Russia are found to have higher percentages of offshore personal wealth relative to their GDP than nations with more stable macroeconomic structures. We thus anticipate significant spikes in offshore wealth to GDP ratios in these countries following the financial crisis.

2 We cannot test for the effect of proximity to Switzerland explicitly as we use a fixed effects model. However, our four countries' respective proximities to Switzerland (and indeed other tax havens) are similar. Hence, we assume that this variable is unlikely to be significant in driving heterogeneities in offshore wealth in this particular study.

We therefore also hypothesize that:

H3: Hungary and the Czech Republic, the 2 countries of the V4 that were most severely affected by the Financial Crisis of 2008-09 would note a structural break in the magnitude of offshore wealth in the years following the crisis.

II. Literature Review

Henry (2012) calculates a revised measure of the distribution of global financial wealth, taking offshore wealth into account, and finds that nearly half of all offshore wealth is owned by 0.001% of the world's population. He finds that the offshore economy is large enough to have very significant negative impacts on the domestic tax bases of "key source countries"[3] , of which Hungary is one. From the 1970s until 2010, private elites in these countries had accumulated $7.3 to $9.3 trillion of unrecorded offshore wealth. Henry's work highlights the implications of private offshore wealth for these countries, both in terms of their international balance sheets and inequality measures.

Shaxon, Christiensen and Mathiason (2012) scale-up BIS offshore deposit data by non-banks by a ratio of deposits to all financial assets. They estimate the total value of offshore private wealth to be $11.5 trillion as of June 2004, approximately $9.5 trillion of which consisted of offshore financial assets.

Novokmet, Piketty and Zucman (2017) present results on the evolution of private and offshore wealth in Russia. They find that Russian-owned offshore wealth is more than three times larger than official foreign reserves. They also find that Poland, the Czech Republic and Hungary have each been characterized by high and rising inequality

3 Those countries that have seen consistent net capital outflows over time.

since 1990. Moreover, inequality varies among post-communist countries, with the top 1% income shares below 5% in Russia but below 3% in the Czech Republic. They attribute this disparity to differing institutional frameworks that emerged after the fall of the Soviet Union, with Eastern European countries boasting a higher rule of law and better protection of property rights[4] than Russia. Institutional and political factors may thus be significant in determining the magnitude of offshore wealth in Eastern European countries.

Genschel, Lierse and Seelkopf (2016) find that at any country size and tax level, poorly governed countries suffer more in terms of capital outflows. Well governed countries boast low corruption and have a reasonably effective tax administration. Poorly governed countries can offer fewer guarantees to investors against the future expropriation of their assets. Thus, they show the regressive distributive effect of tax evasion under poor governance.

The literature on the association between cross-country differences in personal income taxation and offshore wealth magnitude is somewhat contradictory: some studies indicate lower levels of offshore wealth in high-income tax countries (Alstadsæter et al., 2019); others suggest the contrary (Novokmet et al., 2018). However, a reasonably unified perspective on the time-varying characteristics of personal income taxation within a country has been outlined in the research. A one-off increase in private income tax is generally associated with a rise in wealth held offshore by residents (Torslov et al., 2019). This is directly testable with our panel data specification.

4 The higher-quality institutional frameworks are likely a consequence of prospective accession to the EU (Berglof & Roland, 1997).

III. Empirical Approach

We drew on some of the empirical methods used by Zucman (2013) and Alstadsæter, Johannesen and Zucman (2018). The steps of our analysis were:

(a) Investigate the evolution of deposits since the early 1990s, treating it as a proxy[5] for the evolution of offshore wealth. We calculate the total amount of household wealth held in each offshore centre for the time period 2001-15 [using the estimates compiled by Zucman (2017)] and then assign a proportion of this to the four countries. These proportions are based on the percentage of deposits in each respective OFC belonging to residents of each V4 country. From this, we approximate the magnitude of private offshore wealth for each V4 country from 2001 through 2015.

(b) Perform paired-samples t-test to test hypothesis 1, that overall magnitude of offshore wealth has risen in the four counties over the period 2001 to 2015. We account for an increase in Gross Domestic Product during the time period by scaling the results by GDP for each country in question.

(c) Regress our offshore wealth measure on various potential determinants of offshore wealth holdings (as outlined in the literature), including measures of economic and political stability. We ensure our explanatory variables fall within a generally acceptable range of multicollinearity (as specified in Hair et al., 1995; and Ringle et al., 2015).

Our preferred specification is outlined in Equation (1) where refers to the magnitude of offshore household wealth, as proxied by offshore deposits, in a given year and time quarter. The variable refers to an indicator

5 See section VI: 'Caveats'.

of political stability. Also accounted for is a rule of law indicator . Changes in unemployment rate, GDP growth, and public debt, constitute our indicators of economic stability. Change in taxation legislation is proxied by the per-

$$wealth_{it} = 0 + \beta_1 gdp_{it} + \beta_2 debt_{it} + \beta_3 unempl_{it} + \beta_4 politit_{it} + \beta_5 resit_{it} + \beta_6 law_{it} + \beta_7 incit_{it} + \epsilon_{it} \quad (1)$$

IV. Overview of the Data Set

Our dataset is compiled from a number of sources. For the offshore deposit data, we rely on freely available data published by the Bank for International Settlements (BIS, 2019). In particular, our analysis utilizes the international bank deposits data, published quarterly by the BIS office, over 2001-2015 for each of the four Visegrad Group countries. Our analysis uses data on the deposits owned by non-banks only. That is, we always exclude interbank deposits, as they do not reflect households' offshore wealth . As in Alstadsæter et al. (2018), we assume that if (for example) Poles own 10% of the deposits belonging to foreign non-banks in Singapore, then they also own 10% of the household offshore wealth held there—i.e., that the distribution of deposits is the same as that of offshore wealth[7].

Table 1 shows the summary statistics of offshore deposits in each of the Visegrad group countries togeth-

6 Natural resource rents are time variant due to natural endowments, the propensity of governments to commercialize resources, global prices etc.

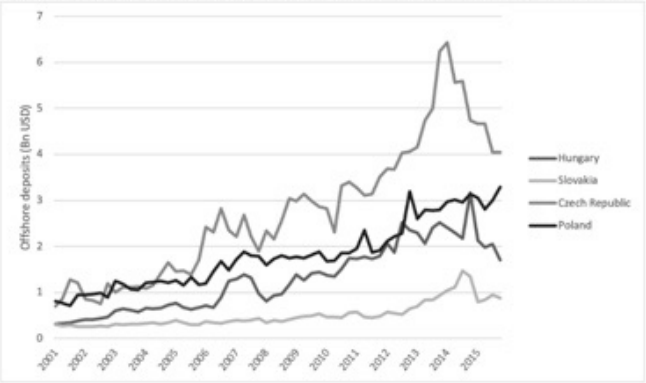
7 The dataset does include a specific measure of household deposits. This household deposit measure does not however allow for wealthy households using financial holding companies as the nominal holders of their assets, in which case their deposits are assigned to the broader category of "non-bank financial" owners (Alstadsæter et al, 2018). Hence, we base our analysis on the general "non-bank financial" deposits measure.

er with providing statistics on average offshore deposits in years 2001, 2005, 2011 and 2015; Figure 1 traces the evolution of offshore deposits over the time period.

Table 1. Summary Statistics of Offshore Deposit Evolution in V4.

	2001 Mean	2005 Mean	2011 Mean	2015 Mean	Total Mean	Total Median	Total SD
Hungary	0.34	0.69	1.75	1.96	1.30	1.28	0.72
Slovakia	0.28	0.33	0.49	0.86	0.51	0.40	0.27
Czech Republic	0.91	1.49	3.23	4.53	2.69	2.49	1.49
Poland	0.81	1.23	2.02	3.04	1.81	1.74	0.72

Figure 1:
Evolution of Offshore Deposits for the Visegrad Group



Note:

(1) The magnitude of offshore deposits is in billions USD. Data is collected quarterly.

(2) We note a clear upward trend during 2000-2015 in all of the four countries; most notably in the Czech Republic and Hungary. However, a temporary drop in offshore wealth in these two countries a few years after the onset of the financial crisis is clearly shown. This is consistent with Czech Republic and Hungary being the two regions most severely impacted by the economic downturn (Pakulski, 2016). In contrast, Slovakia and Poland exhibit much lower deviations from the long-run trend.

As for the potential determinants of offshore wealth holdings, we utilize a number of indicators published by the World Bank (2019); its "Political Stability and Absence of Violence/Terrorism", "Rule of Law" and "Total Natural Resources Rents as a % of GDP" estimates. Changes in unemployment rate, per capita income, GDP growth and public debt from the World Bank's (2019) World Development Indicators constitute our indicators of economic stability. The plots of political stability and GDP growth for each of the four countries over the time period are depicted in Figures 2 and 3. We also include the coefficient of personal income taxation based on statistics from the OECD Tax Database (2019).

Figure 2: Estimates of Political Stability and Absence of Violence/Terrorism

Note: Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, [i.e. ranging from approximately -2.5 to 2.5.]

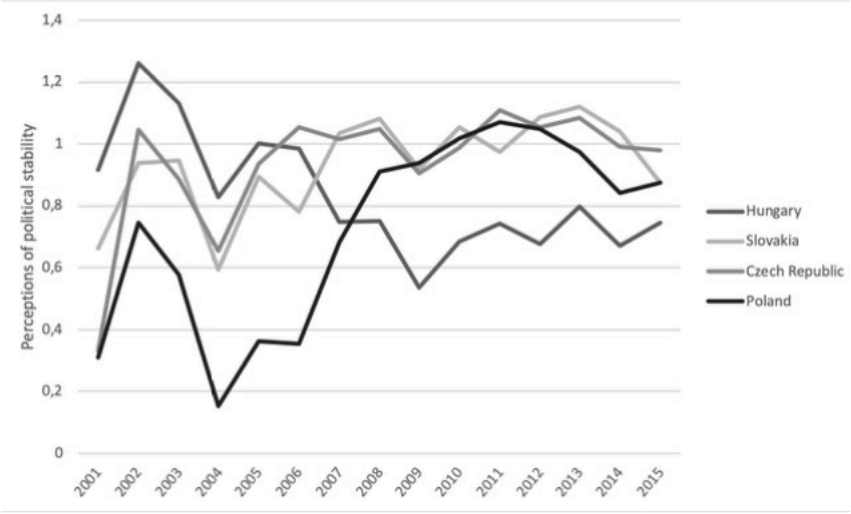
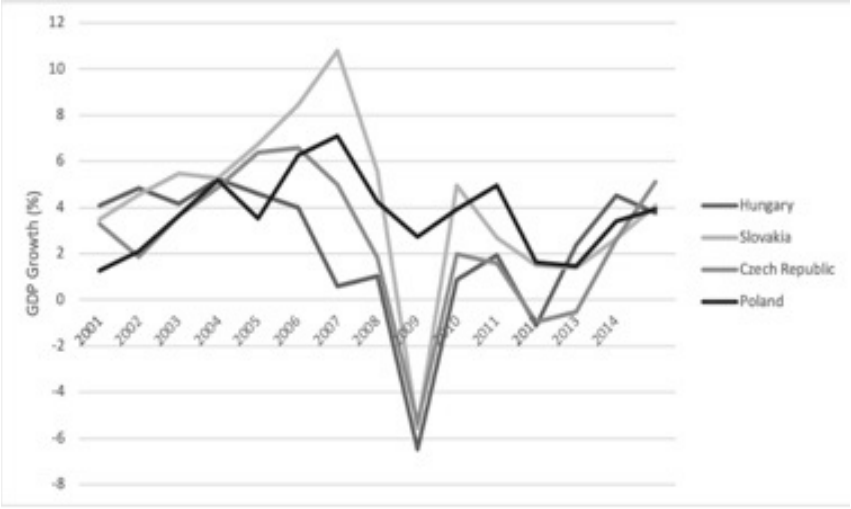


Figure 3: GDP Per Capita Growth

Note: Annual figures on Per Capita GDP Growth in the Visegrad Four. GDP per capita growth in $Bn.



V.Results

We find a significant increase in the mean amount of offshore wealth in the Visegrad countries over 2001-2015. Results of the paired samples t-test for equality of offshore wealth means are summarized in Table 2. We find the increase in the mean amount of offshore wealth holdings between the years 2001 and 2015 to be significant even at the 1% significance level. Furthermore, there is an approximately $1.95 billion increase in the mean amount of non-bank offshore wealth held by the Visegrad Four during the period (see Table A1 in Appendix).

Table 2. Paired samples t-test,

	t-stat	df	Significance (right-tailed)
Difference in offshore wealth between 2001 and 2015	-6.85***	3	0.003

Note: GDP-scaled paired samples t-test with the lower-tailed alternative hypothesis (assumes that the mean difference is less than zero). Statistical significance is as follows ***p < 0.01, **p < 0.05, *p < 0.1.

As for the influence of the 2008 Financial Crisis, we identify a dramatic rise in the magnitude of offshore wealth holdings for the Czech Republic and Hungary in the years following the downturn. More specifically, we find structural breaks in the offshore wealth series of both countries. The main results of structural break testing are reported in Table 3.

For the Czech Republic, we discover a sudden dramatic deviation from the long-run upward time trend in the series between the years 2010 and 2015. This rise is significant even at the 99% confidence level. Per Zeileis et al. (2013), we conclude that a structural break in offshore wealth holdings can be traced back to the first quarter (Q1) of 2013. As for Hungarian offshore wealth holdings, we again conclude a presence of structural break with 99% confidence. The recursive Optimal 2-segment partition F-testing traces the sudden dramatic deviation from the long-run wealth trend to Q4 of 2011.

These results are in accordance with Popov (2015). Since Hungary and the Czech Republic were the two V4 countries most severely impacted by the 2008-09 Global Financial Crisis, their series might exhibit signs of capital flight to more financially secure locations in the aftermath of the crisis.

Table 3. F-Tests for the presence of structural break

	Czech Republic	Hungary
1. Ave-F	87.642*** < 2.2e-16	98.953*** < 2.2e-16
2. Optimal breakpoint	Q1 2013	Q1 2012

Note: (1) We tested the model null hypothesis that non-bank offshore wealth is only a function of a linear trend regressor in Hungary/in the Czech Republic, against the alternative of a breakpoint occurring in offshore wealth series between Q1 2010 and Q4 2015. We employed the Ave F test as specified in Andrews (1993), to test whether the linear trend regression model only fits a subset of our time series country data. We rejected the null hypothesis of offshore wealth rising linearly in the series, against the alternative of a breakpoint being present in the data. Statistical significance is as follows ***p < 0.01, **p < 0.05, *p < 0.1. (2) The optimal breakpoint for each of the two countries was identified using Optimal 2-segment partition F-testing.

The results of our panel data regression estimation[8] are summarized in Table 4. Our preferred specification is outlined in column (1), as it explains most variation in offshore wealth. We find the unemployment rate, public indebtedness, personal income taxation, the rule of law and resources all to be significant determinants of offshore wealth. Contrary to Genschel et al. (2016), we find the Rule of Law index score to have a positive effect on offshore wealth holdings. Higher offshore holdings are discovered among Visegrad residents during periods of good governance. In contrast, political stability and the GDP growth variables have very little explanatory power[9].

8 Having observed country-specific fixed effects among the Visegrad group (refer to Appendix Figure 1 and Appendix Figure 3) and non-zero variance of the random effect (see Table A2), we estimate the preferred panel data specification using fixed effects method. The full range of supplementary diagnostic checks can be found in the Appendix.

9 One possible explanation for this is that high political stability may be associated with strongly

Table 4. Determinants of per-country offshore wealth

	(1)	(2)	(3)	(4)
Political stability	-0.58	1.08		-0.12
	(0.44)	(0.90)		(0.22)
Unemployment rate	-0.14***		0.07**	-0.06**
	(0.01)		(0.01)	(0.02)
Public debt	0.09***		0.07***	0.07***
	(0.01)		(0.01)	(0.01)
Per capita GDP	-0.00		-0.00	-0.00
	(0.00)		(0.00)	(0.00)
Income Taxation	0.03**		0.02***	0.02***
	(0.01)		(0.01)	(0.01)
Rule of law	1.37*			
	(0.56)			
Resources	-0.72**			
	(0.14)			
Observations	240	240	240	240
R2	0.73	0.07	0.63	0.64

Note: Fixed effects regressions based on quarterly data for 2001-2015. Heteroscedasticity robust standard errors also adjusted for observed serial correlation are in parentheses. Statistical significance is as follows ***p < 0.001, **p < 0.01, *p < 0.05.

VI. Caveats

We acknowledge that there are some limitations to our analysis. Our study only examines financial wealth. We exclude foreign residential real estate, gold, art and other non-financial assets as there is no systematic information available on these assets. Moreover, deposits only account for a fraction of total offshore wealth. The BIS dataset we use does not include portfolio equities, mutual share funds and bonds entrusted by households to offshore banks. Following Alstadsæter et al. (2008), we are confident in our assumption that the distribution of offshore bank deposits is strongly cor-

autocratic government. (World Bank, 2014) We would expect political stability to be positively significant (domestic uncertainty is reduced, reducing incentive to hold money abroad) in explaining offshore wealth. However, it is possible that in aggregate the negative effects of stability on wealth (risk of expropriation by an autocratic government or elite in-group, extractive domestic tax regime) counteract the positive, leading to overall insignificance. [see section VI: 'Caveats' for further discussion]

related with that of total offshore wealth. As such, our orders of magnitude are likely robust.

The increasingly widespread use of shell companies since the mid-2000s complicates matters, making it challenging to identify the beneficial owners of wealth held offshore. We anticipate a disproportionate amount of wealth may be assigned to countries where shell corporations are located.

We cannot rule out the possibility that variables with explanatory power may have been omitted. In particular, (following our unexpected result regarding the effects of political stability) further study should include the effects of levels of corruption and democracy on offshore wealth.

VII. Conclusion

Mean offshore wealth belonging to Visegrad residents has increased significantly from 2001-2015. Our analysis indicates that unemployment rates, levels of public indebtedness, personal income taxation, the rule of law and natural resource rents are significant determinants of V4 offshore wealth. Somewhat surprisingly, we find that political stability and GDP growth have very little explanatory power. We find evidence of a structural break in the magnitude of offshore wealth holdings for the Czech Republic and Hungary in the years following the 2008-2009 downturn. We conclude that economic instability is an important factor driving V4 residents to hold wealth in offshore centres, as are institutional and legislative factors. We propose some possible extensions: for one, the dataset used could be expanded to include portfolio security data. Moreover, further research may benefit from a more comprehensive regression analysis, including measures of corruption and democracy. While further study is

needed to provide a comprehensive picture of offshore wealth in the V4 in recent decades, we see our research as a useful starting point for investigation of Central and Eastern European offshore wealth.

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The Impact of Privatisation on Economic Development in China

Niall Maher, Senior Sophister

China is one of the great economic success stories of the past fifty years, having undergone a radical but turbulent transformation from a centrally planned system into the second largest economy in the world by nominal GDP. Under Mao, China was an isolated socialist state; today, however, one could hardly begin to fathom China not being an instrumental player in the world economy. Niall Maher maps the evolution of the Chinese economy in the post-Mao period, arguing that the gradual privatisation of the economy was causally linked to the massive economic growth it has experienced since 1978. He offers a brief lesson in the history of the Chinese economy, outlines the possible causal links between privatisation and economic growth, and demonstrates the strong positive relationship between these two variables. To conclude, Maher argues that compelling evidence exists to prove that the transformative privatisation reforms introduced by China since 1978 caused the huge upsurge in economic growth that China has experienced in the past few decades.

I. Introduction

Since economic reforms began in 1978, China has experienced remarkable change, both in the structure of its economy and in its level of economic development. Understanding these processes, and the connection between them, is vital for understanding how states can pursue effective development policies. In this essay, it will be argued that privatisation and economic development are connected by causation, not just correlation. This argument is divided into four parts. Firstly, a brief history of the economic reforms and subsequent economic history will be given. Then, causal links between privatisation and economic growth will be established, based on four mechanisms: competition, human capital, investment, and different goals. The positive relationship between economic growth and economic development will then be outlined. Finally, counterarguments and responses to this argument will be evaluated. The essay concludes that privatisation undoubtedly improved the level of economic development in China.

II. History of Reforms and Growth

To appreciate the correlation between privatisation and growth, it is necessary to understand a brief history of the economic reforms in China since 1978. China's economic reforms are best understood as an incremental move towards a market economy. The reforms began in 1978 with the development of small-scale township and village enterprises. Although many legal restrictions on private enterprise were lifted during the 1980s, the private sector lacked the explicit support of the government and was viewed with some suspicion by the general populace, who retained the negative im-

pression of entrepreneurs formed during the Cultural Revolution (Nee & Opper 2012: 110). Over time, the CCP relaxed the regulations constraining private firms further. By 1999, a slogan entitled 'Grasp the Large, Let go of the Small' was promoted by the Chinese state to publicise their tactic of privatising small, loss-making State-Owned Enterprises (SOEs) and maintaining control of larger, more strategically important SOEs (Hsieh & Song, 2015). More economic reforms set up stock exchanges in Shanghai and Shenzhen, incorporated SOEs as limited liability companies and redirected managerial focus from goals such as maintaining a high workforce to increasing bottom-line profits. By 2003, the private sector accounted for 59.2% of China's GDP growth, a remarkable change from 30 years previously (Brandt & Rawski, 2008: 3).

The period of reform was followed by a sustained increase in Chinese economic growth. Before the reforms, annual GDP growth was around 4%. This increased to an annual average of 9.5% from 1978-2005 (Wedeman, 2012). This growth rate increased both the absolute and relative size of the Chinese economy. For example, China's output was 37.5% of Japan's in 1978. By 2004, China's output had increased to 219.2% of Japan's (Brandt & Rawski, 2008). Although much of this increase can be credited with increases in labour and physical capital, there have also been large increases in productivity following the reforms. Productivity change accounted for 40.1% of overall GDP growth from 1978–2005, as compared to 11.4% during the period 1952–1978. China's per capita GDP relative to other countries can be examined to control for the economic impact of its population expansion. This figure increased relative to the US from 3.2% to 15.7% from 1978-2005. These statistics indicate that China went through a period of sustained, rapid economic growth

following the instigation of the economic reforms.

III. The Relationship between Privatisation and Economic Growth

This section of the essay will examine the effect of privatisation on economic growth in China, relative to the Chinese system before the economic reforms. The four causal links examined are competition, human capital, investment and different goals.

Increases in competition that follow privatisation lead to increases in efficiency and innovation. In a planned economy, the goods and services of a sector are typically provided by a single state-owned monopoly. When privatisation occurred in China, it increased the number of firms providing the same product (Lee & Lardy, 2008). Competition between these firms drove prices down as they aimed to undercut each other's prices and earn a greater market share. This competition compelled firms to operate more efficiently and to deliver goods and services more innovatively. The effect of competition on efficiency has been observed in a Chinese context even when controlling for selection bias, endogeneity and adjustment costs (Jefferson & Su, 2006). Competition also has a positive effect on SOEs, as they are forced to either improve efficiency or go bankrupt. Hsieh & Song (2015) find that the entry of private firms into a sector correlates with an increase of efficiency in SOEs. The impact of competition on efficiency and innovation is one of the reasons why privatization leads to greater economic growth.

Privatisation also increases growth by encouraging human capital to operate more productively. In the Chinese planned economy, human capital was operating below its po-

tential maximum (Feng & Mason, 2008). As managers and workers received the same payment regardless of their productivity, it was irrational to work extremely hard at their job. This effect was worsened by the chronic hunger that many workers suffered from, that in part resulted from the lack of productivity of planned agriculture (Haggard & Huang, 2008). Following the economic reforms, workers could be rewarded for completing excess work. This incentivised workers to work harder so that they could gain better material benefits. As owners had a greater incentive to operate their firms efficiently when they got to keep the company profits, they made a greater attempt to hire and promote more efficient workers. Due to this, managers in private firms are typically more skilled in important areas such as business management and marketing (Chen & Singh, 2013). The link between managerial success and rewards has been credited with private firms being relatively more market orientated than SOEs (Song et al., 2015). These effects are more apparent when a greater proportion of the company is privately-owned, which supports the idea that private ownership is positively correlated with advancements in human capital. Furthermore, these effects have been found to sustain in the long run (Bai et al., 2009).

A market economy also leads to greater levels of investment, which increases economic growth. Investment provides firms with the capital to rapidly expand or engage in processes such as research and development. Private investors invest in the company with the greatest growth potential, as this usually allows them to make more profit from their investment. In a planned system, all investment decisions are managed by the government. However, states are worse at investing than private investors. Government officials have less

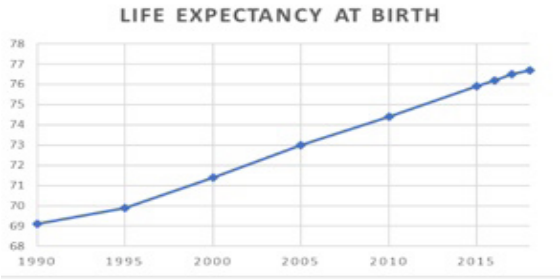
of an incentive than private investors to vet the firms they are providing investment to, as it is not their personal money that they are investing. Therefore, a privatised system of investment allows more efficient firms to grow than in a planned system (Haggard & Huang, 2008). Furthermore, a market system helps prevent efficient firms from being crowded out by less efficient firms that receive government funding. Privatisation has also led to much greater amounts of funding being available for Chinese firms. For example, foreign direct investment from the US surged from nothing under a planned system to an annual inflow of approximately U.S.$70 billion for the period 2004-2006 (Brandt & Rawski, 2008).

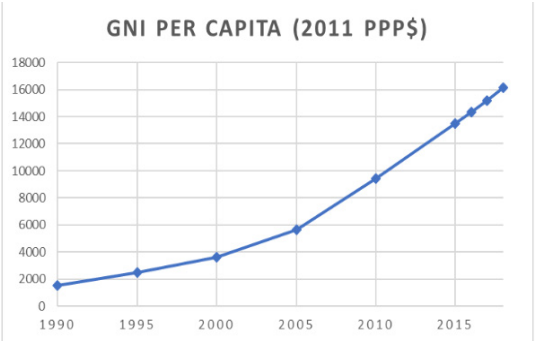
Privatised firms also have more growth-oriented goals than SOEs. The goal of private firms is to be profit maximising. This goal encourages growth in all situations where growth can be achieved cost-efficiently. SOEs typically face several, often conflicting goals. As well as trying to be profitable, they must also balance political objectives such as maintaining a low output price, a high level of employment or a high book value of state assets (Song et al., 2015). These goals can come into conflict with profitability. For example, state bureaus that oversee SOEs often prioritise having a high book value of state values, rather than maximising the market value of the company, even though maximising the market value would be more conducive to growth. The greatest challenge SOEs face when trying to become more competitive is trying to reduce their labour force (Rees et al., 2010). This indicates that the labour force of SOEs are not at a competitive size because of the different political goals that SOEs must balance.

IV. The Relationship between Economic Growth and Economic Development

Although closely intertwined, economic growth and economic development measure different processes. Economic growth measures whether production has increased in a country while economic development measures whether the quality of life of the populace has improved. Although what exactly constitutes an increase in the quality of life is contestable, typical components include increases in life expectancy, literacy and real wage. In this essay, the World Bank's Human Development Index (HDI) will be used as a guide for measuring changes in economic development, as it facilitates international comparison between countries. The HDI is formed by the mean of three dimensions of development; health (measured by life expectancy at birth), education (measured by years of schooling for adults aged 25), and standard of living (measured by gross national income per capita in purchasing power parity). These scores are normalised and aggregated into a composite index using a geometric mean (Sagar & Najam 1998). It is important to note that the HDI does have limitations in its measurement of development, such as its omission of data on inequality, political freedom and human security.

China has undergone a substantial increase in economic development following the reforms of 1978. Between 1990-2017, China's HDI value had increased from .501 to .752 (World Bank, 2018). This means that China is now in the high development category of the index. In the same period, life expectancy in the country increased by 7.1 years, mean years of schooling increased by 3 years and GNI per capita by 898.7%. These results can be seen in the following graphs:





Source: The World Bank (2018)

China's economic development has been caused to a large extent by its economic growth. Economic growth improves all three components of the HDI. Gross national income per capita increases when there is faster economic than population growth, as was the case in China. Economic growth also indirectly increases life expectancy and mean years of schooling, as increases in per capita income increase the ability to afford better healthcare and education services. Furthermore, increased tax revenues improve the government's capacity for fiscal expenditure on healthcare and education. Private businesses have a large incentive to promote policies that increase the health and education of their pool of potential employees, as this causes them to work more productively. It should be noted that the causality for these improvements run both ways, as improvements in health and education also cause increases in income. However, there is compelling evidence that a substantial proportion of the improvement in China's level of economic development stems from its huge increase in economic growth. Furthermore, privatisation can improve levels of education directly. Privatisation creates a wage premium for workers who develop skills in areas where there are talent gaps (Brandt & Rawski, 2008). This encourages people to become more educated. This incentive contrasts with the lack of education attainment found in the Chinese planned economy, particularly the stigmatisation of intellectuals during the Cultural Revolution.

V. Counterarguments and Responses

One response to the argument that privatisation has led to economic development is that privatisation has led to an intensification of corruption in China, which harmed econom-

ic development. Since the economic reforms were initiated, corruption has severely worsened in China (Dong & Torgler, 2013). The economic reforms were not accompanied by political reforms enforcing institutional and legal constraints on the government, which gave greater freedoms to officials to partake in corruption (Hao & Johnson, 1995; Wedeman, 2004). Corruption has a negative impact on economic growth and development. On average, a one-point increase in the Corruption Perceptions Index leads to a 1% decrease in economic growth (Mauro, 1995). Between 1992 and 1996, China's Corruption Perceptions Index score increased by two points. As the economic reforms led to this increase in corruption, it could be argued that privatisation harmed growth.

In response to this argument, I argue that, even if it is accepted that corruption was directly caused by privatisation policies, this increase in corruption did not enough have enough impact to counterweight the positive impact of economic growth on China's economy. From the earlier analysis of the improvement of China's Human Development Value from 1990-2017, China's score improved substantially, and economic growth was a large cause of that improvement. Although corruption may have slowed growth to some degree, China's privatisation policy resulted in a net positive impact on economic development. Even taking different measures of economic development, such as the Inequality-Adjusted Measure of Development, we find that China has dramatically increased its level of economic development in the same period (World Bank, 2018). This analysis can be extended to other negative externalities that could have been caused by privatisation, such as inflation. Even accepting that inflation was caused by privatisation and that it lowered economic development in China, it did not have a large enough negative

effect on economic development to out-weigh the substantial increases in economic development that followed the economic reforms.

Another possible criticism of this argument is that the increases in China's growth rate could have been caused by global or regional macro-economic trends and would have occurred regardless of whether China underwent privatisation. In response to this, firstly it disregards the evidence outlined above linking privatisation and growth. Secondly, if this were true then we would see similar relative increases in the growth of other countries. Between 1990 and 2017, China increased from the 103rd to the 86th most economically developed country. Furthermore, China's HDI score was significantly higher than other countries in East Asia by 2017. This relative increase in size indicated that there are factors specific to China that are causing this economic growth, such as the fact it was undergoing economic reform over the last 40 years.

VI. Conclusion

Since 1978, China has gone through gradual, but transformative economic reforms. The goal of this essay has been to outline the effect of these reforms on economic development and to answer whether they are causally connected to the economic development that followed them. It has been demonstrated that there is compelling evidence that a connection exists. To recap, the essay began with an outline of the economic reform and growth that China underwent. Then, four mechanisms were outlined linking privatisation to economic growth; increased competition, human capital, investment, different goals. Following this, the causal link between

economic growth and economic development was explored. Finally, the counterarguments and limitations of my argument were evaluated, which I believe I successfully rebutted. Synthesizing the evidence presented in the literature, I conclude that privatisation had a positive causal effect on economic development in China.

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Feeling the Bern of Free Trade: Why does free-trade encounter political resistance?

Conor O'Malley, Senior Sophister

With the next U.S. Presidential Election just around the corner, Conor O'Malley very relevantly begins his paper by noting the unusual congruence in the perspectives on free trade of political nemeses Donald Trump and Bernie Sanders. Both men share an aversion to free trade, and what is more interesting is that this perspective is becoming increasingly less radical in the world of politics, despite the fact that economists virtually unanimously agree that free trade is, on balance, beneficial for an economy. O'Malley seeks to understand the divergence between academic consensus and political reality on the issue of free trade. It is acknowledged that there are two natural policy options which are used to respond to the losses associated with free trade: redistribution of the gains of free trade, or protectionism. O'Malley demonstrates that much of the anti-trade sentiment in modern political discourse can be attributed to a demand for protectionist policy amongst the disgruntled "losers" of globalization. Unless the "losers" of free trade are adequately compensated via redistributive mechanisms, he argues, anti-trade sentiment and protectionist policies will continue to thrive.

I. Introduction

Senator Bernie Sanders, one of the most prominent contenders for the Democratic Presidential nomination, has little in common with the President he is trying to replace, Donald Trump. And yet, on the topic of international trade, these two political opposites find a rare issue of policy congruence. Sanders, a self-avowed democratic socialist, has spent his decades-long political career positioning himself firmly as a trade sceptic, opposing the North American Free Trade Agreement (NAFTA), the Trans-Pacific Partnership (TPP), and the Trans-Atlantic Trade and Investment Partnership (TTIP) (Hufbauer & Jung, 2019). As a candidate, Trump was an equally voracious critic of trade, slamming NAFTA as "the worst trade deal, possibly ever", and railing against countries "cheating" in the arena of international trade. Within days of his inauguration, Trump pulled the U.S. out of the TPP. Since then, the President has imposed tariffs on steel and aluminum, and Section 301 tariffs on Chinese goods, thus provoking a trade war between the world's largest two economies (ibid.). Intriguingly, the President and Sanders' convergence on anti-trade policies bears a sharp contrast to the economic academic community. Across generations and ideological spectrums, economists are in near unanimous agreement that free trade is broadly beneficial, spurring economic growth, lowering prices and offering consumers increased variety in goods (Mankiw, 2015). Why then, does free trade encounter so much political resistance?

This essay is motivated by the desire to understand what accounts for the divergence between academic consensus and political reality regarding the trade skepticism that has loomed large in contemporary political discourse. This

essay contends that the failure to smooth the unevenly distributed gains from trade and remunerate those disaffected from trade weakens belief that economic integration brings widespread benefits (Kletzer, 2004). In making this case, this paper first offers a theoretical trade framework, derived from the Heckscher-Ohlin trade model. The model demonstrates that while trade leads to national gains, those gains are unequally distributed across economic actors. Governments then, ought to intervene and ensure that those losers from trade are adequately compensated. After outlining the scope of these policies, we argue that in practice such responses have been insufficient to nullify the economic anxiety caused by job loss. This inadequacy has been exacerbated by the shift away from the post-war "embedded liberalism" doctrine towards a neoliberal economic system, characterised by "rolling back the frontiers of the state" and reducing government welfare expenditure (Ruggie, 1995). As such, Kletzer's (2004) observation that "presumptions of an ability to compensate have only weakly translated into a record of compensation policies and programs" rings true. The penultimate section of this essay documents empirical evidence supporting the idea that exposure to trade in import-competing regions is causally linked to the demand for anti-free trade sentiment across Europe and America, a sentiment right-leaning parties have adapted to supply.

II. Theoretical Foundations of International Trade

At its simplest, economists argue that opening up to free trade expands an economy's consumption possibilities, relaxing constraints imposed in autarky. This section adopts a Heckscher-Ohlin (henceforth HO) model to illustrate na-

tional gains from trade. The justification for choosing the HO model is two-fold. First, the model emphasises a delineation between 'skilled' and 'unskilled labour', offering a more accurate reflection on contemporary levels of sectoral mobility than the frictionless labour specified in the specific-factors model. Relatedly, evaluating trade via the HO model follows the approaches of the extant literature (Mayda and Rodrik, 2001; O'Rourke and Sinnott, 2001; Wood, 1995) in determining attitudes to trade.

The work of Eli Heckscher and Bertil Ohlin culminated in the HO theorem: "countries export goods that use intensively the factor of production with which they are relatively endowed, and import goods that use intensively factors that are relatively scarce at home" (quoted in Jones, 1956). Assume a standard 2x2x2 model. "Country A" is relatively well-endowed with skilled labour, giving it a comparative advantage in the production of machinery, a skill intensive good. Consequently, Country A is skilled-labour abundant and will export machinery. "Country B" is abundant in unskilled labour and has a comparative advantage in the production of textiles. These differences in endowments create potential to trade through encouraging specialisation in their comparative advantage. Each nation will export the good with which they have a lower opportunity cost of production, and import goods that they are less efficient in.

HO theory goes beyond merely predicting patterns of trade and has something to say about the distributional implications of trade, positing that the relationship between trade and wages is linked solely through changes in factor prices. As such, trade benefits individuals who are employed in the abundant, export-oriented sector and hurts those employed in the scarce sector, a proposition known as the Stolper-Samu-

elson Theorem (1941). For instance, let some free-trade arrangement between the two countries be proposed. Country A will export and produce more skilled-labour intensive products and the demand for skilled-labour goods will increase. The country will import more unskilled labour intensive goods, exposing domestic unskilled workers to more efficient import-competition. Their inability to compete with cheaper competition leads to a reduction in demand for unskilled workers, and a fall in the unskilled wage. As this process continues, unskilled workers face the prospect of job loss and unemployment, as their industry downsizes, offshores, or closes down. Wage inequality in Country A will widen, with wages of skilled labourers rising and wages of unskilled workers falling.

Heckscher and Ohlin's framework is theoretically compelling, but to what extent can their work guide our subsequent analysis? Assuming that agents are rational, support for trade is modelled as the change in utility from an initial "before free-trade" state to a "free-trade" state. It is hypothesized that unskilled workers in Country A will seek to oppose free trade, for fear of losing their job from the more efficient import-competing firms of Country B. And indeed, across a broad period of time, factor proportions prove a useful heuristic for evaluating trade receptiveness. Mayda and Rodrik (2001) exploit a cross-country dataset to find that "pro-trade preferences are significantly and robustly correlated with an individual's level of human capital in the manner predicted by the factor endowments model". Writing at a similar time, O'Rourke and Sinnott (2001) find cross-national evidence that "preferences are entirely consistent with [the] theory". Higher skilled workers are "more predisposed toward free trade than the low skilled" and that this "interaction effect is

amplified in richer countries". Balistreri (1976) extends the model to include a range of foods and factors and tests the predicted outcomes of the model against the opinions of Canadians across various occupations. They conclude the model's predictions "seem to contribute significantly to an agent's opinion". Whilst each of these papers caveat that agents' overall preferences are contingent on more than distributional consequences of trade, ranging from "social status, relative incomes, values" (Mayda and Rodrik, 2001), there is sufficient empirical literature to suggest that the predictions of the HO and the Stolper-Samuelson Theorems hold. In skilled abundant countries then, unskilled workers are predicted to be disaffected by trade liberalization and are relatively more likely to oppose free trade than skilled workers.

III. Policy responses: their prospects and their inadequacies

The above confluence of theory and supporting empirical evidence is a necessary but not sufficient explanation of opposition to free trade. Economists have argued that the dislocation of labour that arises from trade can be offset through government intervention, whereby trade "winners" transfer some of their gains to "losers". If sufficient interventions could be provided, the initial losers of trade could share in the gains from trade. The spectrum of such policy options is most succinctly articulated by Rodrik (1997; 1998), who contends that policymakers can choose from three policy recommendations; take no action, take measures to compensate the losers of trade, or adopt a more protectionist trade policy. Assuming that politicians are office-seeking, we rule out policy option one on the grounds that a laissez-faire approach would be po-

litically unpalatable, as it would cement the losses from trade. Confining the policy choice to the latter two options mirrors the contemporary political landscape.

Of the two policies, economists overwhelmingly support redistributive mechanisms, arguing that such mechanisms spread the national welfare gains from trade, irrespective of regions or sectors. The origins of such welfare state policies can be traced to the "embedded liberalism" of the post-war era when "societies embraced international liberalization" but "its effects were cushioned by the newly acquired domestic economic and social policy roles of government" (Ruggie, 1995). The catalyst for their implementation was a desire to avoid the beggar-thy-neighbour policies and political extremism of the inter-war years, which brought disastrous economic and political ramifications. Rodrik (1997) documents a profound shift in government expenditure as a percentage of GDP accompanying the move towards free trade, doubling from 21% before the Second World War to 47% in the years after. Importantly, Rodrik (1997) notes that the "increase in social spending and income transfers drove the expansion of government" spending, indicative of the "New Deal" or "Welfare State" policies of the U.S and Great Britain respectively. More specifically, the HO framework would suggest compensatory mechanisms ought to counter the relative immobility of labour. Through up-skilling programs which enhance factor mobility, unskilled labour could more effectively transition into expanding, highly skilled industries (Feenstra & Lewis, 1994). From a theoretical perspective, compensatory mechanisms represent the best prospect of balancing efficiency and equality considerations surrounding trade. Why then have these policies wilted in popularity over the last three decades, and why have voters gravitated to protectionism?

Firstly, striking the balance of appropriate compensation without distorting the benefits of trade and globalisation more broadly has proven a challenge. For instance, Dixit and Norman (1986) propose the implementation of commodity taxes to compensate the losers of trade, but the premise that this can be done without eliminating the gains from trade has been severely contested. Rodrik (1997) argues that "the increasing mobility of capital has rendered an important segment of the tax base footloose", whilst Brecher and Chourhri (1994) argue a commodity tax large enough to compensate losers may eradicate all gains from trade. Free-flowing capital constrains the ability of national governments to raise revenue to pay for insurance, as any effort to increase taxation may induce capital flight. As such, revenue generating interventions may have an unintended dampening effect, limiting the ability to provide expensive welfare programmes. Coupled with this has been what Rodrik (1998) described as an attack on the welfare state. Upon assuming office in 1981, Reagan cut the weekly compensation associated with Trade Adjustment Assistance (TAA) by 20%, a program which provides re-employment services and compensatory benefits to American workers who lost jobs due to increased import competition (Mishel, 2016). For her part, Thatcher talked about "rolling back the frontiers of the state" and that "public expenditure is at the heart of Britain's present economic difficulties" (quoted in Dean, 2013).

Existing safety nets have always had "a number of holes" but the fiscally conservative policies that have defined much of the last three decades have undoubtedly aggravated workers' anxiety about the prospect of losing their jobs (Kletzer, 2004). Insufficient funding and ineffective utilisation of resources have resulted in an inability for compensa-

tory mechanisms to mitigate the distributional consequences of liberalisation and have led, as HO theory would predict, to widening levels of inequality between unskilled and skilled workers.

The inability of compensatory mechanisms to assuage worker's fears regarding the associated costs with job displacement is a reality best articulated by Kletzer and Litan (2001) and Kletzer (2004). Unemployment insurance is time-limited and generally inadequate, continuing to replace a little less than 50% of the average worker's previous salary. They also face the stress of foregoing expensive items like health insurance. Kletzer (2004) also finds evidence that though import-competing displaced workers are only slightly less likely to be re-employed, they suffer considerable average earning losses, estimated to be about 13% less than their previous mean. Less formally educated workers experience the greatest difficulty maintaining earnings. Kletzer and Litan (2001) provide two solutions. The first is health care subsidies to ensure those unemployed can keep their existing coverage. The second is a form of wage insurance. Crucially, workers would receive a percentage of their lost wages only upon re-employment. These policies marry the need to cushion the losses following displacement with conditionality of the wage insurance to incentivise displaced individuals to accept a new job quickly and to reintegrate into the labour force. As of 2020, neither of these policies have been pursued to any extent by either Democratic or Republican leadership.

The paucity of natural experiments in international economics presents difficulties in capturing the impact of trade on employment. For instance, it may be that workers who apply for re-training programs are more hardworking or enthusiastic than those that do not. One notable case that

allows us to draw tentative conclusions about the effectiveness of such policies is Hyman's (2018) study of the TAA Program. In establishing the causal benefits of exposure to re-training, Hyman exploits quasi-random variation in assignment of TAA applicants to investigators. The author finds that "TAA-approved workers have ~$50,000 greater cumulative earnings, driven by both higher incomes and greater labor force participation". There are, however, significant caveats to this paper. First, these gains erode such that annual incomes among TAA and non-TAA workers fully converge after ten years. Secondly, the authors agree with Jacobson (1998) who states that "workers acquire substantially more human capital enhancing knowledge on the job than in the classroom". For Kletzer (2004), upskilling through on-the-job training is preferable to that of the TAA, which has no effect on formal education and focuses on short run demanded skills which have often become obsolete (Hyman, 2018). We can tentatively conclude that existing schemes have limited abilities to adequately compensate those disaffected, though it must be stressed that the limited available research hamstrings our ability to firmly cite the effectiveness of such up-skilling as mitigating the harms of trade.

Thus far, this essay has argued that trade creates losers, and when these losers are inadequately compensated they less likely to support free-trade policies. How then, does this opposition to free-trade manifest with regards to political resistance? As previously stated, identifying causality and causal mechanisms is complicated given endogeneity concerns in the form of omitted variable bias or reverse causality. For instance, trade may have played a role in the electoral success of Trump, but so too did cultural issues and the unpopularity of Hillary Clinton (Norris & Inglehart, 2019). However, a re-

cent series of papers by David Autor, David Dorn, and Gordon Hanson (2013; 2016) have begun to quantify the role of trade in fuelling the demand for anti-trade sentiment.

Autor, Dorn, and Hanson (2016) note that the radical transformation of the Chinese economy in the latter two decades of the 20th century "provides a rare opportunity to study the impact of a large trade shock on labour markets in developed countries". This "China Shock" allows the authors to bypass issues of endogeneity by "instrument[ing] for the growth in U.S imports from China using Chinese import growth in other high-income markets" (Autor et al., 2013). Of particular relevance are their findings which consolidate the contention that trade has led to displacement, the victims of which have been inadequately compensated. Working with Daron Acemoglu, the authors find that net trade related displacement as a result of this "China shock" ranges from 2 to 2.4 million jobs over the period 1999 to 2011 (Acemoglu et al., 2016). The political ramifications of this dislocation are found to be non-trivial and has created significant demand for a change in policy. Autor et al. (2016) find that from 2004 to 2016, more exposed regions became more likely to adopt right-wing perspectives on economic and cultural issues. Adverse economic shocks induce shifts favouring Republican legislators and Republican Presidential candidates. These pieces providing empirical support for the conventional wisdom that Trump's victory was catalysed by a more trade-sceptic electorate, with workers left behind enthusiastic to embrace protectionist policies in lieu of free-trade.

Colantone and Stanig (2018) extend this discussion by offering a supply side account of the rise of anti-trade sentiment. In particular, they note that across 15 Western European nations nationalist and radical right parties have adopted a

policy agenda of "economic nationalism". National and radical right parties have had stunning electoral success offering a nostalgia that taps into the zeitgeist of those who globalisation has left behind. These parties combine domestic free-market policies with strong protectionist stances. Crucially, they articulate messages which resonate with those exposed to import-competition, appealing to communities that risk losing "national or regional identity from global economic competition" (Colantine & Stanig, 2018). Combined with this reaffirmation of nationalist confidence is a belief that protectionist tools like tariffs and quotas can both blunt globalisation whilst ensuring the continuation of expected welfare gains. Whilst empirically contentious, ignoring the basic premise of comparative advantage, such a narrative is compelling. Irrespective of its veracity, this supply side account crucially illustrates the Republican advantage from the "China Shock". Trump and the Tea Party movement changed the contours of the Republican Party, framing trade agreements as "compromising American sovereignty", and advancing a more unabashed economic nationalist agenda (Autor et al., 2016), policies undoubtedly popular with the disgruntled workers of the Mid-Western states.

IV. Conclusion

Trade theory may make sense amongst academics, but the political reality of trade policy has been a far-cry from the supposed rising tide that lifts all boats. As long as policymakers fail to compensate the losers of globalisation, populist politicians and inward-looking agendas show no sign of abating.

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Do default frames significantly alter individuals' willingness to pay to offset carbon emissions? Evidence from a controlled experiment

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In the first of a number of papers which deal with the application of economic theory and econometrics to the issue of climate change, Liam Brown, Rowan Hamilton, Yannik Obelöer and Charlie Walsh conduct a controlled experiment to evaluate the impact of default frames in determining willingness to pay to offset carbon emissions. Employing a linear probability model analysis, the authors find that using a presumed consent frame, whereby the consumer is opted into offsetting their carbon emissions by default, significantly increases the probability of paying to offset carbon emissions as compared to when an explicit consent frame is used. As the authors note, at a time when the need to reduce carbon emissions is paramount, the use of default frames in the process of purchasing air travel tickets amounts to a simple and cheap solution to nudge people towards behaving in a more environmentally conscious manner. They also note, however, that this is only one small

step towards a carbon neutral future, and that small-scale nudges must be complemented by demand modelling and a radical change in behaviour in order to achieve net neutrality.

I. Introduction

This study analyses the impact of default effects on the uptake rate of carbon emission offsetting in air travel. A default is a condition which is externally preassigned in a choice scenario resulting in a default effect occurring as individuals fail to make a decision which differs from the default on a consistent basis (Pichert & Katsikopoulos, 2008). Default effects have been established as one of a number of robust findings in human deviations from rational decision making (Arana & León, 2013). The industry of interest in the study – the travel industry – currently accounts for 28% of US carbon emissions with 10% being sourced from air travel alone (US EPA, 2018). The industry primarily makes use of command-control methods to address emissions, facilitating economy-wide reduction targets via projects such as the Emissions Trading Scheme (European Union Aviation Safety Agency, 2019). However, carbon offsetting has become a popular option across airlines, with 30 International Aviation Transport Association (IATA) airlines adopting a strategy which allows customers to allocate some funds to the neutralization of their environmental impact via additional carbon neutral investments. This study aims to investigate the hypothesis that when set as the default choice, more people will pay to offset their carbon emissions than if it is set as an optional extra.

II. Literature Review

The air travel industry is one of the most polluting industries in the world, globally contributing to the spread of short- and long-term pollutants (European Union Aviation Safety Agency, 2019). The cost of air travel emissions are measured across three metrics: social costs; the cost of abatement; and the market control penalties on carbon enforced by bodies such as the EU (Jardine, 2005). With little voluntary uptake of bio-based and electro fuels, neoclassical market models have driven the adoption of measures such as tradable permits (European Union Aviation Safety Agency, 2019). Recognition is growing for individualised treatments for pollution (Urmetzer et al., 1999) and in 2018 76 International Civil Association Organisation (ICAO) countries agreed to the Carbon

Offsetting and Reduction Scheme for International Aviation (CORSIA) programme which will require all aircraft operators to offset excess emissions, spreading to all ICAO members by 2024 (European Union Aviation Safety Agency, 2019). Approximately 11% of airlines have adopted offsetting programmes for customers to reduce carbon emissions driven by increasing pressure from bodies such as the EU (Pavlovich & Corner, 2014).

Insights from behavioural economics can potentially be used to increase the effectiveness of carbon offsetting programmes. Behavioural economics has grown in popularity over recent decades with growing evidence for predictable deviations from rationality in consumers (Avineri, 2012). Behavioural programmes have, despite protests over paternalism, been widely adopted in order to achieve large-scale socially desirable outcomes on a consistent basis (Thaler & Sunstein, 2009). These programmes regularly take the form of "nudges", with the prominent use of framing to manipulate cognitive biases and produce socially optimal outcomes (Tversky & Kahneman, 1974). This manipulation takes many forms with one of the most prominent being defaults (Johnson & Goldstein, 2004). Applying these methods to travel is suggested by Avineri (2012) suggesting the adoption of various "soft interventions" such as framing to complement command-control system's "hard interventions". One such framing model suggested by numerous researchers (ibid.) as demonstrating sufficient reliability and predictability is the application of defaults, i.e. making environmentally beneficial options the default rather than an additional option. Johnston and Goldstein (2004) note that defaults are often considered the recommended action as well as the optimal and most efficient decision. Therefore default effects can be applied in air travel to maximise carbon offsetting donations. While this is not a solution to the climate crisis, it represents a cost effective policy that can be used alongside more standard command and control policies.

The structure of default studies typically contains two experimental conditions. The first condition is a presumed-consent frame, whereby the choice maker is opted in as a default. The second is an explicit-consent frame, whereby the choice maker is opted out of the target action (Araña & León, 2013). Johnston and Goldstein (2004) argue that default effects stem from three sources: firstly, defaults are regularly viewed as a recommended option, influencing ill-informed consumers; secondly, sticking with the default reduces the effort required in making a decision,

meaning consumers prioritising efficiency will be subject to default effects due to inertia (Goswami & Urminsky, 2016). The final effect is an anchoring effect as defaults serve as a reference point causing deviations from defaults to be more similar to the default than had it not been present (ibid.).

The use of defaults in offsetting carbon emissions is a sparsely researched field (Araña & León, 2013) with the studies completed demonstrating the opt-in/opt-out structure provides the opportunity to address climate change in areas previously accepted as having inevitable negative externalities.

Offsetting carbon emissions is an extra charge voluntarily levied on the consumer to invest in "sink" projects such as fuel and energy efficiency or nature-based work such as reforestation (Araghi et al., 2014). Engagement rates in this initiative are closely linked to perceptions of collective participation (ibid.) and knowledge of environmental change (Löfgren et al., 2012). In a key study on air travel and default effects, Arana and León (2013) studied the impact of defaults on offsetting carbon emissions via online retailers. The study randomly assigned consumers to offset emissions via either a Presumed-Consent or Explicit-Consent Frame. LPM regression and chi-squared tests demonstrated that the Presumed-Consent Frame produced significantly higher levels of emission offsets than the explicit-consent frame. The study is a key finding in research across both the air transport and default effect fields, demonstrating that framing effects occur in the real marketplace (Samuelson & Zeckhauser, 1988). These findings also demonstrate that individuals, assumed to maximise personal welfare independent of social gains, are willing to adopt individualised actions which serve a collectively beneficial role (Araña & León, 2013).

The research conducted by this study aims to add to the body of literature on the impact of default effects on carbon emission offsetting strategies and thus test the hypothesis that a presumed-consent frame will result in higher levels of offsetting then an identical transaction with an explicit-consent frame.

III. Experimental Design

The experiment, conducted from the 18th to 25th of February 2019, aimed to explore the effect of default options on willingness to

pay a carbon emission offset charge in the context of purchasing flights. Two surveys were created, each identical bar one question. This question referred to the carbon emission offset and was framed in different ways across the surveys. In the first survey, an opt-in option was given to paying the charge ('explicit consent'). In the second, an opt-out option was given ('presumed consent'). The framing of the question was as follows:

Survey 1, Opt-in:
"You have purchased return flights to London for a long weekend break. You will leave on Friday the 24th of May and return on the 27th of May.

The base cost of the flight is **€50.**Please select the additional services you would usually select on a flight"

Check-in Bag Charge (+€10)
Select Seats Charge (+€4)
Carbon Emission Offset Charge (**+€4**)
Travel Insurance Charge (€10)
Transfer from Airport Charge (€9)

Survey 2, Opt-out:
"You have purchased return flights to London for a long weekend break. You will leave on Friday the 24th of May and return on the 27th of May.

The base cost of the flight is **€54.** Please select/deselect the additional services you would usually select on a flight."

Check-in Bag Charge (+€10)
Select Seats Charge (+€4)
Remove Carbon Emission Offset Charge (**-€4**[1])
Travel Insurance Charge (€10)
Transfer from Airport Charge (€9)

1Emphasis added to the changes across surveys was not present during the control experiment.

The default option for Survey 1 was to be opted-out of the climate emission offset charge ("explicit consent" frame). Subjects in the presumed consent default frame had the default option of being opted-in to the climate neutral charge ("presumed consent" frame). The following control variables were added to the survey:

Gender (Male, Female, Other)[2] .
Age Bracket (Below 35, Above 35).
Additional Services (Check-in Bag Charge, Select Seats Charge, Travel Insurance Charge, Transfer from Airport Charge).
Ranking of Important Factors in Purchasing Flights (Cost,Airline, Time of Flight).
Whether the subject flies alone or with a group most of ten.

Two hundred subjects' responses were recorded across the two surveys.

IV. Data Summary

In order to conduct our statistical analysis, dummy variables were implemented mirroring each of the survey questions (see table A1 in Appendix). Before testing the actual effects of the default option, randomization of the data has to be inspected. Illustration 1 shows graphically what a Pearson's chi-squared test (Table 1) proves quantitatively. Apart from age, none of the differences between the two surveys are significantly different. Thus, there is little observable evidence that the sample of either survey is significantly different to the other. Due to the potential bias from the difference in the age variable, this variable is not considered for separate analysis.

V. Chi-Squared difference testing

As already demonstrated with the other independent variables, chi-squared tests are used for finding differences in a two-sample investigation. Table 2 visualises the different outcomes. A simple Pearson's chi-squared test (see Table 3) reaffirms the obvious difference between the two surveys at all reasonable confidence levels with the opt-in

2 For the control variable 'Gender', no subject selected 'Other'. Therefore, it was omitted during statistical analysis.

survey having a far larger number of participants offsetting their climate cost.

Illustration 1 Distribution of responses across the two surveys, series 1 = opt-in

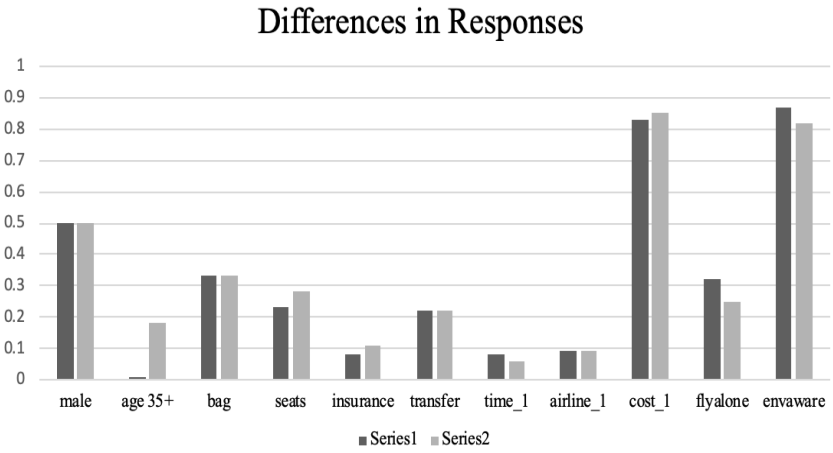

Table 1 Statistical difference between two surveys from contingency tables

Variable	Opt-Out Survey	Opt-In Survey	Chi-Square (p-value)
Male	0.50	0.50	1.000
Age35+	0.18	0.1	0.000 (***)
bag	0.33	0.33	1.000
seats	0.28	0.23	0.417
insurance	0.11	0.08	0.469
transfer	0.22	0.22	1.000
flyalone	0.25	0.32	0.273
envaware	0.82	0.87	0.329
time_1	0.06	0.08	0.372
airline_1	0.09	0.09	1.000
cost_1	0.85	0.83	0.700

Table 2 Contingency table opt_out and offset

Individual faced an opt-out option, 1 = yes	Climate cost was offset, 1 = yes 0	1	Total
0	82	18	100
1	25	75	100
Total	107	93	200

Table 3 Statistical difference on offset between two surveys

Variable	Opt-Out Survey	Opt-In Survey	Chi-Square (p-value)
Climate cost offset	75	25	0.000 (***)

VI. Results

Linear Probability Model (LPM)

$$offset_i = \beta_1 opt\_out_i + \beta_2 male_i + \beta_3 bag_i + \beta_4 insurance_i + \beta_5 transfer_i + \beta_6 seats_i + \beta_7 flyalone_i + \beta_8 envaware_i + \beta_9 time\_1_i + \beta_{10} airline\_1_i$$

Overall our preferred specification has significant explanatory power with an R^2 of 0.3855. Facing a presumed consent frame increases the probability of offsetting the carbon emissions by approximately 57%. This coefficient is significant at the 99% confidence level. While also significant, the increase of 13.6% in the probability of offsetting emissions when the individual surveyed is male contradicts the standard view in the literature, which generally finds greater environmental concern among women (Mohai, 1992)[3]. Another striking observation is that other add-ons to the price do not have significant effects on whether the carbon emissions are offset. While flying behaviour does not seem to have a large impact, environmentally aware individuals surprisingly are less likely to offset climate costs. This could simply be a result of misstated preferences, a common issue in state-preference

3 This effect might be due to a non-fulfilment of a randomised trial in a sense that the sample population had an unrepresentative group of environmentally aware male participants.

surveys such as this. Whether time or airline was ranked as most important compared to ranking cost as most important had some effect on the likelihood of offsetting emissions. While time was not significantly different to cost, airline as the highest ranking seems to increase the probability of choosing to offset emissions compared to ranking cost at number 1 by about 19.5%. This is in line with the expected results that individuals mostly focusing on low price flights might be less likely to choose an offsetting option than those more interested in the time of the flight or the quality of the airline.

While yielding satisfactory results, there are also some statistical shortcoming of the Linear Probability Model used in this study. LPMs are often criticised in a more general sense for potential non-normality of the disturbance, heteroscedastic variances of the disturbance and the absence of probability boundaries. However, non-normality does not pose a major problem to the statistical results as with n =200 and 190 degrees of freedom, a close to normal distribution may be assumed. Heteroscedasticity is also corrected for by using robust coefficient estimators with a feasible generalised least squares model. Probability boundaries may have led to problems but as no absolute value of the coefficient estimates is outside [0,1], using an LPM seems appropriate in the case of this study.

Table 5 Results different specifications of LPM

VARIABLES	(1) Opt_out	(2) +male	(3) +bag	(4) +insurance	(5) +transfer	(6) +seats	(7) +flyalone	(8) +envaware	(9) +time_1	(10) +airline_1
opt_out	0.570***	0.570***	0.570***	0.565***	0.566***	0.563***	0.571***	0.567***	0.568***	0.568***
	(0.0582)	(0.0576)	(0.0577)	(0.0580)	(0.0580)	(0.0583)	(0.0572)	(0.0576)	(0.0576)	(0.0573)
male		0.130**	0.128**	0.130**	0.129**	0.132**	0.123**	0.126**	0.131**	0.138**
		(0.0576)	(0.0595)	(0.0594)	(0.0593)	(0.0598)	(0.0596)	(0.0595)	(0.0600)	(0.0604)
bag			-0.0151	-0.0275	-0.0249	-0.0325	-0.0394	-0.0451	-0.0444	-0.0573
			(0.0604)	(0.0615)	(0.0618)	(0.0606)	(0.0599)	(0.0595)	(0.0596)	(0.0594)
insurance				0.152	0.142	0.117	0.118	0.114	0.117	0.107
				(0.115)	(0.115)	(0.120)	(0.122)	(0.122)	(0.122)	(0.120)
transfer					0.0575	0.0596	0.0477	0.0492	0.0500	0.0382
					(0.0706)	(0.0720)	(0.0722)	(0.0724)	(0.0724)	(0.0725)
seats						0.0746	0.0665	0.0619	0.0595	0.0601
						(0.0702)	(0.0703)	(0.0705)	(0.0712)	(0.0715)
flyalone							0.117*	0.127*	0.118*	0.123*
							(0.0649)	(0.0651)	(0.0680)	(0.0675)
envaware								-0.110*	-0.113*	-0.122*
								(0.0612)	(0.0613)	(0.0637)
time_1									0.0744	0.0938
									(0.116)	(0.118)
airline_1										0.195*
										(0.101)
Constant	0.180***	0.115***	0.121**	0.112**	0.0996*	0.0849	0.0591	0.153**	0.149**	0.141*
	(0.0386)	(0.0399)	(0.0511)	(0.0495)	(0.0523)	(0.0567)	(0.0564)	(0.0740)	(0.0737)	(0.0767)
Observations	200	200	200	200	200	200	200	200	200	200
R-squared	0.326	0.343	0.344	0.351	0.354	0.358	0.368	0.375	0.376	0.388

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VII. Discussion

The results above confirm our initial hypothesis that, when set as a default, more people will pay to offset their carbon emissions than if it were set as an optional extra. Respondents in our survey were 57.07% more likely to pay the carbon offsetting charge if it was already included in the price of the plane ticket, than if it were an optional extra, all else equal. Our chi-squared test rejected the hypothesis that the proportion of "presumed consent" and "explicit consent" respondents who paid the carbon offset charge was selected from the same binomial distribution. This is in line with other research which has shown the effect of default options on organ donations (Johnson & Goldstein, 2004), green energy uptake (Pichert & Katsikopoulos, 2008) and choice of health insurance plans and pension schemes (Samuelson & Zeckhauser, 1988). Furthermore, it supports the findings of Araña and León (2013) who concluded that the default option had a larger effect on the acceptance of the carbon offsetting charge when framed as an opt-out alternative, than when framed as an opt in alternative.

The authors believe there are two main explanations for our results. The first is loss aversion. In the "explicit consent frame" an individual was comparing the loss of €4 to the gain of offsetting their carbon footprint. In the 'presumed consent frame' the individual compared the gain of €4 to the loss of no longer carbon offsetting. This explains the higher proportion of people paying the carbon offset charge in the "presumed consent" frame since, according to loss aversion, losses are weighted more highly than equal gains (Kahneman & Tversky, 1979). Our second explanation revolves around social norms. Araghi et al. (2014) showed that individuals are more likely to offset their emissions if they feel it is a social norm. By setting payment as the default option, individuals may view it as the recommended course of action and feel that payment is a social norm.

Our results are of great significance to policymakers as they attempt to reach the targets set out in the 2016 Paris Climate Agreement. Policymakers typically rely on demand modelling policies to change consumer behaviour by providing more information and altering incentives (Avineri, 2012). These policies are expensive, time consuming and have been shown to be ineffective in areas such as organ donations (Kherani et al., 2003). Our analysis has shown that manipulating the choice architecture by introducing a presumed consent frame is a near costless way of nudg-

ing individuals to behave in a more environmentally responsible manner. At a time when the need to reduce carbon emissions is paramount, this amounts to a simple and cheap solution to influence behaviour for the better.

Despite the strength of our results, there are a number of important caveats and criticisms that can be pointed at the use of defaults for carbon offsetting programmes. Firstly, they are not a substitute for demand modelling policies aimed directly at curbing the harmful behaviour. Utilising defaults takes advantage of behavioural biases to nudge individuals in a desired direction, however, by definition they do not limit the consumers' freedom of choice. As such, the environmentally harmful option remains a possibility likely to be chosen by a proportion of the population. Defaults are simply one tool to be used alongside a package of methods to ensure a sustainable environment into the future. The use of defaults has also been criticised on ethical grounds. If the default effect is occurring due to inertia, where consumers are simply failing to make a decision, then it could be argued that "presumed consent" frames are taking advantage of individuals who are not paying enough attention. While this may not be a big ethical issue for a €4 payment, as the sum increases this becomes a bigger concern.

Further criticisms have been directed at carbon offsetting policies more generally for failing to address the behaviour that has the damaging effect in the first place – flying. Paying to offset carbon emissions has no actual effect on the emission level of a flight. Instead they are used to fund initiatives known as "sink" projects such as afforestation or reforestation (Araghi et al., 2014). However, afforestation is not an effective means of carbon reduction as the scale of land required to compensate for carbon emission is largely unfeasible (Gössling et al., 2007). As such, carbon offsetting can be seen as simply alleviating one's guilt, detaching them from the long-term solution of flying less (Araghi et al., 2014). The researchers recognise these criticisms, and while they acknowledge that utilising default effects and carbon offsetting charges are not a long term solution to climate change, they are cheap and easy to implement and as such can be used alongside demand modelling policies aimed at addressing the damaging behaviour.

There are a number of possible extensions to this experiment that further research can explore. First of all, this experiment could be recreated in the field, partnering with airlines to introduce the two default conditions and measure their impact on willingness to pay. Secondly, it would be in-

formative to observe how the scale of the default effect changes as flight prices and the carbon emission offset charges change. This would allow us to investigate absolute and relative price effects on the default bias and the decision making in this context. This research would aid in identifying the optimal default carbon offset charge to maximise donation revenue.

VIII. Conclusion

This paper aimed to investigate the impact of a default frame on individuals' willingness to pay to offset the carbon emissions of their flights. The results returned from a controlled experiment showed that the default frame did have a significant effect on their willingness to pay. It contributes to the growing literature on the applications of default framing and, more importantly, on adapting the world economy to the realities of climate change. The recent IPCC report stated that "far reaching, multi-level and cross-sectoral climate mitigation by both incremental and transformational adaptation" are needed to combat future climate related risks (IPCC, 2018). As such, default framing, such as that outlined in this paper, can form a cost-effective part of a larger, overarching strategy to tackle climate change. As a result of the affirmation of this paper's hypothesis, it would be worthwhile to replicate and extend the experiment to shed more light on the possible limitations and benefits of default frames.

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X. Appendix

Table A1 Description of the variables

Variable	Description
offset	Dummy variable that is used as the independent variable in the later model, describes whether money was paid to offset carbon emissions of a flight; if offset = 1
opt_out	Dummy variable for distinguishing the two surveys; if individuals faced a default option of the inclusion of the donation (opt-out / presumed consent), the variable = 1
age35+	Dummy variable for age bracket of 18-34 and 35+; if in bracket 35+ = 1 (age was translated into a single dummy due to very small number of observations in different brackets, later dropped)
male	Dummy variable for sexes; if male = 1
bag	Dummy variable for option to pay an extra fee of €10 to take an extra bag onto the flight; if willing to pay = 1
seats	Dummy variable for option to pay an extra fee of €4 to be able to select the seat; if willing to pay = 1
insurance	Dummy variable for option to pay an extra fee of €10 for travel insurance; if willing to pay = 1
transfer	Dummy variable for option to pay an extra fee of €9 for transfer to the airport; if willing to pay = 1
flyalone	Dummy variable for flight behaviour; if mostly fly alone = 1
envaware	Dummy variable for environmental awareness; if individual considers itself environmentally aware = 1
time_1	Dummy variable for ranking of key aspect when flying; if first rank is "Time of flight" = 1
airline_1	Dummy variable for ranking of key aspect when flying; if first rank is "Airline" = 1
cost_1	Dummy variable for ranking of key aspect when flying; if first rank is "Cost" = 1 (dropped in model to avoid dummy variable trap)

"German Cage" or unsung savior? The effect of Eurozone membership on Italy's economy and economic policymaking

Kate Devane, Senior Sophister

Notorious for its ever-changing governments and a seemingly spiraling debt-to-GDP ratio, Italy is undoubtedly not what one might consider an economic success story of the European Project. Indeed, in a number of economic measures it continues to be vastly outperformed by its more northerly European cousins. In this paper, Kate Devane analyses the impact that membership of the Eurozone has had on the economy of Italy, noting the binding effect that the adoption of the Euro has had on monetary and fiscal policymaking. Despite the superficial drawbacks of membership of the Eurozone and the unpopularity of austerity policies implemented in Italy over the past two decades, Devane shows that joining the Euro was certainly beneficial to the Italian economy, and that, without it, the economy would not be what it is today. What some Italians view as a "German cage" might be more of a saviour than outwardly appears.

I. Introduction

Since the introduction of the Euro, Italy has consistently underperformed economically in comparison with its peers, with its growth far exceeded by that of Germany, France and even Spain. The Italian economy has barely increased in size since the turn of the millennium and it has the third largest sovereign debt burden in the world (Giugliano & Odenhal, 2016). The Euro has oft been held accountable for Italy's economic woes in recent decades, blame which is largely unfounded. Eurozone membership has had both positive and negative effects on the Italian economy. An analysis of the effects of Eurozone membership on Italy's economy and policymaking reveals that Italy's problems lie not with the Euro but with the structural domestic flaws that have long plagued the country.

II. The Italian economy and the Euro

A brief examination of several aspects of the economy highlights the costs and benefits of Eurozone membership for Italy. Manasse et al. (2014) construct a synthetic control (simulating an Italy that had never joined the Eurozone) in order to test the counterfactual. This proves a useful tool in analyzing the effects that the Euro has had on the Italian economy.

GDP per Capita

Italian GDP per capita today, when adjusted for inflation, is less than it was in 2000 (Romei, 2008), indicating the country's underwhelming economic performance since the adoption of the Euro during 1999-2002. The popular perception of the Euro is that of a "German cage" (Paolo Savona, Minister of European Affairs, 2018-19), depriving weaker countries - including Italy - of the policy instrument of devaluation. The Euro is seen as a currency created and managed on Germany's terms to the detriment of Italy. This, the argument goes, has allowed Germany to issue cheap loans to weaker economies to increase their purchases of German goods (Bershidsky, 2018). The evidence however, in the form of the relative growths in GDP per capita of both countries as Euro members compared to their respective counterfactuals, refutes this theory. It is true that Italian GDP per capita has suffered somewhat as a consequence of the Euro, showing a cumulative loss of 3.7% during the period 1999-2011 relative to the counterfactual. Contrary to popular perception, how-

ever, Italy's loss was not to the benefit of Northern Europe: Germany's loss of potential GDP was in fact greater than Italy's, with a cumulative loss over the same period of 7.4% relative to its counterfactual control.

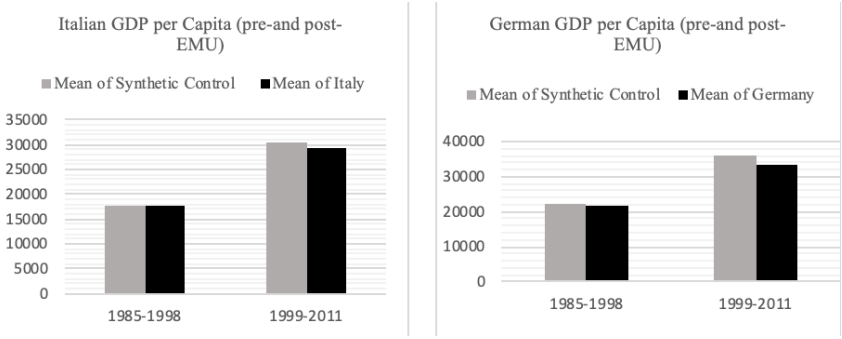

Figure 1. Change in GDP per capita relative to their controls for Italy and Germany (Manasse et al., 20140

It seems reasonable to conclude, therefore, that Italian GDP per capita has not suffered disproportionately as a result of the Euro.

Inflation

Italy's decision to join the Eurozone was partly motivated by a need to curb inflation, which had reached double digits in the preceding decade. Manasse et al. (2014) show that while rising prices are often attributed to the Euro, in its early years the common currency contributed to a cumulative reduction in inflation (compared to the counterfactual) – albeit a temporary one – of 0.7% per year (1999-2009). The Euro, therefore, had the desired effect of reigning in Italian inflation somewhat. Characterized by political instability and low levels of social peace, an Italy with complete monetary policy independence would, as the past has demonstrated, be highly inflation prone. The Euro therefore is an effective shield against the domestic policymaking process's potential for hyperinflation.

Labour Productivity

Italian labour productivity (expressed as GDP per hour worked) slowed from the late 1990s, stagnating after the introduction of the Euro – in

sharp contrast to the continual rise of the synthetic control (Manasse et al., 2008). A plausible explanation is that with the loss of devaluation strategy, resources may have been transferred from the once-competitive productive tradable sector to the protected, less productive non-tradable sector. This provides further evidence that the Euro left structural reforms, which Italy failed to implement, as its only policy option to raise competitiveness.

The 'Euro Privilege'

Italian interest rates began to decline from the mid-1990s, most clearly illustrated using the interest yields on 10-year government bonds, as seen in Figure 2. This decline can be attributed to the impending elimination of the Lira-Deutschmark exchange rate depreciation risk, the disinflation process as Italy aimed to meet the convergence criteria for euro entry, and the new-found credibility associated with the ECB's price stability objective. The lower interest rates that accompanied the introduction of the Euro provided an opportunity for Italy to reduce its debt burden at a relatively low expense.

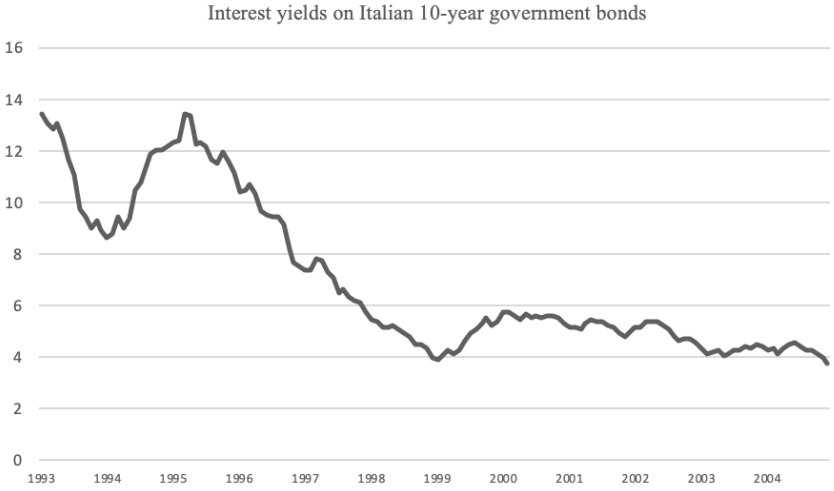

Figure 2. Interest yields on Italian 10-year government Bonds (OECD, 2020)

However, Italian authorities failed to take advantage of this cheaper debt service: debt has now risen to 131.8% (having never come close to ap-

proaching the required 60% threshold) in the wake of the crisis. Now facing high interest rates and bond yields, Italy's 2018 expenditure on debt stood at 3.7% of GDP and is forecast to rise to 3.9% in 2020. Eurozone membership can in part be blamed for these higher rates and bond yields, as discussed below, highlighting that Italy has both benefited and lost from the Euro in terms of rates on its public debt. However, failure to take advantage of the benefits shows that the fault lies with domestic policymakers, not the Euro.

III. Italy, the Euro, and shocks

The insulating role of the Euro

Fratzsher and Stracca (2009) argue that domestic policymaking not only responds to idiosyncratic shocks but is itself subject to shocks arising from political instability. The Euro, in reducing policy autonomy, then plays a role in reducing the impact of such shocks on economic policy and outcomes. Italy, characterized by a particularly unstable political sphere – having had over 60 governments in the postwar period (Fratzsher and Stracca, 2009) - benefits significantly from this aspect of EMU.

Indeed, the authors find that "political events have exerted a statistically and economically significant effect on Italy's financial markets" prior to the introduction to the Euro. Moreover, their investigation suggests that the Euro has had a significant positive role in "insulating financial markets from such adverse shocks". In general, Italian financial markets tend to exhibit "roller-coaster" behaviour around political events such as government collapses and formations. Government collapses have tended to lead to higher short-term interest rates (by an average of 40 basis points), lower equity returns (by an average of 5%) and a depreciation in the effective exchange rate of the lira, as well as raising levels of uncertainty in financial markets (Fratzsher and Stracca, 2009). Since the introduction of the Euro, however, financial markets have been shielded substantially from the effects of political turmoil. Equity returns and short-term interest rates are now influenced by events in the Euro area as a whole, causing domestic events to have a lesser impact on Italian asset prices. Exchange rate uncertainty is also reduced.

This insulating effect is not strictly positive: as Fratzsher and Stracca note, reduced responsiveness of asset prices to domestic events in particular may reduce the disciplining role that financial markets have

traditionally held over domestic policymakers. Thus the insulating effect of the euro has had mixed results for Italy.

Business Cycle Synchronization

Italy has long had a high level of business cycle synchronization with the Euro average: in comparing Italy before and after the introduction of the Euro, Amisano et al. (2009) find no significant difference in the impulse responses in the two regimes to idiosyncratic supply and demand shocks.

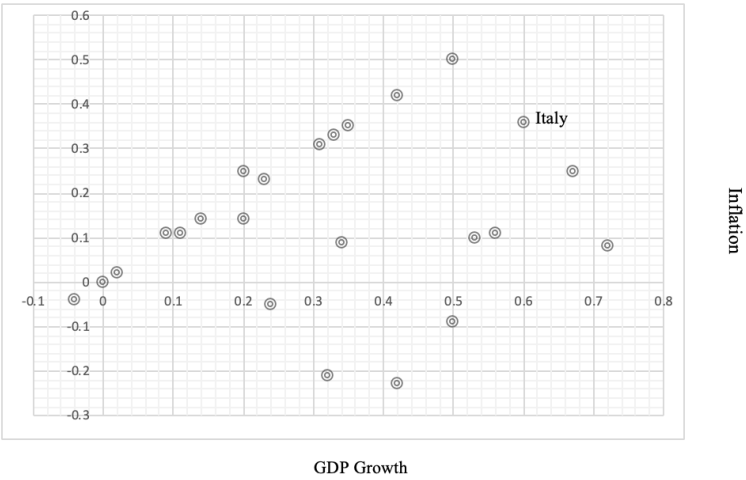

Figure 3. Correlation of cyclical components of GDP growth and inflation between the Euro area and selected countries (Broz, 2008)

The Euro has nonetheless had an effect in reducing the "variability of the divergence in real economic performance" between Italy and the rest of the Eurozone. This is due to the eradication of idiosyncratic monetary shocks as a result of integrated monetary policy.

IV. A new policymaking toolbox

Monetary Policy

Upon adoption of the Euro Italy relinquished control of its monetary policy to the European Central Bank. In adopting the common currency Italy gave up the strategy of devaluations that it had previously

relied upon as a way of keeping Italian industry competitive. The relatively good performance of the Italian economy during the 1980s and 1990s was debt-driven, resulting in sizeable expenditure with relatively poor growth in total factor productivity. For almost two decades the devaluation strategy had been a key policy instrument: this "quick fix" allowed it to offset the structural inefficiencies of the economic system and compensate for relatively high inflation and wage growth. This system of devaluations benefited the large number of small to medium-sized enterprises that have long characterized the Italian economy, but it did not address the economy's long-term growth issues.

Italy has failed to modernize its industry: businesses remain small and costs are high. Without the ability to restore competitiveness through devaluations of the lira, it has suffered "the biggest drop in export market share of any developed country" (Elliot, 2016). In the absence of structural reforms exports have continued to flounder. Structural reform options are often politically unpopular – labour market reforms proposed by Matteo Renzi in 2016 were heavily defeated (59.1% voted against the proposals) by referendum, for example (Elliot, 2016). Devaluations had the advantage of meeting little public resistance. With the absence of devaluations as a viable policy option, Italy's need to address structural problems has been exposed.

Italy is likely to have struggled economically with or without the Euro: its inflexible markets, inefficient bureaucracy, and failure to modernize its industry resulted in slow true growth even before the introduction of the single currency. However, it is true that the Euro has exposed Italy's structural weaknesses and robbed it of its main compensatory strategy.

Fiscal Policy

Eurozone membership has constrained Italy's use of fiscal policy somewhat, although not to the extent that might have been expected upon entry. The desire to qualify for Euro membership provided Italy with the motivation necessary to reduce its substantial level of public debt, which peaked at almost 127% of GDP in 1994 (Sapir, 2018). Effort to meet the Maastricht Treaty's debt requirement were initially considerable, with debt-to-GDP dropping to 111% by 1998. However, Italy's fiscal efforts declined upon entry to the Eurozone, reaching only around 100% in 2002 and remaining relatively constant until 2007, at which point the crisis

worsened affairs (Sapir, 2018).

Poor efforts to continue to strive to meet the criteria highlights the failure of EMU rules to have a binding effect on Italy's policymaking – often to the country's own detriment. Public debt now stands at close to 132% of GDP and, left to their own devices, the Five Star and Lega coalition government would implement an expansionary budget worth close to 1% of GDP. In the face of sanctions of up to 0.5% of GDP (Euractiv, 2019), Italy conceded to the European Commission's demands that it revise its 2019 budget so as to reduce the initial planned deficit of 2.4% (ibid.). This recent development shows that the Stability and Growth Pact continues to exercise at least some constraining power on domestic policymakers.

Italy is legally committed to the Stability and Growth Pact through EU membership. Given its extensive flouting of the rules however (the 2019 budget issue is only the latest in a series of clashes between Rome and Brussels), it can reasonably be assumed that without the stricter enforcement mechanisms Italy is subject to by virtue of being a Eurozone member, the Pact would have been unlikely to bring any significant level of fiscal discipline to the country. It can be concluded that Euro Area membership has limited domestic Italian fiscal policymaking somewhat, although not to the extent it would have were Italy to be more cooperative with the fiscal rules it has nominally agreed to.

Impact of the crisis

Euro Area membership has indisputably affected the extent and manner in which Italy has been affected by the Eurozone crisis. In May 2010 fears that Greek sovereign debt would spread to other "Club Med" countries (including Italy) caused markets to demand higher yields on Italian government bonds. Italian public debt, being the largest in the Euro Area (in value terms) was a source of concern for markets. The failure of Euro rules to constrain Italian public debt in previous years became particularly salient. The ensuing austerity measures introduced by the Berlusconi government in efforts to reassure markets depressed both private consumption and growth (Sapir, 2018), as seen in Figure 4.

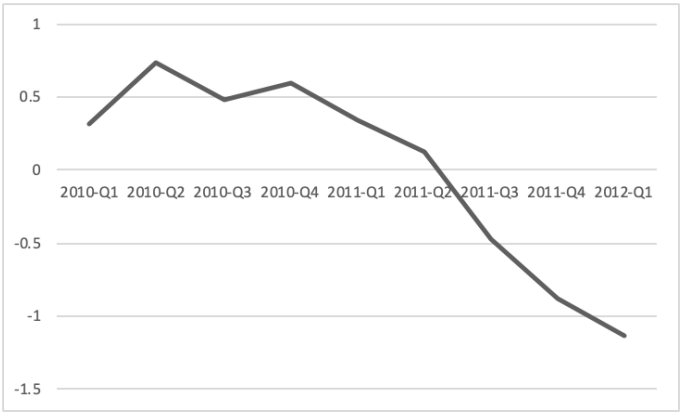

Figure 4. Italian GDP growth 2010-2012 (OECD, 2020)

Contrary to Mody's (2018) claim that the ECB's "big focus was on more fiscal austerity", the austerity-only measures implemented by Italy 2010 and 2011 were not part of an agenda set by the ECB – in fact, Jean-Claude Trichet called for "significant measures to enhance potential growth".

The most significant effect of the Eurozone in causing Italian recession was therefore through the "perceptions of vulnerability to contagion" (Sapir, 2018) from debt crises of fellow Euro Area members such as Greece. As the crisis worsened, the potential redenomination risk of Greek exit from the Eurozone spread quickly to Italy, whose credit rating dropped accordingly. The "panic-driven austerity" imposed by domestic policymakers that led to recession was a consequence of this market perception of potential contagion within the Eurozone (De Grauwe, 2011).

V. Conclusion: Italy and the Eurozone – a neglected opportunity

Membership of the Eurozone has greatly altered Italy's economic policymaking through the elimination of its independent monetary policy. Fiscal policy has also been altered, although to a much lesser extent. These changes have not, contrary to popular opinion, caused the dismal economic state Italy finds itself in – they have simply served to reveal the underlying problems in Italy's economic system. The case of Bel-

gium demonstrates the potential that the Euro held for Italy. At the time of the Maastricht Treaty, Belgian public debt was even higher than that of Italy; Belgian interest rates following entry were lower (Sapir, 2018). Belgian authorities, in contrast to their Italian counterparts, showed absolute commitment to the fiscal goals of the EMU, and thus reaped the benefits of the Euro, reducing debt and gaining stability, enabling Belgium to withstand the crisis while Italy floundered. Italy has no doubt suffered due to contagion effects in the Eurozone crisis. However, Eurozone membership has offered a wealth of benefits, many of which Italian policymakers have simply failed to utilize.

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In support of an EU-wide unemployment insurance programme

Cian Devine Prendergast, Senior Sophister

In this paper, Cian Devine Prendergast tackles the issue of introducing a bloc-wide unemployment insurance programme in the European Union. Such a programme would harmonise unemployment benefit policy across the EU, a move that Prendergast views as both economically beneficial, in that it would have significant capacity as an automatic stabilization mechanism, and conducive to fostering a greater sense of solidarity amongst the populaces of EU member states. Both the advantages and possible drawbacks of such a policy are considered, and a comparison with an alternative policy (standardising national unemployment insurance programmes across the EU) explored. Ultimately, in weighing up the pros and cons, Prendergast finds that an EUIP would have a net positive impact on both the economy and the social unity of the European Union.

I. Introduction

In this policy report I shall evaluate the need for an EU-wide unemployment insurance programme (henceforth, EUIP). I will perform this evaluation by firstly outlining what it is we are to understand by an EUIP. I shall then outline the likely benefits of an EUIP to the European Union, putting particular emphasis on its capacity to act as a stabilisation mechanism against macroeconomic shocks, as well as its propensity to foster a greater sense of

solidarity within the Union. Against these benefits, I shall consider two arguments typically made against the implementation of an EUIP: firstly, that it would represent too great a moral hazard risk, with the potential for irresponsible government; and secondly, that it would be politically unfeasible. I shall eventually come to reject these arguments on the grounds that these concerns would be mitigated by the structure an EUIP would likely take on. I shall finally come to consider the question of whether the benefits of an EUIP cannot be more easily attained by simply introducing federal legislation that standardizes all national unemployment programs. Here I will argue that the standardization of national unemployment programs is insufficient to achieve the stabilisation benefits of an EUIP, and on this basis shall conclude that an EUIP should in fact be implemented.

II. What would an EU-wide unemployment insurance programme look like?

Before delving into the question of whether there ought to be an EUIP, it is first necessary to clarify what exactly such a programme would entail. At present, unemployment insurance programmes across the EU are determined on a national basis, with nationally elected governments establishing programmes which tend to differ from each other in terms of eligibility, generosity and duration (Beblavý, Marconi & Maselli, 2017). As many as eighteen different proposals for an EUIP have been made to the European Commission, however commentary on all within the confines of this report would prove impossible, and I will as such focus only on the model provided by Dullien (2013), which has been lauded as the leading proposal in this field. Dullien proposes that all national unemployment insurance schemes within the EU be replaced by a single EUIP, financed by a fund drawn from the wages of workers within the EU. Under this system, eligible beneficiaries within the EU would receive individual benefits from the EUIP fund, with this level being set a at common minimum level relative to a country's wage level (ibid.).

III. Arguments in favour of an EUIP's implementation

3.1 The EUIP as an ideal automatic stabilization mechanism

Perhaps the most obvious benefit of an EUIP would be its capacity to provide a strong and seemingly well-needed automatic stabilization mechanism[1] for the EU. The EU's need for such a mechanism became clear to many in the aftermath of the Great Recession, during which it was revealed that the EU was uniquely ill-equipped to deal with asymmetric shocks[2] that can cause widespread unemployment and subsequent social unrest in affected areas (Beblavý & Lenaerts, 2017). Federal unions like the EU typically deal with asymmetric shocks through a combination of market mechanisms (e.g. the newly unemployed simply leave adversely affected areas and migrate to more fruitful, unaffected areas), and monetary policy, whereby interest rates may be lowered to stimulate growth and reduce unemployment in affected areas (ibid.). Neither of these mechanisms, however, are available to the EU: cultural and linguistic diversity within the Union has contributed to an immobile EU workforce, such that the unemployed in affected areas are unlikely to move to areas of lower unemployment, and the EU's common monetary policy means that reducing interest rates is as likely to lead to a deterioration in the conditions of unaffected areas via over-heating[3] as it is to significantly improve conditions in affected areas (ibid.). Furthermore, the EU would appear unable to remedy asymmetric shocks via the individual fiscal policies of its member states, for empirical evidence has shown us that fiscal policy tends to be pro-cyclical both across countries and over time, rather than counter cyclical as a remedy to an asymmetric shock

1 An automatic stabilisation mechanism is an economic policy that would offset fluctuations in member state economic activity without the need for government intervention (Dullien, 2013).
2 An asymmetric shock is an economic shock that adversely affects one part of the Union without impacting others (Dullien, 2013).
3An economy is said to be over-heating when it can no longer meet the demand of consumers, firms and government (Beblavý & Lenaerts, 2017).

would require (Alcidi & Thirion, 2016).

Realising the inadequacy of the above tools, it becomes clear that the EU sorely needs an automatic stabilisation mechanism if it is to avoid the consequences of an asymmetric shock, and it is here that we see the true utility of an EUIP. Elmendorf and Fuhrman (2008) have suggested that macroeconomic stabilisers should be timely, targeted and temporary if they are to produce desired affects, and an EUIP would appear to fulfil all of these criteria. It is timely in that it kicks in as soon as the business cycle is negatively affected and people become unemployed; it is targeted in that it supports the unemployed who would otherwise bear the costs of an economic shock; and it is temporary in that it ceases once the business cycle recovers and those laid off as a consequence of the shock regain employment (Dullien, 2013).

3.2 The EUIP as a solidarity-inspiring force

The next argument I shall put forth in favour of an EUIP is concerned with its potentially beneficial impact on solidarity within the EU. Fundamental to the European Project is a belief in and trust of European institutions: the task of integrating 28 economies while simultaneously allowing the national governments which reside over them a significant degree of independence comes almost by definition with a large degree of risk, and a sense of solidarity amongst EU citizens and governments is thus crucial to its successful operation (Beblavý & Lenaerts, 2017). However, trust in EU institutions has come under significant duress following the Great Recession, pointing us towards the notion that solidarity within the EU presently rests more so upon the economic well-being of its member states than on any true sense of European identity held by its citizens (European Commission, 2017). Many have speculated that it has been the EU's failure to interact with its populaces in meaningful ways that is responsible for the delicate state of institutional trust within the Union, arguing that solidarity will always be hard-built if the public do not see anything the Union does for them with their own eyes (van der Cruijsen et al., 2010). It is in

following this line of reasoning that we come across yet another potential benefit of an EUIP, for such a programme could put a "human face" on an otherwise abstract European project, giving the EU an opportunity to interact with its public as they face times of hardship, thus sending to them a clear signal of solidarity (Wood, 2017). That an EUIP would truly have this benefit is further attested to by the survey data of Wood (2017), who finds that 32% of European citizens answer that an "EU social welfare system harmonized between member states" would strengthen their feeling of European citizenship, leaving little room for doubt as to an EUIP's capacity to positively impact solidarity within the EU.

IV. Typical Objections to the introduction of an EUIP

4.1 The moral hazard risk of an EUIP

Many have argued that an EUIP should not be implemented on the grounds that it carries too great a moral hazard risk. It is reasoned that with an EUIP in place, governments of member states would appear to face incentives misaligned with their providing optimally responsible governance. Under this programme they would be aware that the costs of their bad governance would be covered not by them, but by an EUIP fund, and that the EU would likely be reluctant to punish them in response to their irresponsible governance for fear that their increased costs were in truth due to some external factor (Beblavý & Lenaerts, 2017). Thus, it is concluded, irresponsible governance is a likely outcome of the implementation of an EUIP.

Against this, however, I argue that institutional moral hazard risk should be of little concern to any debate over the utility of an EUIP, for the impact it has on the incentives of member state governments can be significantly mitigated by punishment mechanisms built into the foundation of the EUIP. Dullien (2013), for example, proposes a claw-back mechanism in which the contribution of each country to the EUIP fund is tied to the net balance of past contributions that each country has made towards the EUIP,

such that countries are punished for extended periods of negative net contribution. For example, a country's contribution rate might increase by 0.03% of GDP if its net contribution has been negative for over 4 years (ibid.). In this way, the institutional moral hazard risk carried by an EUIP could be greatly reduced, for each national government within the EU would face strong incentives to minimize its own social risks such that its net contributions towards the EUIP fund remain positive.

It could of course be argued that the imposition of such a mechanism would diminish the beneficial capacities of an EUIP as an automatic stabiliser, punishing the employed population of a country with already wide-spread unemployment. However, simulations run by Dullien (2013) on the impact of an EUIP with a claw-back mechanism within the EU have shown that, in reality, a claw-back mechanism would have only a minor impact on the stabilization capacity of the EUIP.

4.2 The political feasibility of an EUIP

It has further been argued that an EUIP would be politically unfeasible, for it would simply represent a permanent transfer of wealth from certain member states to others. It is argued that because certain member state economies are structured in such a way that they are less likely to produce unemployment than others, they would find themselves in a near constant position of net-contribution toward an EUIP fund, causing anger among their electorate and making an EUIP extremely unpopular.

This would at first appear a reasonable concern: many regional economies within the Union reliably produce high levels of seasonal unemployment via their reliance on agriculture and tourism, and if such forms of unemployment were to be covered by an EUIP, then an EUIP truly would constitute a permanent transfer of wealth from economies with low seasonal unemployment to economies with high seasonal unemployment (Dullien, 2012). Much like concerns over moral hazard risk however, concerns over the political feasibility of an EUIP can be alleviated by simply exam-

ining more closely the likely structure that an EUIP would take on. If, for example, workers were required to make continuous contributions to the EUIP fund prior to unemployment (over say 22 of the last 24 months), EUIP funds could be withheld from the seasonally unemployed who typically work only in short 3-6 month bursts, greatly reducing the likelihood of permanent transfers from certain member states to others, and making an EUIP a far more politically feasible policy (ibid.).

V. Weighing the benefits of an EUIP against an EU with standardized national unemployment insurance programs

I shall spend the final section of this policy report addressing concerns that the benefits of an EUIP could be more easily achieved by simply introducing legislation which standardizes national unemployment insurance programs across the European Union. This critique essentially claims that we can both mitigate the adverse effects of an asymmetric shock, as well as inspire greater EU solidarity, without having to overcome the political and legal challenges that an EUIP would imply by simply passing legislation at the federal level which would mandate high minimum standards across all member state unemployment insurance programs. It argues that with more generous unemployment insurance programs in place across the EU, workers would enjoy far greater conditions when made unemployed and would consequently be far less likely to contribute to social unrest in the event of the Union being hit by an asymmetric shock (Beblavý & Lenaerts, 2017). Furthermore, such legislation could prove beneficial to solidarity within the EU, as it would send a clear message to EU citizens that the EU has their protection in its interests (Wood, 2017).

Effective as this argument might seem on first reading, it ultimately fails to match up to the benefits of an EUIP, for, unlike an EUIP, this legislation would not allow for spatial smoothing in its defence against asymmetric shocks (Dullien, 2013). Crucial to the

EUIP's capacity as an automatic stabiliser is its ability to spread the costs of an asymmetric shock over a wide range of countries, many of which rely upon divergent factors for their economic well-being (ibid.). It is as such unlikely that a single shock could ever leave the EU in the position of being unable to fund an increase in the cost of its EUIP in the same way it could leave a national unemployment program: a national unemployment program is funded by the wages of its own citizens only, not the wages of EU workers in their entirety as an EUIP would be, and is therefore far more susceptible to financing issues in the face of an asymmetric shock, no matter what the program's mandated level of generosity (Beblavý & Lenaerts, 2017). We therefore see that, although mandating higher minimum standards for unemployment insurance across member states might come with less legal and political challenges than an EUIP, it would ultimately not provide the same benefits as an EUIP, for it would not prove as effective an automatic stabiliser in the face of asymmetric shocks.

VI. Conclusion

In conclusion, I have argued that the EU should implement an EUIP.I have arrived at this conclusion by firstly outlining the likely benefits of an EUIP, citing its capacity to act as an automatic stabiliser against macroeconomic shocks, as well as its capacity to inspire a greater sense of solidarity within the EU. Against these benefits I considered two commonly made objections to the imposition of an EUIP, analysing in turn whether it carried too great a moral hazard risk and whether it would be politically feasible. Both objections, however, were found to be either implausible or capable of being resolved simple structural designs in an EUIP. I finally came to consider whether the benefits of an EUIP could be more easily achieved by simply implementing legislation that would standardize all member state unemployment insurance programs, but eventually concluded that it could not, for such legislation would lack the stabilization benefits brought by an EUIP.

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Do donor countries consider personal freedom for Official Development Aid?

Evidence from a panel analysis

Yannik Obelöer, Senior Sophister

Yannik Obelöer investigates whether the level of freedom within an Official Development Aid recipient country impacts the level of aid received. While there is an ample literature on the role of aid in promoting economic development, little research has been conducted on whether or not donor countries consider a recipient country's human rights record when making aid allocation decisions. Obelöer, employing a Feasible Generalised Least Squares approach with Fixed Effects (FE), finds that there is evidence that donor countries consider human rights records when making aid allocation decisions, with countries which have higher freedom scores having a higher proportion of ODA to GNI. However, it is suggested that further research into individual donor countries' aid practices must be done in order to disaggregate standard ODA from "strategic" aid, thus giving a more complete picture of how ODA is distributed. Ghana is the world's second largest producer of cocoa beans, with the commodity dominating its economy.

I. Introduction

In recent decades, Official Development Aid (ODA) has often been critically viewed as an instrument to induce policy change in receiving countries. While there is extensive literature on the effectiveness of such aid, there has been less analysis on whether the decision-making process of donor countries maps the endeavour of encouraging policy change. Acknowledging that events specific to donor countries such as financial crises can negatively affect ODA by up to 28% (Dang et al., 2013), the focus of this study will lie on the characteristics of the recipient countries. More specifically, this paper investigates whether donor countries seem to make decisions factoring in the level of personal freedom that is present in the recipient country. For some time already, the quality of institutions became more important to donor countries to assess the effectiveness of aid (Collier & Dollar, 2002), as tying aid to some conditionality such as specific humanitarian and economic indicators is increasingly advised by academics since the early 2000s (Dollar & Svensson, 2000). Therefore, this paper will shed more light onto whether donor countries have followed these recommendations. Key to the analysis are the aspects of political and personal liberty, which both may in fact make aid more effective in increasing the quality of life (Kosack, 2003). In order to control for characteristics affecting personal freedom as well as the level of aid, variables such as the income level, education or being a former colony are added to the model. An additional unique aspect of this study is to include a variable for rents on natural resources. This serves as a proxy for political participation. Moreover, a high coefficient has the potential to identify profit orientated investment strategy of donor countries in the primary sector. In order to answer the question of aid and freedom, the paper utilises a rich data set of 144 receiving ODA countries, which was compiled over a nine-year time span from 2009 to 2017. This paper will find some evidence that among ODA receiving countries, those with higher personal freedom scores are able to secure more aid relative to Gross National Product (GNI).

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II. Background

The Development Assistance Committee (DAC) of the OECD defines ODA as "government aid that promotes and specifically targets the economic development and welfare of developing countries" (OECD, 2019a). Institutions such as the World Bank argue that aid ought to be selective depending on certain characteristics of the recipient country in order to incentivise improvement of institutions of specific agencies as well as the overall state (Annen & Knack, 2018). This conditional aid should not be confused with tied aid, whereby recipients may only utilise funds for business with the donor country. The latter strategy is

opposed by both the academic community and international NGOs due to the scope for restriction of freedom and inefficiencies (OECD, 2019a). Hence, it is crucial to investigate the factors actually playing a role in the donor behaviour of OECD countries in term of ODA as a percentage of Gross National Income (GNI).

Answering the question of the most efficient way to distribute aid, Collier and Dollar (2002) find that the focus should be on states facing stark poverty but showing suitable policies. Thus, countries with high levels of personal freedom should be targeted strongly after controlling for other country-specific aspects. Lumsdaine (1993) pioneered the idea of the level of democracy in a country being instrumental in how much ODA it receives. In addition, a higher index-level for institutional strength positively and significantly correlates with ODA as a percentage of GDP (Collier and Dollar, 2002). In case studies in Mali and Ethiopia, policy improvement was observed to correlate with increases in aid (Devarajan et al., 2002). However, there is also some literature strongly opposing this more altruistic motivation of aid arguing for strategic gains from aid by donor countries. The United States' engagement in the Middle East may be an example of such behaviour (Alesina & Dollar, 2000). This paper will add to the literature by offering an econometric investigation which utilizes a rich dataset to form a more sophisticated view on overall donor behaviour.

Other often-cited aspects that may influence the level of ODA are the level of poverty and colonial history (ibid.). Moreover, ODA as percentage of GDP correlates positively with higher poverty levels. The OECD (2017) found that comparatively lower-income countries received disproportionally more ODA than other LDCs.

While there are some instances in which the positive effect of aid on democracy may be proven, a general problem of reverse causality is not shown by the literature. As aid does not have a clear direct effect on policy improvement (Burnside & Dollar, 2004), there are instances where ODA both fostered a positive impact on policies concerning personal freedom and where it was harmful to policy reform (Devarajan et al., 2001). However, this paper does not seek to reach a verdict on the effect of aid but rather on the motivation of donor countries.

III. Empirical Approach

This paper utilizes a dataset collected from different sources encompassing all countries which have at least once received ODA (144) during the period 2009-2017. In order to face data availability challenges, two different independent variables are used to assess the impact on ODA distribution. On the one hand, personal freedom is tested using the Freedom House ranking. On the other hand, a dummy variable approach using the categories "Free", "Partly Free" and "Not Free" is utilised. While the ranking showed more variation, the categorical data used had fewer missing values. Moreover, donor countries may also rather think in one of the three categories when making decisions about ODA rather than in a precise ranking. In addition, due to a lack of observations on colonies, some were grouped together into the dummy variable $col\_notgbfra_{it}$ indicating a colonial past where neither Great Britain nor France were the colonizers.

Moreover, different statistical approaches are used to find that a Feasible Generalised Least Squares approach with Fixed Effects (FE) is the preferred specification. However, due to the nature of FE, historical invariant data on colonies could not be included in the specification. In order to capture these effects, cross sectional models for each year were used (see Appendix, Table A1). The succession of specifications of the different models is shown in the results section, but only the preferred specification will be interpreted.

Model Freedom House Ranking

The FE model where the variables denote the within estimators, i.e. the difference between the value at time t and the mean is the following:

$$ODA_{it} = \alpha_0 + \alpha_1\, frhs\_free_{it} + \alpha_2\, frhs\_prtlyfree_{it} + \alpha_3\, lmi_{it} + \alpha_4\, umi_{it} + \alpha_5\, lfexpec_{it} + \alpha_6\, yrs\_schlng_{it} + \alpha_7\, natres\_rent_{it} + v_{it}$$

Model Freedom House Brackets

Similarly, for testing whether different freedom brackets were significant the following model was used:

$$ODA_{it} = \beta_0 + \beta_1 frhs\_hmnfreedm_{it} + \beta_2 lmi_{it} + \beta_3 umi_{it} + \beta_4 lfexpec_{it} + \beta_5 yrs\_schlng_{it} + \beta_6 natres\_rent_{it} + u_{it}$$

where the dependent variable indicates Official Development Aid as a percentage of GNI, the independent variables for human freedom are either included by categories or an index with a value of one being the freest country in the ranking. The latter was compiled by using indicators in line with the Universal Declaration of Human Rights in order to assess the level of political rights and civil liberties. The second specification assigns each country to a bracket of human freedom. While "free" and "partially free" are included in the specification, "not free" is the base category. Moreover, controls for economic well-being and rents on natural resources are added.

All variables have also been carefully selected in order to meet the outlined economic theory. Concerning the dependent variable, the ratio of ODA over GNI accounts for the amount of aid relative to the size of the country and its income. The control variables are also founded in theory: I employ these variables in the model to avoid a violation of the Zero Conditional Mean assumption which is present if some variables that affect freedom levels as well as ODA/GNI are only captured by the error term. Life expectancy controls for the level of healthcare in the country and the years of schooling act as a proxy for the strength of the education system, which both may support the level of freedom and are at the same time likely to be correlated to the level of aid. Additionally, the rent on natural resources, as a proxy for the potential of economic exploitability, may also heavily affect the level of freedom in a given country.

Ex ante the level of human freedom is expected to be positively correlated to ODA as a share of GNI. Two decades ago Alesina and Dollar (2000) claimed this relationship to be positive as donor countries value freedom in recipient countries.

IV. Description of Data

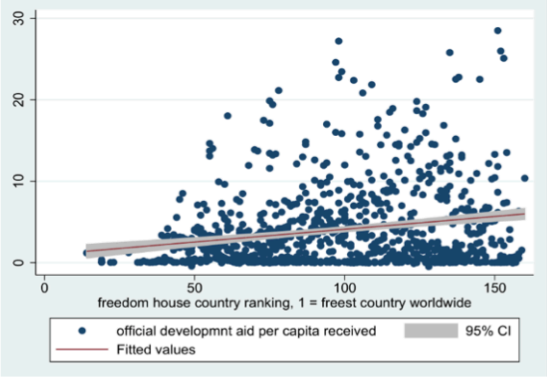
The dataset was compiled using the World Bank's database for ODA (2019a) and rent on natural resources (2019b), the Freedom House database for data on freedom levels (Freedom House, 2019), the UN Population Division (2019) for life expectancy, the UN Development Program's database (2019) for data on expected years of schooling and the Issue Correlates of War Project's database (2018) for data on colonies.

The sample of 144 low-income and middle-income countries was chosen between the years of 2007 and 2017 as the structure of the aid framework governed by the OECD changed before and after this time. As visible in the figure for the number of observations (Table 1), there are some missing variables for the dependent and some of the independent variables. Thus, a small number of entries for specific years and countries had to be excluded from the dataset when running regressions, resulting in an unbalanced dataset. However, this does not pose a big problem as missing values are unlikely correlated to ODA/GNI levels.

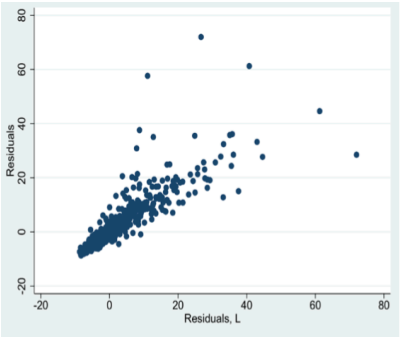
The summary statistics of the numerical variables (Table 1) also give a first insight to the dataset. One may observe that ODA/GNI is fairly scattered with a standard deviation of 9.577, a negative minimum bound of -0.483 and a maximum of 89.04. The negative value can be explained by the fact that ODA/GNI is negative when a country pays back more loans than it is receiving in a specific year. Similarly, the minimum of the rent of natural resources of zero is explained by the fact that not every country in the dataset has a sector for natural resources. Moreover, a simple scatterplot and fitted values indicate a slight positive relationship between the freedom ranking of a country and the level of aid received (Graph 1).

VARIABLES	N	mean	sd	min	max
oda	1.233	6,286	9,577	-0.483	89.04
lfexpec	1.233	64.36	16.21	0	80.14
yrs_schlng	1.233	11.89	2,962	0	17.40
frhs_hmnfreedm	1.233	71.04	51.24	0	160
natres_rent	1.233	9,092	11.63	0	60.40

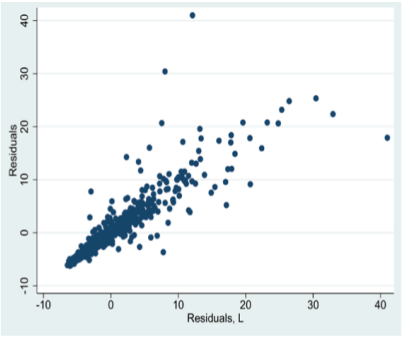
Table 1: Descriptive Statistics Numerical Variables



Graph 1: correlation Freedom Index and ODA as % of GNI



Graph 2: Residuals and lagged Residuals, Freedom Bracket Specification



Graph 3: Residuals and lagged Residuals, Freedom Index Specification

V. Tests and Transformations

In order to find the preferred specification, multiple tests were conducted to combat sources of statistical errors in both models – the index as well as the brackets. Such tests are key as the research question can hardly be answered using experimental or quasi experimental evidence at national level and thus time series data is the best alternative. Testing of the research question started with a pooled OLS. As heteroscedasticity was found in this model using the Breusch-Pagan test, robust standard errors were used. The Ramsey RESET test was used to test for a misspecification but also omitted variable bias. As the H_0 of no omitted variables was rejected, a Fixed Effect model was set up controlling for time-invariant omitted factors. Autocorrelation was investigated graphically by plotting the error term against the lagged error term. Graphs 2 and 3 (specification using brackets and index data respectively) clearly show a positive correlation of the error terms. Thus, as outlined by Musau et al. (2015), the feasible GLS estimation for a fixed effect model ought to be used to control for this aspect.

VI. Results

The results from the two different models do not only give a valuable insight into ODA donor behaviour individually but the comparison of the two makes the argument concerning the level of freedom more convincing. The model using a freedom ranking proves the expected positive relationship between freedom levels and ODA/GNI as change in the freedom index is highly significant. More precisely, the coefficient indicates a decrease of ODA/GNI of 0.0288 when moving one rank down the index towards a relatively less free state (ceteris paribus). The model utilizing freedom brackets instead of a relative ranking offers a more dynamic view, although most of the results are statistically insignificant. The overall observation that can be made of the results is in line with the testing conducted by Collier and Dollar (2002), which found a positive relationship between more democratic policies and aid levels.

Due to the scope of this paper, only the coefficients of the model using the freedom index (Table 4) will be investigated more closely. This model reinforces the investigation of the OECD (2017) that lower income countries receive a disproportionate amount of ODA. The differ-

ence from a lower income country to a middle-income country makes a stark difference of around 4% more ODA relative to GNI (ceteris paribus). This may be explained by a focus of donor countries on those in most need but also because the GNI growth over time reduces the figure for ODA/GNI. Still, there is a rather small difference between lower and upper middle-income countries. The negative and highly significant coefficients for life expectancy and years of schooling further support the idea that donor countries direct their aid towards regions with the greatest need.

The coefficient for rent on natural resources is more ambiguous with different (but also rather insignificant) results across the two models. More research would have to be conducted to make a clear judgement on this effect. However, it might also just not be taken into account at all when donor countries decide upon their aid flows. With the FE model, the effect of former colonies receiving disproportionate aid could not be observed. As pooled OLS models suffer from autocorrelation, cross sectional models for each year (see appendix, Table A1) were used to infer more about the impact of colonial history. These simple models do not indicate an overall focus of aid on former colonies, as all coefficients are insignificant.

Table 3: Results Freedom Brackets

VARIABLES	(1) ODA/GNI	(2) ODA/GNI	(3) ODA/GNI	(4) ODA/GNI	(5) ODA/GNI
Partly Free	-0.276	0.517	0.679**	0.676**	-0.528
	(0.421)	(0.328)	(0.307)	(0.308)	(0.521)
Free	1.177**	0.687**	0.801**	0.804**	0.992*
	(0.593)	(0.328)	(0.341)	(0.342)	(0.528)
LMI	-4.367***		0.227	0.212	-4.645***
	(0.605)		(0.450)	(0.464)	(0.576)
UMI	-6.322***		1.569***	1.581***	-6.854***
	(0.600)		(0.588)	(0.581)	(0.693)
Life	-0.269***			0.0356	-0.0817*
Expectancy	(0.0489)			(0.174)	(0.0424)
Years of	-0.345***		-0.437	-0.438	-0.307**
Schooling	(0.133)		(0.419)	(0.420)	(0.132)
Rents Nat.	-0.0325		-0.0695	-0.0697	-0.0355*
Resources	(0.0246)		(0.0445)	(0.0444)	(0.0195)
Colony	-4.222***				
France	(0.686)				
Colony	-4.190***				
GB	(0.718)				
Colony but	-5.287***				
Not FRA/GB	(0.772)				
Constant	32.55***	6.265***	11.55**	9.235	18.68***
	(3.213)	(0.354)	(4.768)	(11.99)	(2.520)
Estimation Method	OLS	FE	FE	FE	FGLS FE
Observations	1,174	1,174	1,174	1,174	1,174
R-squared	0.289	0.053	0.066	0.066	
Number of Countries		136	136	136	136

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Results Freedom Index

VARIABLES	(1) ODA/GNI	(2) ODA/GNI	(3) ODA/GNI	(4) ODA/GNI	(5) ODA/GNI
Freedom Index	-0.0230***	0.00366	0.00379	0.00402	-0.0288***
	(0.00482)	(0.0115)	(0.0116)	(0.0113)	(0.00514)
LMI	-4.035***		0.384	0.389	-4.286***
	(0.380)		(0.361)	(0.362)	(0.385)
UMI	-4.374***		1.194**	1.214***	-4.609***
	(0.426)		(0.459)	(0.460)	(0.475)
Life	-0.305***		-0.0520	-0.0537	-0.212***
Expectancy	(0.0409)		(0.163)	(0.162)	(0.0281)
Years of	-0.304***			-0.150	-0.325***
Schooling	(0.0891)			(0.321)	(0.100)
Rents Nat.	0.0201			0.0237	0.0273*
Resources	(0.0230)			(0.0379)	(0.0150)
Colony	-1.614***				
France	(0.577)				
Colony	-2.575***				
GB	(0.650)				
Colony	-2.041***				
Not GB/FRA	(0.657)				
Constant	33.36***	4.724***	7.717	9.227	27.24***
	(2.806)	(1.127)	(11.00)	(11.41)	(1.875)
Estimation Method	OLS	FE	FE	FE	FGLS FE
Observations	912	912	912	912	912
R-squared	0.456	0.051	0.058	0.060	
Number of Countries		113	113	113	113

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VII. Conclusion

This paper set out to explore the effect of the level of freedom in an ODA recipient country on donor behaviour. It did so by using a Feasible GLS estimation for panel data over a span of nine years and across 144 countries. The empirical results suggest that donor countries indeed reward freedom to some degree. More aid is given to countries which are relatively freer: ODA/GNI increases by 0.0288 when a country rises one rank in the Freedom House index (when controlling for humanitarian and economic circumstances and keeping all else constant). When inspecting freedom brackets rather than a relative ranking, there are indicators for a nonlinear relationship. In other words, there might be a certain region of personal freedom in which donor countries may be more willing to supply aid. However, even though these aggregate figures indicate that there is evidence for on overall rewards of human freedom, it does not rule out occasional strategic aid giving by some countries. Hence, beside this overall impression of ODA behaviour, country specific studies are a necessary complement to form an exhaustive picture. The other coefficients were also in line with prior literature and general intuition. Due to the used statistical approach, the effect of being a former colony could not be sufficiently tested to refute Alesina and Dollar's (2000) claims but cross-sectional models do not show significant indicators of colonial linkages. These insightful results from this unique dataset may be a good start for further research into more specific events such as political crises or the importance of former donation behaviour through lagged variables. Overall, especially due to the advanced model and the large dataset, the stated results are a strong indicator that donor countries may in fact be rewarding progressive legislation in recipient countries through their ODA decisions.

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IX. Appendix

Table A1: Yearly Cross-Sectional Model

	(1)	(2)	(3)	(4)	(5)	(6)
	2012	2013	2014	2015	2016	2017
VARIABLES	ODA as % of GNI					
frhs_hmnfree	-0.0231*	-0.00735	-0.00852	-0.0308*	-0.0129	-0.0214**
	(0.0134)	(0.0134)	(0.0102)	(0.0157)	(0.0127)	(0.00920)
lmi	-2.850***	-3.321***	-2.841***	-3.176***	-3.357***	-3.579***
	(0.962)	(0.946)	(0.976)	(1.045)	(1.081)	(0.995)
umi	-2.752***	-3.235***	-2.620**	-2.588**	-2.231*	-2.941***
	(0.976)	(0.981)	(1.022)	(1.091)	(1.144)	(1.062)
lfexpec	-0.294**	-0.301***	-0.343**	-0.271**	-0.333**	-0.269**
	(0.113)	(0.110)	(0.150)	(0.127)	(0.158)	(0.113)
yrs_schlng	-0.456*	-0.268	-0.338*	-0.651***	-0.447	-0.421*
	(0.241)	(0.213)	(0.198)	(0.247)	(0.284)	(0.232)
natres_rent	-0.0426*	-0.0732***	-0.0497	0.112	0.162*	0.0761
	(0.0224)	(0.0211)	(0.0426)	(0.125)	(0.0895)	(0.0631)
col_fra	-0.439	-0.939	-0.527	-1.704	-2.243	-0.820
	(1.391)	(1.272)	(1.405)	(1.816)	(1.686)	(1.213)
col_gb	-1.409	-1.923	-2.843	-2.236	-2.052	-1.168
	(1.864)	(1.839)	(1.885)	(1.770)	(2.151)	(1.935)
col_notgbfra	-1.383	-1.349	-2.524	-2.919	-3.002	-1.898
	(1.628)	(1.564)	(1.668)	(1.797)	(2.000)	(1.325)
Constant	34.00***	31.39***	34.74***	34.74***	35.09***	31.51***
	(6.713)	(6.201)	(9.939)	(9.194)	(9.712)	(7.657)
Observations	104	104	108	110	110	113
R-squared	0.487	0.508	0.433	0.445	0.489	0.479

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Credit, Consensus & Confusion

Cillian Bissett, Senior Sophister

The word "microcredit" did not exist prior to the 1970s, but in the past few decades, microcredit programmes implemented across the developing world have burgeoned, offering a new method by which we can tackle the issue of poverty. Cillian Bissett dives into this ever-expanding field of research, offering a comprehensive summary of findings in the literature to date. As is illustrated, the impact of microcredit programmes in developing nations is still somewhat ambiguous, with significant dissonance within the literature, yet as time wears on and the research output increases, we appear to be coming closer to a consensus on the benefits and drawbacks of microcredit programmes. That being said, further research undoubtedly must be undertaken to gauge the success of microcredit as a means of alleviating poverty across the globe, and more than just economic factors ought to be considered when conducting such research.

I. Introduction

There is a growing body of evidence suggesting the impact of microcredit can be more complicated than intuition may suggest, particularly in terms of the ability of small-scale loans to reduce poverty. The dissonance within the literature across settings clearly indicates that further research is needed, in spite of emerging trends within recent findings.

The Need for a Loan

Microcredit was originally conceived as a means to tackle poverty, by means of extending financial services to tackle those as-

pects of the poverty cycle which may be linked to credit constraints. Critically, it serves as a means to give credit in a financially sustainable way to those people who would have little or no access to formal credit. The institutions one would think of as providing "formal" credit are essentially banks. Formal lenders operating in relatively less well-off countries tend to serve the wealthier portion of the market; institutions providing credit tend to have relatively strict requirements, especially due to requiring collateral which the less fortunate simply cannot provide, shutting them off from one of the main sources of credit in a given economy. Hence, an alternative was needed.

Muhammad Yunus conceptualized this idea in the Grameen Bank. The basic principle was that small loans would be provided to each of a small group of borrowers. If even a single borrower within that group were to default, none of the recipients would be eligible to receive any microcredit in the future. This incentivizes two key changes in behaviour. Firstly, people will essentially screen their own groups to ensure they are only with people who they view as reliable, which overcomes the information asymmetry that exists between lenders and borrowers. Secondly, it encourages members of groups to monitor the use of the funds, to ensure they are put to the use for which they were originally given out. This lending mechanism has several variants, such as sequentially offering the loans to members of a group, and some microcredit providers actually offer products to individuals. At the very least, it seems Grameen Bank was successful, having loaned almost $29.04bn from the inception of the programme (Grameen Bank, 2020). Moreover, Yunus, the architect behind the programme, was awarded the 2006 Nobel Peace Prize. That said, while we can see that the schemes are at least sustainable, and seem to be helping a large number of people, can we find evidence that this is indeed going to be key in eradicating poverty globally?

To fully understand the issues facing the sector, it is necessary to have a clear-cut picture of the market as it stands today. Microcredit is a key area of growth within the international banking sector. In 2018, 139.9 million people directly benefited from microcredit, as compared to 98 million in 2009, with an average annualized growth rate of 11.5% over a 5-year period (convergences.org). The total outstanding loan portfolio had a total value of $124bn, with approximately 80% of all borrowers being female, and 65% of all borrowers living in rural areas. The market has several leading areas: namely, South America and Southeast

Asia. South America has the biggest market according to portfolio value, at $48.3bn, whilst Southeast Asia dominates when measured by the number of people availing of microcredit, with 85.6 million people availing of microcredit in 2018 (a growth rate of almost 14% on the previous year). Furthermore, Southeast Asia is the location of the three countries with the largest numbers of borrowers: India, Bangladesh and Vietnam. A key idea to take note of is that microcredit is being pushed in two ways: firstly, as means of female empowerment (recall the fact that 80% of borrowers are female), and secondly, as a means of helping poorer rural communities (also recall that 65% of borrowers are rural dwellers).

Effects on Service Users

The first item to focus on in attempting to settle the debate: what can microcredit do for those who avail of the service? There are quite a few studies suggesting that there may be a role for microcredit in helping to alleviate poverty, or at least in addressing certain symptoms of poverty. Evidence has been found indicating positive net impacts on the borrowers in question on a wide variety of outcomes (which have typically varied significantly by setting) such as consumption, economic self-sufficiency, outlook, and mental health being positively affected in South Africa (Zinman & Carlan, 2015), which were brought about by use of microcredit to pay off debts (28.3% of overall use), with transport and other work-related expenses being the next most common usages. In other settings, small business investment, business profits, and durable good consumption increased in Hyderabad, India (Banerjee et al., 2014), with similar effects being detected in other settings such as Morocco (Duflo et al., 2011). Clearly, seeing such variability in what outcomes we see affected suggests two things; firstly, impacts of microcredit are clearly context-dependent. Secondly, microcredit may have the potential to affect a vast array of outcomes, provided it is enacted in a particular manner. Indeed, papers trying to identify causal channels have concluded that the channels through which microcredit acts will vary by the country's income (Maksudova, 2010), and that the impact also varies by gender of the recipient (Khandker, 2005).

There has also been indication within the literature that perhaps the effects are not all positive. The aforementioned study in Hyderabad found non-durable consumption actually fell, rather than increased (due

to increased likelihood to save to complement the loan). In some cases grace periods are provided, where loan repayment does not immediately commence upon receipt of the loan. This suggests that we see the recipients being encouraged to cut back consumption on a day to day basis - while the extra savings may help them create more value from the loan, this could have a substantial negative impact on their welfare, particularly in cases where essentials are being sacrificed in order to complement the loan. Furthermore, while we see higher investments into businesses and profit growth, there are also higher default rates (Field et al., 2013). Thus, one can conclude that it may be preferable for providers to have no grace periods, to ensure careful use of funds; this in turn would reduce the investment into businesses (particularly those of a risky nature), mitigating at least in part one of the purported benefits of microcredit programs in terms of boosting entrepreneurship.

It is not unreasonable to suggest that in many cases where microcredit has been successful, the positive impacts may have stemmed from unmet demand in the market. One of the basic ideas underpinning microcredit is that those who avail of small loans may not have access to credit from other sources outside the informal market. Empirically, it has been found that expansion of microcredit did not seem to crowd out other forms of lending, suggesting there is essentially untapped demand in these markets (Carlan & Zinman, 2011). This is encouraging as it supports the principle of credit rationing: that is, for a given interest rate, borrowers in these markets will want to borrow more than they are offered. Unfortunately, even where it seems there was a supply constraint there were no clear positive impacts on the number of businesses operated or on the number of paid employees working for a household. Indeed, the effects amongst the treatment group were slightly negative, significant at the 10% level. Further negative effects were uncovered on subjective well-being, at a 10% significance level. Admittedly, while this is not as strong as indication as we may like, it is well worth bearing in mind and is still highly likely to be non-random.

Turning our attention from income, personal finances and entrepreneurship to emotional wellbeing, we get a slightly bleaker picture. Poor rural women in Bangladesh reported depression-like symptoms, with microcredit doing nothing to ease emotional stress. This was often due to new roles women found themselves in within the household (Ahmed et al., 2001), which ought to be weighted particularly heavily in any judge-

ment of the market, as women are the biggest market segment, followed by rural dwellers. Case studies have found borrowers can be protected from peer-pressure induced stress in group lending situations through the use of flexible repayment options, offering savings facilities, and short duration consumption loans with high interest rates (Montgomery, 1996). That said, evidence has been found that receipt of microcredit makes the recipient a generally more responsive and active agent, both financially and more broadly in their own lives (Basher, 2007). Worth noting, Basher's discussion of spill-over effects refers to effects upon nonfinancial aspects of a person's life, not spill-over effects upon non-recipients.

Methods matter

One issue of particular concern is the way in which microcredit is practiced, as cases of malpractice have been seen to have serious detrimental effects upon recipients. One of the more prominent cases of this can be seen in southern India in 2010. Here, lending behaviours were reported within the media to have mirrored those within the US property market, and lead in turn to a suicide epidemic due to financial stress within the Andhra Pradesh region (Biswas, 2010). Collins et al. (2009) suggest that the type of Micro Finance Institutes that are savings-driven rather than credit-driven yield better outcomes for borrowers. In this case, India's regulatory environment did not permit MFIs to provide savings products, which have been identified to be a key element of providing microcredit. Indeed, the absence of savings products has been suggested to have been a key component in causing the issues seen in India at that time (Schmidt, 2010). As the borrowers had no savings facilities on offer, it was substantially more difficult to manage one's finances. This in turn meant it was more difficult to meet repayment obligations to the lender. Indeed, providing microcredit and a savings facility is valued very highly by the service users, who typically accept very high interest rates, and are willing to take little to no interest on their savings. In fact, cash flows into and out of these accounts can range from 75% to 500% of a household's annual income (Rosenberg, 2010).

Furthermore, there is a big ethical question hanging over the fairest method for group lending - the debate pits simultaneous against sequential lending. Sequential lending means subsets of a borrowing group are given their loans first, and as they repay, loans are extend-

ed to other members of the group over time. Should an earlier recipient fail to pay back a loan, members of the group who have yet to receive any financial aid will still be blacklisted and unable to avail of such services in the future. In the simultaneous case, though they will still be blacklisted, they will still have received their loan, and had the opportunity to set up a business. In principle, justification offered for sequential lending is that withholding the loans to some members of a group conditional on others repaying creates greater social pressure to pay back, enabling the credit provider to serve more people.

The communal impact

Spill-over effects are rarely examined in great individual detail in the context of microcredit. Where they have been examined, it has been looking at villages that did not receive any program benefits and drawing comparisons to those that did. In these cases, spill-over effects were typically scarce and, where they existed, were typically small, such as only hiring approximately 4 extra days of labour during agricultural season (Beaman et al., 2014), which is asserted to be quite small and unlikely to affect output in a meaningful way.

One of the few advances in examining spill-over effects came from treating the credit market as having two sectors and adverse selection, and showing that real world data fit the behaviour predicted in the model. In particular, under some circumstances increases in the interest rate charged to people outside of the microfinance sector were triggered, which could harm the welfare of those borrowers (Demont, 2013). Specifically, this can occur when safe borrowers can get access to individual loans and microfinance providers are unable to serve the entire market. Clearly, this indicates the market conditions and financial health of the microfinance providers are key in determining the nature of the spill-over effects.

Spill-over effects have been detected on poverty and female empowerment at a municipal level within Bolivia (Gonzalez et al., 2018), with spill-over effects on poverty corroborated by the aforementioned 2005 paper by Khandker. Indeed, Karlan, Goldberg and Copestake state unambiguously that RCTs are the best possible approach to evaluating the impact of microfinance programs (Karlan et al, 2009). Note that many previously-referenced studies used a random phase-in approach

Conclusion

Given a lot of conflicting evidence, it can be quite difficult to infer what the "true" impact of microcredit is. Surveys of the literature, across different settings, have reached the conclusion that while positive impacts should be expected, these are typically small, and rarely transformative as some would claim (Banerjee et al., 2015, Develtere et al., 2005), with papers examining a variety of outcomes suggesting they do some good with minimal negative effects (Angelucci et al., 2013). We can safely claim we are approaching some sort of loose consensus on the direct impacts of microcredit, with the emergence of certain trends amongst the recent literature and consumers voting with their feet and signing up en masse.

That said, we cannot truly claim the effects are particularly clear-cut, as there are still a number of studies which have found neutral or negative effects. Furthermore, there is a strong case to suggest the emotional & psychological impacts may be negative, especially in cases where the service is implemented in a manner that is not consumer friendly. Thus, to truly discuss the impact of microcredit, an age-old question must be grappled with: how should we measure the success of microcredit? It is fair to claim on the basis of the available evidence that microcredit can be, but not always, successful at helping tackle financial issues related to poverty. Considering happiness, emotional well-being and psychological impacts yields a much darker view. Is this unique to microcredit as a solution to poverty? Not necessarily, but to finish the debate once and for all, further research on this aspect is necessary. One thing alone can be stated with absolute certainty: these small loans can have a very big impact.

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Adam Smith and the Division of Labour: Influences, Ancient and Modern

Ciarán Mulqueen, Senior Sophister

Adam Smith is often referred to as the "Father of Modern Economics", and thus it is unsurprising that he makes an appearance in the Student Economic Review. Indeed, Smith's thought is still taught to Economics students the world over, despite the fact that the field has progressed by leaps and bounds since he published his magnum opus, "The Wealth of Nations". In this paper, Ciarán Mulqueen explores the influence of the doctrine laid out in this very book, comparing the thought contained within its pages to that of ancient writers and of Smith's contemporaries. Mulqueen finds that, when compared to similar ideas propounded by ancient writers, there is a clear improvement in the works of Smith, with his work possessing a more scientific edge and focusing on the quantity of production rather than the quality of production seen in Plato's arguments for the division of labour. He also finds that, contrary to popular belief, Smith's analysis for the division of labour was not wholly original, and that the arguments laid out in "The Wealth of Nations" were fairly well established by the mid-18th Century. Even some of the finer points of Smith's argumentation had featured in the works of others. The only mentionable difference found between the works of Smith and that of his contemporaries is the clarity of exposition and the power of his emphasis. Maybe this forceful emphasis, then, is the reason why Smith's name has been eternally attached to the idea of the division of labour, and why he has been immortalised as the "Father of Modern Economics".

I. Introduction

Provocatively, scholars such as Schumpeter and Rashid have claimed that there is not a single new analytic idea to be found in the Wealth of Nations (Rashid, 1998: p. 6; Schumpeter, 2006: pg. 179). Even defenders of Smith, such as Jacob Viner, have said that his "main merits as an 'analytical' or 'scientific' theorist… lie in his eclecticism" (1991: pg.257), a statement meant to down-play the originality of the work, concentrating instead on other qualities. In this essay, I will attempt to assess the originality of Adam Smith's doctrine of the division of labour (DL) by tracing its origin in both ancient and modern authors. Although Smith had several other defining doctrines, such as the distinction between productive and unproductive labour, and that free trade was beneficial to all the countries involved, his views on the DL, the specialisation of labour and the tasks labourers perform stood apart from other theories due to the great emphasis he put on the DL in his work. Several scholars have noted the importance he placed on the doctrine. For example, Schumpeter remarks that: "With A. Smith [the division of labour] is practically the only factor in economic progress" (2006: pg. 182); and more recently, Skinner and Campbell (2009) wrote that, for Smith, "…the division of labour remained in practice the fundamental cause of economic growth". Indeed, if we had to answer, as Smith himself would, his guiding research question, "what determines the wealth of a nation?", as sparingly as possible, we would do well to say it is "the extent of the division of labour". To begin, I shall lay out Smith's own view on the DL and how it compares to those of ancient authors.

II. Adam Smith's doctrine and its advance over the ancients

It is usually nothing more than a bad anachronism to claim, after citing a passing remark from an ancient author, that the author in question anticipated the work of a modern scholar, or, even more boldly, to claim that the modern scholar in question was influenced by the work of the former. However, in the case of the DL and Adam Smith there is at least, prima facie, evidence that this is not the case. First, several ancient authors such as Xenophon and especially Plato wrote about the DL, or "the eternal commonplace of economics", as Schumpeter calls it,

in more than just some passing remarks (Republic 369E-370E; Republic 374A-374E; Cyropaedia 8.2.5). Second, we are in a position to know from biographical sources that Smith was a curious individual with a wide range of interests (Viner, 1991: pg. 250) and he had the opportunity to read the works in question when he studied moral philosophy at the University of Glasgow, and also during his time as a Snell exhibitioner (essentially time that could be dedicated to private study) at Balliol College Oxford (Phillipson, 2010). The Republic, particularly, would have been a staple in any philosophical education. Third, we know, from his library, that at the time of his death he held several copies of Plato's complete works (Bonar, 1894: pg. 86). Most importantly, Smith himself implies that he had read Plato's entire catalogue when he writes about one of Plato's beliefs that, "there is not a single dialogue in all of his works which does not refer to it" (Smith, 1967: pg. 127; as cited by Foley, 1974: pg.242).

However, Smith's work contrasts to Plato's in at least three respects. Firstly, while Smith stresses that a rise in the DL would lead to an increase in the *quantity* of goods produced; Plato thought it would only improve the *quality* of goods[1] (cf. Smith, 1976: pg.21; Republic 370B). Second, Plato believed this stemmed from individuals being naturally different. This, he claimed, left some individuals with a greater natural ability to perform certain tasks (ibid.). For Smith, the differences we observe in people are not so much the cause of the division of labour but its effect (McNulty, 1975: pg. 376). Instead, Smith gives three reasons for the beneficial effects of the DL (1976: pg. 21-22). In the order he presents them, they are;

1) The increase of dexterity in every workman;
2) The saving of time from switching from one task to another;
3) The invention of new machines to complete the workman's task.

1 I am only aware of one passage where Plato, uncharacteristically, mentions that an increase in specialization would lead to an increase in the quantity produced. He writes "The, result, then, is that more plentiful better-quality goods are more easily produced if each person does one thing for which he is naturally suited…" (Republic 370C).

While I will have more to say about them and their origin in the subsequent sections of this essay, the first two are sufficiently clear, as they are presented, to pass over without explanation. On Smith's third reason, he believed that when people are focused on one specific task their mind will naturally wonder about how to ease its completion. This would, he thought, lead workers to invent new machines that would help them in the completion of their tasks (Smith, 1976: pg. 24).

Thirdly, Plato's views differ as they are prescriptive and general while Smith's are descriptive and specific. Plato thought that people were naturally different and so, he thought, only capable of specific virtues. For instance, he thought the virtue of soldiers was courage, whilst the virtue of leaders was wisdom. For these reasons, Plato thought individuals morally ought to fill specific societal roles. This was both broader than Smith's view, which was particularly about productive activity, and moralising, which Smith's view was not.

One of Smith's well-known views, that the DL is limited by the extent of the market, has no parallels in ancient texts. His main argument for the view is that, as individuals only specialise in order to trade the product of their labour, they will only have an incentive to do so if there is a market for this product (Smith, 1976: pg. 35). This would rightly be considered as a significant advance over ancient authors if it was still accepted by contemporary economists without clarification. However, it is not. Now that I have laid out Adam Smith's central views on the DL, and commented on them with respect to ancient authors, I will progress onto how his views on the DL were influenced by modern authors.

III. The modern influences on Smith's "division of labour"

When establishing what contemporary (or near contemporary) influences Smith drew on in forming his views on the DL it can be tempting to point to the first publication of the "Wealth of Nations" in 1776 as a cut-off-point. We might say that anything before that point could have influenced him, while anything written after could have been influenced by him. However, after the scholarly work of Cannan (Smith, 1896) and Scott (1937), this is no longer a tenable position. The former published notes from Smith's lectures on jurisprudence that touch on several of

the themes in the "Wealth of Nations". The latter, on the other hand, published two fragments of Smith's work and what is now considered an early draft of the Wealth of Nations itself. These publications present us with earlier, previously unpublished, portions of Smith's writing which vividly show the growth of his economic views. Summing up, Scott believes that Smith's earliest writing on the division of labour date from his time lecturing at Edinburgh. More recently, Meek and Skinner have argued that the earliest fragments date from a later period, which they tentatively claim is around the 1760s (1973: pg. 1096).

With this in mind, some sources still clearly pre-date Smith's contributions. As Campbell and Skinner point out in a footnote (1981), the first specific mention of the word "division" (in the economic context we are concerned with) comes from William Petty when he writes in 1683:

> *For in so vast a City Manufactures will beget one another, and each Manufacture will be divided into as many parts as possible, whereby the work of each Artisan will be simple and easy: As for Example. In the making of a Watch, If one Man shall make the Wheels, another the Spring, another shall Engrave the Dial-plate, and another shall make the Cases, then the Watch will be better and cheaper, than if the whole Work be put upon any one Man. (Petty, 1899: pg. 457)*

This quote quite clearly shows a keen appreciation of both the improvement in quantity and quality that comes from the division of labour. It also points to an anticipation of Smith's doctrine that the DL is limited by the extent of the market. In fact, some scholars have gone further. Schumpeter, for example, saw in Petty's work a full anticipation of all Smith's essential views on the DL (2006: pg. 207). While there is some evidence for Schumpeter's position, at no point does Petty clearly and explicitly lay out Smith's view, that the extent of the market limits the division of labour. Smith's clarity represents an advance.

The work of one of Smith's Professors, Francis Hutchinson, also played a formative role in the development of Smith's views on the DL. This is, perhaps, the clearest and most direct line connecting Smith's own economic thought to one of his predecessors. Cannan (and Scott before him) drew attention to the fact that the economic themes in Hutchinson's

"System" and Smith's lectures on jurisprudence are laid out in nearly exactly the same order (1904, pg. xli). Quite reasonably, he concludes that Smith had drawn on his old lecture notes when preparing his own course. Hutchinson specifically addressed the division of labour, noting:

"Nay, 'tis well known that the produce of the labours of any given number, twenty for instance, in providing the necessities and conveniences of life, shall be much greater by assigning to one, a certain type of work of one kind, in which he will acquire skill and dexterity, and to another assigning the work of a different kind, than if each one of the twenty was obliged to employ himself, by turns in all sorts of labour requisite for subsistence, without sufficient dexterity in any" (1755, pg. 288).

First, it is worth highlighting that Hutchinson claims his statement about the division of labour, which asserts that as the DL increases so too does the quantity produced, is already well-known at this stage. Second, his discussion of increased dexterity parallels Smith's first reason for the beneficial effects of the DL. It is also worth mentioning that although the first edition of this work was published posthumously in 1755 (still nearly twenty years before the first publication of the Wealth of Nations), at the latest, earlier manuscripts of the work existed in 1746, the year of Hutchinson's death, that would have pre-dated even Smith's earliest economic writings.

There is also clear evidence that Smith took inspiration from the French encyclopédistes when he crafted his theory of the DL. First noticed by Garnier in his preface to the French translation (1802), Smith's renowned pin making example was largely based on Delaire's article in the encyclopédie titled "Épingles" (cf. Delaire, 1763: pg. 804-808; Smith, 1976: pg. 1819). In both cases, the two authors claim there are eighteen separate operations that go into the making of a single pin. Further, some of the examples Smith uses correspond to those given by Delaire. As Peaucelle points out, there is also significant biographical and textual evidence that Smith read and approved of the encyclopédie (Peaucelle, 2006: pg. 492). First, even though he was criticized by his colleagues, Smith made a subscription to the encyclopédie as part of his

duties purchasing books and articles for the library of the University of Glasgow. Second, Smith gave quite a positive review of the encyclopédie in the Edinburgh Review (1756: pg. 66). It seems uncontroversial then, to claim that this is another source of influence for Smith's theory.

IV. Conclusion

In this essay, I assessed the originality of Adam Smith's doctrine on the DL, the heart of his theoretical contribution to political economy. I started by tracing its historical sources from the most influential ancient authors. Smith's doctrine was, in fact, a clear improvement over ancient authors. Smith did not moralize in his views on the division of labour nor did he claim that the benefits arose, as Plato did, from the natural abilities and talents of individuals. Smith also concerned himself with the quantity of goods, not just their quality, which was the overwhelming focus of ancient authors. On the other hand, when Smith is compared to modern authors his lack of originality becomes much more blatant. The DL and its benefits were already a well-established topic of discussion by the mid-18th Century. Even in the finer points of Smith's theory, such as the claim that the DL is limited by the extent of the market, he was only partially original. Further, on some points, it seemed likely that Smith had taken both the examples and structure of previous authors without acknowledgement.

If Smith stands out at all from these earlier sources it is only that in his exposition, he is slightly clearer, and, in his emphasis, he is more forceful. In conclusion, Adam Smith's doctrine of the DL, the most important doctrine in his economic thinking, was not, in any significant sense, an original contribution to political economy.

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Twelve Years Left: The impact of the dominance of neoclassical economics on our ailing planet

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One of the defining raisons d'être of the Student Economic Review is to offer undergraduate students a platform to explore and challenge conventional economic wisdom. Whilst the application of traditional economic theory to new areas is valuable, equally (if not more) valuable is the work which challenges tradition, preventing us from falling into blind faith. Such a challenge is posed in this paper, entitled "Twelve Years Left", by Sarah McGuinness. In it, McGuinness lays down a scathing critique of neoclassical economic theory, vilifying the field of economics for its dogmatism and hiding behind mathematical models and jargon. She laments the domination of neoclassical thought over academic and political discourse, and urges a swift transition into a new mode of thinking which welcomes other schools of economic thought and takes a more multidisciplinary approach. To finish, McGuinness highlights that this transition is direly needed in the face of climate catastrophe, and that, if it is not completed swiftly, there will be serious ramifications for both us and the planet on which we live.

On the 31st of October 1517, an Augustinian monk arrived at the Castle Church in Wittenberg with a piece of paper outlining his grievances about the practices of Catholicism. The flame of the Reformation was ignited, and a schism in the Catholic Church soon followed. Today, the publication of the 95 Theses remains an integral part of world and religious history. Whether Martin Luther did in fact nail his Theses to a church door as opposed to posting them in a letter is disputed (Brecht, 1985), but five centuries on, his act is still considered to be one of symbolic resistance. In October 2017, 500 years after the publication of Luther's Theses, many economists, academics, and concerned citizens believed it was time to reform another dominant and influential set of beliefs: those of neoclassical economics. To that end, the New Weather Institute and the campaign group Rethinking Economics wrote and published the 33 Theses for an Economics Reformation (2017). Dressed in a monk's habit and armed with an inflatable hammer, economist Steve Keen then performatively "nailed" them to the door of the London School of Economics Students' Union (Lloyd, 2018).

The point made by Keen and his colleagues was a straightforward one: modern economics desperately needed to be reformed, just as the Catholic church had 500 years previously. Over the last forty years, neoclassical economics has become a hegemonic force not entirely unlike the medieval Catholic Church. Its evolution has been similar to that of most religious belief systems, with the main theories being derived from a handful of fundamental tenets that are almost untouched in academic and political debate. Indeed, as Nadeau (2003: xii) states most succinctly, the assumptions of neoclassical economics have an appeal that is "profoundly religious in character". Convoluted mathematical theories are now utilized in the same manner that the priests of Luther's era once used Latin; that is, as a means of presenting a veneer of expertise while simultaneously masking anything that the average layperson might deem questionable. Indeed, neoclassical economics has come to dominate academic discourse and public policy, and its patrons claim to speak with empirical authority on many matters. According to Varoufakis (n.d.), it still retains a "hold over the economics mainstream".

Furthermore, the imparting of neoclassical economic knowledge has become more of an indoctrination than an education (Fullbrook, 2004a; Parvin, 1992), and its "insufficiently literate" students are grad-

uating with "an uncritical and unjustified belief that the foundations of economic analysis are sound" (Keen, 2011: 21). It continues to "get in the way of an adequate treatment of policy-making processes" (Killick, 1990: 42) and repeatedly fails to accurately predict financial crises (Krugman, 2009). Furthermore, the concepts within neoclassical economics are "wholly incompatible with" our environment (Nadeau, 2003: x). The import, export, and mass production of products are leading to a relentless rise in carbon dioxide in the atmosphere (International Transport Forum, 2015), and the mathematical foundation upon which neoclassical economics is built does not facilitate the implementation of viable solutions for the problems arising from climate change (Nadeau, 2009).

Like the rest of the social sciences, economics has been built upon a foundation of many different schools of thought (Faccarello & Kurz, 2016). Neoclassicism developed and emerged in the late 19th and early 20th century, with the first recorded usage of the term "neoclassical economics" being in the work of Norwegian-American economist Thorstein Veblen (1900). The discipline grew through the work of notable economists such as John Stuart Mill, Adam Smith, and Alfred Marshall. Marshall was especially influential in that he devised the curves of supply and demand, and as such, is considered to be a founding father of neoclassical economics (Aspers, 1999). Today, the term refers to what one would consider mainstream economics. Indeed, many have suggested that to refer to economics itself in this modern era is to refer to neoclassical economics by default (Hamilton, 1994; Keen, 2011, Weintraub, 2002).

Weintraub (2002) describes neoclassical economics as a "metatheory": that is, it is one composed of various fundamental assumptions. The first of these is that humans are rational beings who focus on the maximization of utility. An economic theorist looking through a neoclassical lens sees an economy and society populated by "homoeconomicus"; that is to say, the perfectly rational self-interested economic man described by John Stuart Mill (1992) and Klaus Mathis (2009). One could hypothesize that this may be because said behaviour, i.e. inclination towards the maximization of outcomes, is quite easily captured by empirical observation under the sub-category of data and price markets. In short, humans are motivated to consume an increasing amount of goods and services due to a longing for a supposed level of happiness. The belief in this inherent

motivation forms part of the foundation of neoclassical economics.

A second assumption of neoclassical economics is that scarce resources will be allocated most efficiently through the means of the "market". Relying on interpretations of Smith's "invisible hand", proponents of neoclassical economics posit that in the absence of state intervention, supply and demand will redirect capital, goods, labour, and services to where they are most required in society (e.g. Rothschild, 1994). They have what Khan and Aziz (2011: 2) call an "unwavering faith" in the market's ability to provide efficiently. This is accompanied by the belief that government intervention would only serve to interfere with the market's tendency to distribute wealth, and "amount to injecting the sources of instability" (Khan and Aziz 2011: 2). In short, the market should be free of centralised intervention as it cannot easily adjust to this where the efficient production of outcomes is concerned. Additionally, neoclassical economic theory both assumes that is possible to define and measure human behaviour and presupposes the ability of mathematically underpinned models to represent it in a relatively accurate fashion (Hamilton, 1994).

Though it is the most widely adopted school of economic thought, neoclassicism is not without its critics. Klein (2019) writes that it is "failing the majority of people on multiple fronts", while Varoufakis (n.d.) contends that neoclassical economics owes its "hegemonic position in the social sciences" to "theoretical failure". Furthermore, many authors have produced counterarguments to the assumptions mentioned above, with Nell and Errouaki (2011: 30) arguing that "the DNA of neoclassical economics is defective". Firstly, the integrity of rational choice theory has been disputed: theorists such as Kahneman (2013), McKinnon (2012), and Nobel Prize winner Richard Thaler (2016) have all suggested that it has more of an ideological than a scientific basis. Indeed, it is not entirely clear whether the "economic man" is even partially representative of real people (Bowbrick, 1996). Furthermore, to presuppose that all individuals act rationally is to ignore fundamental aspects of humanity and its propensity to act unexpectedly (Blau, 1997). As such, in assuming human behaviour as something eternally rational, neoclassical economics is inherently reductionist (Dupré & O'Neill, 1998).

Secondly, the invisible hand may potentially be misrepresented by neoclassical economists who take it too literally; indeed, they appear

to have forgotten that Smith argued for a combination of mathematics and observation (Fleischacker, 2004). Lastly, the convoluted mathematical models that neoclassical economists so heavily rely on "make their theories incomprehensible to anyone without significant training" and are often "utterly detached from reality" (Valdes Viera, 2017: 2). Many neoclassical economists tend to litter their speech with tightly coded jargon, thus preventing the discussion of morality or ethics. Given that up to 60% of adults cannot even accurately define GDP (Inman, 2015), a simplification of economic jargon is clearly necessary. Indeed, author and journalist David Dobbs (2013) is of the emphatic but reasonable belief that in any form of science writing, social or otherwise, modern society should "hunt down jargon, mercilessly like a mercenary possessed, and kill it". If a society cannot fully grasp the decisions made for and about it by its government, then how can its members possibly react accordingly, and fully exercise their democratic privileges?

One may very well question how neoclassical economics has become such a hegemonic power despite its faults; how, indeed, has it become the sine qua non? A position of dominance over academic discourse is one likely factor. Indeed, only a cursory glance at the labour market is necessary to see the extent to which neoclassical economics has dominated academia. As Weintraub (2002) stated most succinctly: "the status of non-neoclassical economists in the economics departments in English-speaking universities is similar to that of flat-earthers in geography departments". In short, it is a status considered essentially non-existent. In academia, adherents to modern neoclassical economics often consider themselves to be at the "top of the hierarchy", as it were. As a discipline, it remains exclusionary; Lee (2009: 4) wrote that neoclassical economists are unperturbed by the academic lynching of economists from other schools, and "eliminate them from institutions of higher education and from the economics profession". In terms of teaching, Kaufmann (1962) also found that neoclassical economics often failed to explore the issue of ethics. Furthermore, one need only to consider the example of journals to see the extent of the insular power neoclassical economics holds over academic discourse. It does not tend to adapt an interdisciplinary approach as the other social sciences do. Jacobs (2013) found that 81 percent of citations in economics were from within the field. The figures were considerably lower for political science, anthropology and sociology (at 59, 53, and 52 percent respectively).

Indeed, this domination over discourse is not just seen in the labour market or academic publications: economics is also the only social science in which it is possible for one to win a Nobel Prize, with said prize existing solely because of a sizeable donation from Sweden's central bank Sveriges Riksbank (The Nobel Foundation, n.d.). Proponents have also been said to erect barriers to the employment of non-neoclassical economists, thus narrowing the curriculum on offer to students (Fullbrook, 2004a). Students have long been hemmed in by the walls of neoclassical theory: in their study on the teaching of economics, Klamer & Colander (1990) reported feelings of powerlessness among students, who disapproved of what they saw as the "over-mathematization" of their courses and worried they were being "brainwashed". The dissatisfaction of economics students with the dominance of neoclassicism has been so great that many have begun to take matters into their own hands.

In late 2011, as Earle, Moran and Ward-Perkins were sitting in lecture halls at the beginning of their undergraduate career, the Eurozone was ablaze. It appeared to them that there was a clear discrepancy between the neoclassical economics they were being taught, and the reality of the financial crises faced by the world at the time; crises that had inspired many of them to study economics in the first place. Upon analysing their module content, they found that "only 11 out of 48 [topics] even mentioned the words 'critical', 'evaluate' or 'compare'" (Ward-Perkins and Earle, 2013). Their "education" was merely one continuous lesson on memorization and regurgitation of neoclassical tenets, and to that end, the three students of economics at Manchester University formed the Post-Crash Economics Society, with the intent that it would serve as an educational haven from the dominance of neoclassicism, and broaden student perspectives on other schools of economic thought. It inspired many "copy-cat" societies in other universities such as Cambridge, UCL, and LSE (Ward-Perkins & Earle, 2013), and they went on to write a book called The Econocracy, wherein they explained further their reasons for founding the PCES; namely that the global financial crisis did not feature in their lectures, and what they were learning did not appear to be of any use (Earle et al., 2016). In short, many modern curricula and indeed, academics, appear to be ignoring the fact that neoclassicism simply does not make up the whole of economics, something that is contributing greatly to its domination of discourse.

Of course, this domination is not just limited to academic course; neoclassical economics has also had many implications for public policy. Neo-classicists believe in low tax rates and limited government spending, which they posit will allow the private sector, and thus the economy as a whole, to flourish (Dotsey & Mao, 1994). However, there is a sizeable amount of evidence that challenges this strongly held belief. World economic history continues to repeat itself, and we see a recurring cycle of financial crises where countries lend, borrow, crash and then recover. Experts proclaim that "this time is different", that old rules no longer apply, and that the newest crisis bears no similarity at all to past ones; yet "bubbles" continuously evolve without widespread detection. Economists at LSE were even questioned by the Queen of England as to why they and their neoclassical counterparts had failed so dramatically in predicting the 2008 crash and the ensuing Global Financial Crisis (Beattie, 2008). Indeed, as Reinhart and Rogoff (2009) outline, it does not appear that neoclassical economics has the capacity to accurately or easily predict crises, and its passive approach to fiscal policy remains largely inept in that regard.

As a means of further analysing the dominance of neoclassical economics on public policy, the Washington Consensus as outlined by Williamson (1990) is most useful. The term refers to a list of policy recommendations for developing countries (Latin America in particular) experiencing debt crises that became popular during the late 1980s. The economists behind it were neoclassically trained and had considerable influence over the decision-making processes in those countries. Indeed, the Washington Consensus could be said to be perhaps the most studied event of the pitfalls of neoclassical economics in a real-world scenario. It was based on the belief that "unfettered free markets provided the formula to make rich countries out of poor" and was spearheaded by the U.S. Department of the Treasury, the IMF, and the World Bank (Broad & Cavanagh, 1999: 79). The consensus represents a most illustrative example of the ways in which neoclassical economic policies can produce results that are far from optimal. Firstly, the economic liberalization contained within the Washington Consensus' neoclassical policies led to growing inequality and by 1999, the wealth of the world's top three billionaires constituted "more than the combined GNP of all least developed countries and their 600 million people" (UN Development Programme, 1999: 3). Furthermore, the increase in factory openings due to low tax and other

incentives resulted in workers who were "underpaid, overworked, and denied fundamental rights, including the right to. . . a safe working environment" (Broad & Cavanagh, 1999: 81). It also caused widespread environmental damage with the focus on export and growth leading to extensive deforestation (Horning, 2018) and an expansion of cattle production to meet growing demands for beef (Broad & Cavanagh, 2009).

Indeed, it is not just the Washington Consensus but neoclassical economics as a whole that has created many challenges for climate change and our planet. The discipline both continues to have a disregard for and fails to consider the importance of the Earth's physical limits. The aforementioned economic liberalization and free trade that accompanies neoclassicism leads to an increased production of goods, with many of these goods then being transported vast distances by cargo ship. In 2018 alone, 139 million tonnes of carbon dioxide were released into the atmosphere through the shipping sector, a number which equals the amount emitted by a quarter of all of the 68 million passenger cars in Europe (Abbasov et al., 2019).

Furthermore, work such as Broad and Cavanagh's (1999) indicates that the system of neoclassical economics could very well be deemed dysfunctional at its core; that is to say, its processes are destroying the natural world and ecosystem through the relentless consumption of non-renewable resources. We are exhausting our planet: the current economic system does not appear to be congruous with healthy maintenance of our ecosphere, and as Klein (2014) outlines, it is warring with many lifeforms on Earth, including human life. In order to avoid total collapse, she says, humanity must seriously contract its use of the planet's resources. Furthermore, it is not just our planet we should worry about, but also society as a whole. It has long been predicted that global warming is inherently linked to inequality (Diffenbaugh & Burke, 2019; Worland, 2019), an issue which serves to present yet another problem that neoclassical economics may struggle to adequately address. Diffenbaugh and Burke (2019) do not argue that global warming created inequality itself, rather that higher temperatures lead to a decreased economic output.

Indeed, climate change may have come into wider societal consciousness as early as the 1960s (Baines & Folland, 2007; Metzner, n.d.) but experts have been slow to incorporate it into the mainstream thinking of neoclassical economics. If we are to limit climate change catastrophe,

something which the UN believes we may only have twelve years to do (Watts, 2018), it is imperative that neoclassical economists venture outside of their discipline's bubble and begin enacting real, effective strategies to save our planet. As stated by Klein (2019: 70):

"*There is simply no way to square a belief system that vilifies collective action and venerates total market freedom with a problem that demands collective action on an unprecedented scale and a dramatic reining in of market forces that created and are deepening the crisis.*"

In conclusion, true economics is not about approximating reality using mathematical models as much as it is about explaining human phenomena in an accurate, quantifiable way, even without the full support of mathematical models. The paradigms and core tenets contained within neoclassical economics may indeed be incredibly useful, but as the preceding essay has shown, they can also come to have incredibly detrimental effects on the integrity of academic discourse and feasibility of public policy. Not only that, the processes of neoclassical economics continue to have negative ramifications for climate change and the planet upon which we live, which facilitates the livelihoods and the health of our global citizens. If we truly do only have twelve years to avert mass catastrophe, then it is humanity's best interests to begin embracing other schools of economic thought and adopt a multi-disciplinary approach.

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Riding with Stabilisers: Ireland's Macroprudential Policy

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Despite the recovery in property prices over the past decade, it is very difficult to forget the monumental crash in the Irish property market in 2007 and the subsequent banking crisis. The bursting of the property bubble wrought economic and social havoc upon Ireland, and naturally, the Central Bank of Ireland have recently implemented policy seeking to avoid a repetition of this catastrophe. Conor Murphy and Philip Pollock investigate the efficacy of the "Mortgage Measures" introduced by the Central Bank, using dynamic panel-data regression techniques to determine whether or not these measures have successfully prevented or contained another Irish property bubble. The mortgage measures have been subject to quite considerable criticism from the general populace given that they are perceived to be pricing many first-time buyers out of the market, but is this the only way to escape the boom and bust cycle of the property market? The authors suggest that, when complemented by an increase in the supply of housing, the mortgage measures can be successful in reining in property prices and ensuring economic stability.

Abstract

The Irish housing market has been a turbulent issue for a number of years. Recent policy has attempted to constrain the unsustainable demand for housing witnessed during the Celtic Tiger Era, seeking to avoid another housing bubble and crash as was seen in 2007-2008. Our paper tests the efficacy of this policy, in the face of increasing political scrutiny,

and discusses the implications of these results for policymakers.

I. Introduction

Two issues loomed large in Ireland's recent general election: health and housing. This paper deals with the latter, bearing a perspective towards the Central Bank of Ireland's recent macroprudential policy - the Mortgage Measures. The paper will be structured in two parts. Initially we will seek to find evidence of a relationship between the Mortgage Measures & House Prices using dynamic panel-data regression techniques. Our findings will then be applied to the current housing market, in the interest of identifying the potential containment of a housing bubble in recent years.

What are the Mortgage Measures?

The mortgage measures were introduced by the Central Bank of Ireland (CBI) in 2015. They are a form of macroprudential policy, that is, regulation aimed at mitigating risk to the financial sector as a whole. Specifically, the mortgage measures aim to prevent the build-up of excess leverage in the mortgage market and improve the resilience of the economy in the long run. The mortgage measures require that first-time buyers (FTBs) possess a 10% deposit on their mortgage (Loan-to-value ratio [LTV]) and that they cannot borrow for an amount which exceeds their gross income by three and a half times (Loan-to-income ratio [LTI]) (CBI, 2019).

Following the Global Financial Crisis, macroprudential policy has become a common feature of the policymaker's toolkit. The crisis revealed that reckless lending had led to an unsustainable build-up of credit in the financial system. In Ireland, the excessive build-up of credit was particularly prevalent in the housing market - as such, when the bubble burst, it brought the whole economy to its knees (Lyons, 2013).

Same Background, Different Story?

Interestingly, the economic environment of Ireland today is quite similar to the climate that spurred the housing bubble. Interest rates are low, and look set to persist at the present rate. The economy is performing well, as evidenced by near-potential employment rates (RTÉ, 2019). While immigration may not be as pronounced as it was in the early 2000s, the supply of housing is much tighter, particularly across Dublin. These

conditions have caused an upsurge in prices over the last few years, a phenomenon well-documented by the media, with the country declared to be in the grips of a housing crisis.

Drawing from the Financial Crash & bursting bubble, the measures appear to have been a sensible policy response. However, there has been strong socio-political backlash to these measures, with former Taoiseach, Leo Varadkar taking the unusual step of criticising the CBI directly over this policy (Kelly & Leahy, 2019). The mortgage measures' stringent requirements have made it more difficult to obtain the credit necessary to acquire a house, particularly as house prices show little sign of decline. Therefore, the measures have had the effect of crowding some buyers out of the market, coming under criticism as a result.

This paper presents evidence that the mortgage measures have placed a cap on house prices, underlying the importance of the credit channel in determining Irish house prices. While we cannot conclusively say that the measures have contained a house price bubble, we can say that they are achieving their stated aims; preventing the excessive build-up of credit in the Irish housing market and improving the resilience of the wider economy as a result. These aims are surely in the interest of the wider public in the long run, despite causing some short-term pain. They give credence to the notion of Central Bank independence, particularly given the political pressures these policies have come under due to their short-run consequences.

The rest of the paper is structured as follows: Section 2 provides a description of the dataset, outlining the basis for selected control variables in the construction of our regression model. Section 3 investigates the influence that the mortgage measures have had over house prices and sets out the empirical approach taken to determine if a bubble was/is present in the Irish housing market. Section 4 concludes by breaking our findings down to a context applicable to policymakers.

II. Description of dataset

As the mortgage measures were introduced in early 2015, our dataset suffers from a limited timescale. Data was collected across 11 regions on a quarterly basis between 2010 and mid-2019. This captured the drop in house prices at the start of the decade before their resurgence preceding 2013, a common trend as depicted in figure 1.

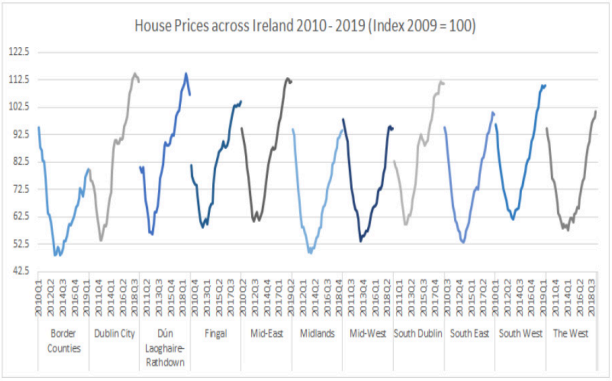

Figure 1

Interestingly, one can note an apparent slump in the growth of house prices almost simultaneous to the introduction of the mortgage measures, a trend more apparent when examining the rate of change depicted in *Figure 2*.

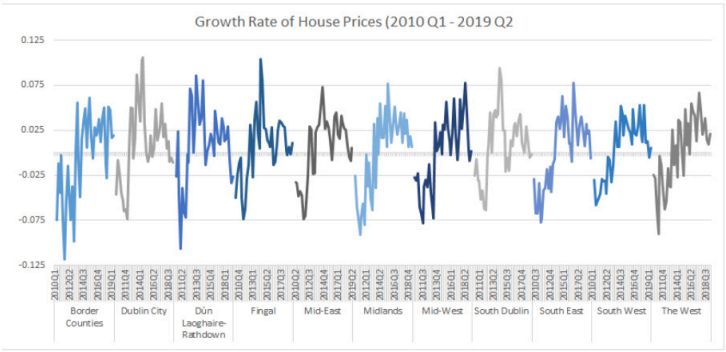

Figure 2

The initial volatility appears to level off as we see a slowdown in the growth of house prices, suggesting a positive influence of the mortgage measures - a relationship we seek to better understand within the scope of this paper.

Controlling for other variables that affect house prices, Mangan

(2019) provides useful proxies for the determinants of housing supply: items like construction costs, house registrations and the number of planning permissions granted. Drawing from Lyons (2014), local authority permissions granted for dwellings acts as a proxy for construction regulation, assuming that an increased cost for construction reduces the number of applications for planning permission.

Given the scope of this paper, the other control proxies were limited to primary macroeconomic factors such as net migration, population size, the interest rate and the unemployment rate. Sibley (2018) outlines that increases in the population play a fundamental role in elevating demand. The Irish Independent (2018) claims the average age for home buyers has increased in recent years, with FTBs on average being 34 years old whilst Second & Subsequent Buyers (SSBs) are now likely to be 41 years old on average - prompting a closer examination of the impact 25-44 year olds have in determining house prices, either through migration or their overall proportion in the population.

Variable	Key	Obs	Mean	Std. Dev.	Min.	Max	Source
Region Code	RCODE	418	6	3.166	1	11	
Time per Year & Quarter	TIME_YQ	418	218.5	10.979	200	237	
Log of House Prices	lnPRICE	418	4.337	0.219	3.884	4.744	CSO
Log of Rental Incomes	lnRENT	418	4.475	0.152	4.277	4.828	RTB & ESRI
FTBs Loan-to-Income Ratio	FTLTI	418	4.068	0.414	3.7	4.9	CBI
Log of FTBs Loan-to-Value Ratio	lnFTLTV	418	4.511	0.109	4.5	4.522	
SSBs Loan-to-Income Ratio	SSLI	418	3.437	0.16	3.2	3.8	CBI
Log of SSBs Loan-to-Value Ratio	lnSSLTV	418	4.464	0.04	4.396	4.5	
Net Migration	NMIG	418	-1.595	22.932	-27.5	34	CSO
Net Migration for 25-44 year olds	MYA	418	0.726	12.192	-17.7	20	CSO
Log of Population	lnPOP	418	8.452	0.023	8.424	8.0501	CSO
Log of Population of 25-44 year olds	lnYPOP	418	7.255	0.014	7.241	7.278	CSO
Unempliyment Rate	UNEMR	418	11.009	3.762	5.067	15.967	CSO
Log of Construction Costs	lnCCOST	418	5.334	0.0145	5.304	5.352	CSO
Log of Housing Registrations	lnREG	418	6.547	1.024	4.828	8.006	CSO
Interest Rate	INTR	418	-0.105	0.304	-0.4	0.75	ECB
Log of Planning Permissions Granted	lnPERM	418	7.099	0.275	6.621	7.508	CSO

Figure 3 - Summary Statistics

Inclusion of the unemployment rate serves as a simple proxy for Irish economic performance, a method proposed by Roche (2003). Interest rates are controlled for given their well-defined influence over money supply within the mortgage market. Similarly, pathologists of the Financial Crisis often cite inappropriate interest rates across the periph-

ery of the Eurozone as a leading factor for preceding financial instability (Seyfried, 2010). Lastly, data for housing rents is collected for use in determining if the mortgage measures contained the formation of a more recent housing bubble in Ireland.

Summary statistics for the included variables are depicted in Figure 3, outlining data sources such as the Central Statistics Office, the European Central Bank, the Central Bank of Ireland and lastly the Residential Tenancies Board and the Economic & Social Research Institute.

III. Empirical approach

As mentioned, this paper employs a two-step investigation, first seeking to establish the relationship between mortgage measures and house prices before investigating for the presence of a housing bubble within the dataset.

Establishing the Model

The regression equation (1) is constructed incorporating a cross-sectional component across our studied regions and a time-series process between 2010 and 2019. Variables are selected on the basis of correlation, in an attempt to avoid multicollinearity in the model, while lagged dependent variables are proposed to control for omitted variable bias.

$$\ln PRICE_{it} = \beta_0 + \beta_1 \ln FTLTV_{it} + \beta_2 SSLTI_{it} + \beta_3 \ln RENT_{it} + \beta_4 \ln PRICE_{it-1} + \beta_5 \ln PRICE_{it-2} + \beta_6 NMIG_{it} + \beta_7 UNEMR_{it} + \beta_8 INTR_{it} + \varepsilon_{it} \quad (1)$$

Empirical Approach

This paper follows three different regression techniques in pursuit of identifying a relationship between our variables of interest, beginning with a fixed-effects panel data estimation. This method intends to correct for the presence of unobserved or misspecified regional-specific effects within the sample data.

Building from this, concerns exist around the model's vulnerability to autocorrelation & heteroscedasticity, prompting the use of a Generalized Least Squares (GLS) model. While neither autocorrelation nor heteroscedasticity violate the point estimates of our regression coefficients, they bias the error terms for our figures, rendering hypothesis

testing or other means of statistical inference as void. GLS widens the range of our error terms in an attempt to better account for these possible deficiencies.

Finally, the simplicity of our model spikes fears of the presence of endogeneity - a phenomenon characterised by a correlation of the independent variables to the error, resulting in a violation of the Gauss-Markov assumptions and bias of the point estimates. The Arellano-Bond generalized method of moments estimation (GMM) is conducted as it better accounts for the dynamism of the dataset (Baum, 2013). The GMM approach is widely adopted in practise as it better draws from the information of the model, offsetting the need for an instrumental variable approach in correcting for endogeneity.

Empirical Results & Robustness

Regression 1 finds the Loan-to-Income ratio of Second & Subsequent buyers to be lowly significant, however an analysis of regressions residual output confirms suspicions of the model's vulnerability to autocorrelation & heteroscedasticity. A scatter plot reveals a strong, positive relationship between the residual and its lagged value, a relationship deemed significant following a regression of these two variables.

Deviations in the point estimates of regression 2, our GLS model, imply the coefficient estimates of regression 1 were biased, likely as a result of the previously assumed endogeneity - justifying the usage of the Arellano-Bond GMM approach in regression 3. In this final case (3), both variables of interest, lnFTLTV and SSLTI, are found to be significant. We find a 1% increase in the LTV ratio for first-time buyers leads to a 0.64% increase in house prices, a finding in line with those of Lyons (2018) albeit at a lower magnitude. This deviation is likely due to the simplicity of our data, and the lesser focus employed to the microeconomic determinants of house prices. Consequently, a unit increase in the LTI ratio for second & subsequent buyers indicates a 0.055% increase in house prices, a finding of greater magnitude to what was suggested by the limited output of regression 1. It is important to distinguish terminology, such that an increase in the LTI or LTV ratio implies looser regulation, i.e. the potential buyer will have to hold lower collateral.

	(1) lnPRICE	(2) lnPRICE	(3) lnPRICE
lnFTLTV	0.535	0.368	0.642*
	(0.295)	(0.302)	(0.282)
SSLTI	0.0322*	-0.00605	0.0551***
	(0.0152)	(0.0142)	(0.0155)
lnRENT	0.0905*	0.0825**	0.0838*
	(0.0386)	(0.0264)	(0.0376)
L.lnPRICE	1.213***	1.320***	1.150***
	(0.0471)	(0.0446)	(0.0472)
L2.lnPRICE	-0.338***	-0.387***	-0.307***
	(0.0458)	(0.0441)	(0.0442)
NMIG	-0.00126***	-0.00136***	-0.00118***
	(0.000374)	(0.000384)	(0.000356)
UNEMR	-0.00977***	-0.00802***	-0.0111***
	(0.00250)	(0.00236)	(0.00240)
INTR	-0.0464***	-0.0492***	-0.0444***
	(0.0102)	(0.0104)	(0.00966)
_cons	-2.285	-1.637	-2.660*
	(1.340)	(1.374)	(1.277)
N	396	396	385
R-sq	0.986		
adj. R-sq	0.985		
rmse	0.0245		
rss	0.226		0.406

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

These findings suggest that in an environment of loose credit conditions and a relaxing of lending standards house prices will rise. This highlights the significant role the credit channel plays in the determination of Irish house prices, and consequently supports the basis for capping these ratios under the mortgage measures proposed by the Central Bank of Ireland.

Finally, the significance of the lagged variables implores us to consider the role of expectations in the determination of house prices, an idea that will later be discussed with reference to the financial accelerator mechanism. One can consider the mortgage measures as an attempt to disrupt rising expectations, serving as a means of anchoring expectations in the face of rising house prices and containing the volatility of this asset class. This suggestion prompts the second piece of our analysis, investi-

gating whether the mortgage measures may have contained the formation of another Irish Housing Bubble during the period of resurgence in 2013.

The Bubble Case

Literature

A bubble is typically characterised by a discrepancy between an asset's price and its fundamentals (Vyacheslav & Zemčík, 2009). This divergence can continue growing and cause prices to increase to unsustainable levels, eventually causing the bubble to burst. Irving Fisher (1933) aptly captures the economic sentiment towards bubbles by saying: *"over-investment & overspeculation are often important; but they would have far less serious results were they not conducted with borrowed money"*.

An asset bubble can be characterised by exploring the mechanism of the financial accelerator: the idea that developments within the financial system amplify real changes in the economy (e.g. how relatively small changes in credit conditions could trigger larger shocks throughout the economy) (Bernake et al., 1999). The financial accelerator theory proposes that economies overextend themselves as they reach the peak of the business cycle. To put this into a recent context, financial innovations such as mortgage securitization led to misconceptions surrounding the risk of leveraging & lending in the lead up to the Great Recession of 2008. This surge of borrowing inspired exorbitant levels of economic activity and prosperity, yet crippled the economy once it began to default.

Empirical Approach

This paper follows the methodology outlined by Diba & Grossman (1988), examining properties of stationarity for the respective price and dividend series (PRICEit and RENTit) of an asset class. If rental prices are explosive compared to house prices, then a bubble is present. This is a straight-forward test checking the individual series for the presence of a unit root, regressing them against one another and subsequently testing the residual output, such that:

$$\text{Given: } PRICE_{it} \sim I(1) \text{ and } RENT_{it} \sim I(1)$$

$$\text{Run: } PRICE_{it} = \beta_0 + \beta_1 RENT_{it} + \varepsilon_{it}$$

Isolate residual such that:

$$\varepsilon_{it} = PRICE_{it} - \beta_0 - \beta_1 RENT_{it}$$

$$\varepsilon_{it} \sim I(1) = \text{Bubble} \quad or \quad \varepsilon_{it} \sim I(0) = \text{No bubble}$$

This procedure will be run three times over, applied to different time periods to ensure a concise evaluation of our sample data in the event a bubble is found. The entire time period will be examined first, before breaking it into two: testing for a bubble prior to the introduction of the mortgage measures in Q1 of 2015 and in the period that followed.

This seemingly simple approach for the determination of an asset bubble is not without critique: Evans (1991) comments that the tests for stationarity lose power if the sample data includes multiple bubbles that emerge and collapse across the sample. Given the limited scope of this investigation, the use of panel data is an attempt to ensure a greater level of accuracy for subsequent testing, achieved through a higher number of observations.

The conventional test for stationarity, the Dickey-Fuller test, is not applicable for panel data, prompting use of the Levin-Lin-Chu unit root test instead, where a rejection of the null hypothesis implies stationarity of all panels within the dataset. Failure to reject the null hypothesis for the initial level, followed by a subsequent rejection when examining the first difference of this series, provides sufficient evidence to suggest the series is integrated to the order of one, an I(1) process.

Findings & Implications

The dependent variable is found to contain a unit root at its level, lnPRICEit, with this finding rejected under first differencing, d.lnPRICEit. It is therefore interpreted to be an I(1) process, an expected finding given the substance of this variable in reality. The same outcome occurs for lnRENTit, the dividend series for this asset class.

The variables are regressed upon one another with the residuals identified as stationary at its level, I(0). As discussed, this finding suggests a bubble is not present, an outcome occurring for testing of each period. As such, there is no substantial evidence to suggest an explosive growth in rental prices relative to house prices, but rather we can confirm a steady co-integrated movement of these variables together across time. This finding signifies that should house prices decrease, rental incomes will follow.

The work of Wheaton & Nechayev (2008) builds on this point as they find that house prices are more likely to deviate from their fundamental value in regions with substantial subprime lending. Suppressing reckless leveraging by capping the LTV ratio can act as a way to disrupt the feedback flow of the financial accelerator mechanism. These findings highlight the importance of macroprudential policy, particularly for the CBI given the fragility of the Irish housing market (Galati & Moessner, 2018).

IV. Implications for policymakers and conclusion

Owing to the admitted shortcomings of this paper, it is inconclusive to say the mortgage measures directly prevented or contained another Irish housing bubble. LTI & LTV ratios were falling prior to the introduction of the mortgage measures as a result of self-imposed regulation & scrutiny on part of the banking system, yet this policy could be investigated from another angle as a way of quantifying & communicating intent to qualm rising house prices, therefore shackling expectations going forward.

With this in mind, it is therefore important to consider the intention of the mortgage measures, rather than abandon judgement to the obloquy they have endured - a consequence of shortcomings in the market which exceed the scope of this policy. The mortgage measures are concerned with the sustainability of the financial system, implementing

limitations for the amount an individual can borrow with respect to their income (LTI) or ensuring the loan is unlikely to enter negative equity (LTV) - relatively simplistic requirements that were brushed under the carpet during the era of the Celtic Tiger. As such, the mortgage measures focus on the demand side for the housing market, ensuring unsustainable or reckless borrowing does not pollute the financial system.

Frustrations towards the mortgage measures are understandable, if not justified, as they by design do restrict individuals from entering the market. The magnitude of discontent is likely relative to a perceived over-pricing of houses, as many feel unjustly forced out of the market. Speaking towards a long-term perspective, these measures on the demand side of the market will be considered fairer in response to coordinated policy on the supply side, be it through lowered construction costs or better incentives for developers to build.

Ed Sibley of the CBI (2018) has recognised the mismatch between supply and demand in the Irish housing market but has insisted that the solution is not reckless lending; rather, it is an increase in the supply of homes. Our paper has shown that the measures go some way in controlling the rise of prices, yet more importantly that they achieve their stated aims in ensuring economic stability. Following an election that has been centred on housing, the new government should take heed of these findings. The best solution to reducing house prices is to build more homes. Meanwhile, the CBI must be allowed their constitutional independence to continue guarding consumer welfare.

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Evaluating the U.S Policy Tradition on Predatory Pricing

Owen Graham-O'Regan, Senior Freshman

As Owen Graham-O'Regan notes, the "robber barons" of the American industrial age have now been replaced by much more modern counterparts in the form of big tech companies such as Google, Facebook, Microsoft and Amazon. Just as the unscrupulous behaviour of the robber barons had to be reined in, so too must authorities begin to clamp down on modern anticompetitive behaviour. Graham-O'Regan evaluates the current policy employed to punish those who participate in anticompetitive behaviour, finding it to be sorely deficient in its scope and ability to charge misbehaving firms. His paper focuses specifically on predatory pricing policy, which employs the "cost" and "recoupment" criteria to gauge whether or not a firm is acting anticompetitively. However, as is argued, the cost and recoupment criteria both often overlook predatory behavior that harms consumer welfare. The flaws in the criteria are especially visible as today's firms increasingly engage in nonprice competition and operate in multiple markets. Graham-O'Regan seamlessly interweaves both economic and legal theory to produce a compelling argument for the requirement for much improved anticompetition policy in the United States. It is for this reason that his paper has been recognized as the "Best Freshman Paper" of the Student Economic Review XXXIV.

I. Introduction

In the United States, probes into the anticompetitive behavior of firms have reemerged at state and federal levels (Stucke & Ezrachi, 2017). Over the summer of 2019, the Department of Justice and the Federal Trade Commission (FTC) began investigating market-dominating firms such as Google, Facebook, and Amazon: firms akin to the 19th Century "robber barons" (McKinnon, 2019). Today, politicians, such as presidential candidates Elizabeth Warren and Bernie Sanders, warn that the foundations of the U.S economy are once again held by a powerful few (Meisenzahl, 2019). Steel and oil trusts have been replaced by internet and technology giants. Firms with mounting market dominance are readily able to abuse positions of power and stifle efficient markets. U.S. antitrust policy evolved to prioritize consumer welfare. The FTC outlines policy goals that "protect consumers by stopping unfair, deceptive or fraudulent practices in the marketplace" (Federal Trade Commission, n.d.). Consumer welfare is robust when markets optimize overall efficiency: both static and dynamic efficiency. Statically and dynamically efficient markets optimally allocate resources in the short run and reduce price while increasing quality of goods over the long run (Gundlach & Moss, 2015: 92-93). To protect consumer welfare, courts must protect these market efficiencies. Competition amongst firms drives market efficiencies by rewarding firms that effectively employ resources to create the best consumer product (Brozen, 1969: 659). Harm to the competitive nature of a market inhibits the efficiencies that benefit consumers. To combat inefficiency, the U.S Supreme Court passed multiple acts intended to extinguish anticompetitive behavior. The Sherman Antitrust Act of 1890 prohibited anti-competitive agreements or attempts to artificially monopolize a market [15 U.S.C. §§ 1-7 (1890)]. This was followed by the Clayton Act of 1914, banning price discrimination along with anti-competitive mergers and acquisitions [15 U.S.C. §§ 12-27 (1914)]. These acts curbed a multitude of harmful business practices, but one practice in particular still causes great confusion amongst judges and policymakers. The practice of predatory pricing has faced inconsistency and controversy in both law and academia. As the Justice Department and Congress revive dormant antitrust policy, they must examine the current state of the legislative tradition addressing predatory pricing. The current tradition is insufficient, omitting numerous forms of inefficient predatory behavior.

II. What is Predatory Pricing?

In competitive markets, prices fall as firms enter a market. When competitors enter, incumbent firms must decrease their prices to operate at a profit-maximizing output (see Figure 1). Marginal revenue decreases as the incumbent firms' consumer demand shifts from D(p) to $D_{I.}$ Their new profit-maximizing output represents a lower price, shifting from P^m to $\hat{P}_I$. .This is the desired outcome for consumers, who gain surplus from lower market prices.

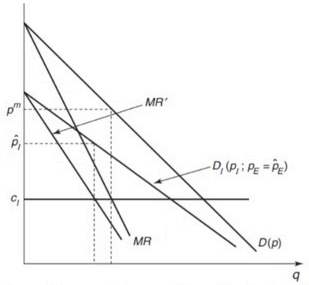

Figure. 1 Post-entry situation with normal competition. Graph from (Viscusi et al., 2018: 335).

Not all price decreases, in response to competition, are considered beneficial to consumers. Predatory pricing (henceforth, PP) occurs when an incumbent firm specifically focuses on reducing the number of entrants or competitors in a market. The incumbent firm employs PP by lowering prices beyond the profit-maximizing point where marginal cost is greater than marginal revenue (see Figure 2). This is represented by the shift from $\tilde{P}_I$ to $\bar{P}_I$.

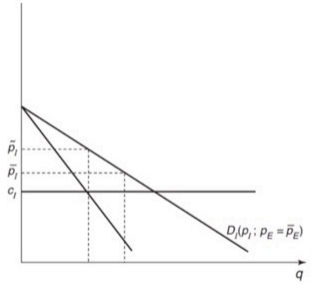

Figure. 2 Post-entry situation with predatory pricing. Graph from (Viscusi et al., 2018: 336).

To remain competitive, rival firms must match the price decrease, possibly incurring losses for every unit sold. This potentially forces firms into bankruptcy or deters them from continuing investment in the market. The incumbent firm continues predation until all current or potential competition exit the market. At this point, the predator increases prices to a supracompetitive level, gaining monopoly profits. This behavior harms consumers by potentially driving out firms operating as or more efficiently (operating at an equal or lower marginal cost) to the predatory firm. While equally or more efficient, these firms may lack sufficient reserves to outlast the predatory period or be discouraged by low investment returns in the market (Viscusi et al., 2018: 336). The removal of these firms decreases the market's overall efficiency, causing consumer surplus to fall. Facing supracompetitive prices, consumers must pay more than in an efficient market. This anti-competitive behavior is illegal because it artificially monopolizes a market, falling under section 2 of the Sherman Antitrust Act [15 U.S.C. §§ 2 (1890)].

The Brooke Group Ltd. v. Brown & Williamson Tobacco Corp. case of 1993 set the precedent for Supreme Court policy on PP over the last three decades. The case required the plaintiff to prove prices were below an appropriate measure of the predator's costs and demonstrate a "reasonable prospect" of the predator recouping all profits lost during predation *(Brooke Group v. Brown & Williamson Tobacco, 1993)*. This policy design fails to avoid type 2 errors, overlooking realistic and harmful forms of predation.

III. The Cost Rule

Post-Brooke policy requires the demonstration of both below-cost pricing and a strong probability of recoupment for a firm to be convicted for PP. We can examine each criterion independently to observe the legitimacy of the post-Brooke tradition. First, we will inspect the cost rule: a criterion derived from Areeda and Turner's (1974) predation test, which attempted to provide a convenient rule for courtroom analysis. They believed pricing below a firm's short-run marginal cost was sufficiently predatory (1974: 712). Their argument stipulates that if a firm chooses to price below "avoidable" or "incremental" costs, it is clear "the firm cannot rationally plan to maintain this low price; if it does not expect to raise

its price, it would do better to discontinue production" *(Barry Wright Corp. v. ITT Grinnell Corp., 1983)*.

Pricing below one's cost is considered harmful to consumer welfare because it can drive an equally or more efficient firm from the market (Gifford, 1994: 448). To use accessible data, Areeda and Turner (1974: 716) substituted short-run marginal cost with a firm's short-run average variable cost. The post-*Brooke* decisions continue the tradition of requiring price to fall below a similar "measure of incremental cost" for liable predation *(Brooke Group v. Brown & Williamson Tobacco, 1993)*. However, the below-cost rule may not always allow for legitimate rulings as Areeda and Turner believed.

Asymmetric information game (AIG) models involving predation suggest the predator's costs are irrelevant. For those assuming markets have perfect information, a predator must sacrifice sufficient revenue by cutting prices to drive their competitors out of the market (McGee, 1958: 140). The predator would only harm efficiency if it forced competitive firms to incur losses and drove them to bankruptcy. However, AIG models realistically assume markets have amounts of asymmetric information (Giocoli, 2014: 292). In predatory campaigns, it is unlikely the prey has full knowledge of the predator's costs. They are unaware if price cuts are due to increased efficiency or predatory campaigns; it is unclear whether the predator can maintain low prices. Under conditions of asymmetric information, a predator will not have to drive competition to bankruptcy, but simply "discourage competitors from entering, or remaining in the market by manipulating their beliefs" (Giocoli, 2014: 295).

Examples of manipulation strategies include signaling predation and test-market predation. Signaling predation occurs when a firm signals to competitors that their costs are low and that they can aggressively respond to market entrants (Milgrom & Roberts, 1990: 125-126). In AIG, firms may be discouraged from continuing operations if the predator signals the ability to aggressively cut prices in response to competition. This type of predation shows little relation to the predator's real marginal costs, but simply aims at artificially manipulating "rivals' expectations of future profits" (Giocoli, 2014: 296). The second form of a manipulation strategy is test-market predation. Before entering a market, firms employ market tests to gain information on potential profitability. Incumbents can utilize PP to manipulate the entrant firm's test data, causing the prey

to face prices much lower than natural market settings. The manipulated data suggests the market has limited profitability, deterring the prey's entrance and artificially limiting competition in the market (Bolton et al., 2000: 2311-2312). Again, the success of predation does not depend on the predator's costs, but rather the manipulation of the prey's expected profitability in the market. The use of predator's costs to determine predation seems irrelevant in real-world markets where information is often asymmetric. Firms can deter competition simply by manipulating market information. Since this strategy of predation involves distorting known market conditions (prices), the predator's real unknown costs tell us little about the harm to competition. Rivals leave the market due to beliefs of unprofitability relating to their own costs and not the real, unknown costs of the predator.

A predator can even harmfully manipulate market conditions without pricing below their costs. A low-cost monopoly may fight competition by cutting prices below the costs of entrant firms but above their own costs. If a market provides economies of scale, entrants can reduce market prices as their marginal costs fall, increasing consumer welfare. However, if the low-cost monopoly adopts such a pricing strategy, new firms may be deterred or forced from the market before developing economies of scale (Edlin, 2002: 956). The monopoly will be able to reinstate high supracompetitive prices, recouping any forgone profit from the price cut. This harmful predation goes unrecognized if courts continue to rely on below-cost pricing.

IV. The Cost Rule & Consumer Data Predation

The below-cost rule is also irrelevant when competition does not involve the pricing of goods. Increasingly, consumers interact with firms that offer "free" products. Consumers pay in other ways, such as by providing their personal data which firms sell to advertisers (Esayas, 2018: 1). Companies like Facebook and Twitter do not compete using product pricing and instead "compete in a market for information about users" (Waller, 2012: 1784). These firms could employ predatory campaigns by limiting or stopping their sales of data to clear the market of competition. Consumers predominantly value online privacy, meaning firms can enhance privacy policies "as a way to attract and retain users" (Harbour

& Koslov, 2010: 793). Consumer surplus expands when a firm increases the consumer's data privacy and limits the sale of data. A firm offering the product with greater consumer surplus may be able to capture consumers from their competitors and drive competitors from the market. While they initially forgo data sales, the firm is able to demand and sell supracompetitive amounts of consumer data once the market clears of competitors. This would force consumers to provide greater quantities of personal data than in a competitive market. The monopoly gains their position through inefficient means, injuring consumer welfare. Predatory firms cannot be charged with this harmful business practice if below-cost pricing is considered a necessary criterion. No recognizable price change occurs in the consumer market and the predator is not undercutting prices of data in the advertiser market. While this model exhibits both predation and recoupment, the below-cost rule fails to reveal these predatory intentions.

V. The Recoupment Rule

The post-*Brooke* rulings require evidence of a "reasonable" or "dangerous probability" of the predator recouping all losses incurred during predation *(Brooke Group v. Brown & Williamson Tobacco, 1993)*. Predatory firms must raise prices to supracompetitive levels after their predation extinguishes competition. The price increase and the duration of monopoly conditions must be sufficient to recoup all losses the predator incurred during the price-cutting period. Several scholars and judges believe PP "is only harmful when the predator succeeds in recouping the losses it suffered by its earlier below-cost pricing" (e.g. *W. Parcel Express v. UPS*, 1998). Below-cost pricing is only considered damaging once the predator erases any consumer surplus derived from price-cutting and begins creating a net loss in total consumer surplus by charging supracompetitive prices (Leslie, 2013: 1708).

Recoupment tests are used prior to the below-cost pricing rule, as analysis of below-cost pricing is resource-intensive. The recoupment tests are utilized to filter illegitimate cases, limiting the expense of court resources (Leslie, 2013: 1706). Necessary conditions for probable recoupment include high market concentration, high barriers to entry, and the predator's capacity to supply the demand once rivals have left the

market (*Cargill, Inc. v. Monfort of Colorado, Inc*., 1986). A defendant firm only needs to disprove one condition (*AA Poultry Farms, Inc. v. Rose Acres Farms, Inc*, 1989). Since probability of recoupment is necessary to prove PP, court analysis requires accurate results. However, courts can make poor rulings through the recoupment test, overlooking certain predatory strategies that injure the consumer.

Similar to the cost rule, the recoupment rule often fails to recognize strategies attempting to manipulate beliefs and expectations of rival firms. A prominent oversight occurs when analyzing a market's barriers to entry. The recoupment rule specifies that recoupment requires sufficient barriers to entry in the market. These barriers inhibit new competition from entering the market after the predatory campaign, allowing the predator to maintain monopoly conditions and fully recoup their losses. The current policy is deficient in its scope of possible barriers to entry. It fails to recognize the manipulation of the prey's beliefs as a real barrier to entry. For example, the reputation of price-cutting derived from predatory behavior can discourage new firms from entering a market during the recoupment period (Trujillo, 1994: 821-822). Entrant firms face the threat of possible future predation which would force them to incur losses. Even if a market lacks structural barriers, entrants can be sufficiently deterred given the predator's reputation of acting aggressively towards competition. The threat of predation itself acts as a barrier to entry and may increase the profitability of PP through greater probability for recoupment. If courts fail to recognize reputational strategies as sufficient barriers to entry, predator firms may be found innocent of PP even when they successfully recoup their losses by maintaining an artificial monopoly.

Some courts have narrowed their assumptions of how recoupment occurs. They assume predation and recoupment occur in the same market (Leslie, 2013: 1720). However, the predator may operate in multiple markets: cutting prices in one market and recouping losses in another. Robert Bork (2003) outlines an example of this behavior in the case of Microsoft. Microsoft held monopoly power in the operating system market, however increasing competition and innovation in the internet browser market would mean consumers would become less reliant on Microsoft's operating system. Microsoft created its own browser, Internet Explorer, and gave it away for free. By undercutting the browser market, Microsoft

faced losses of over $100 million a year. However, this quelled competitive advancement in the internet browser market which would have led to the obsolescence of Microsoft's operating system. Thus, Microsoft was able to recoup losses from Internet Explorer by protecting its monopoly position in the operating system market (Bork, 2003: 47-56). In this case, recoupment would be unrecognizable if courts only observed the internet browser market where price-cutting occurred.

Courts may make the wrong assumptions on the probability of recoupment. However, it is also possible that the probability of recoupment is irrelevant to consumer injury. Courts outlaw anti-competitive monopolization because it harms efficient competition and consumer welfare. If so, courts should fight any predation harmful to consumer welfare even if it fails to result in monopolization. The current policy requires a strong likelihood for successful monopolization shown through the probability of complete recoupment. This overlooks the negative effects of PP that does not completely recoup losses. During predation, consumers are initially better off when the price of a normal good decreases. After predation, the predator increases prices, producing at a monopoly level of output. Consumer surplus shrinks, making consumers worse off than in a competitive market. It is irrelevant whether the duration of the post-predatory period is sufficient for the complete recoupment of losses. As soon as the firm increases prices to a supracompetitive level, consumers are injured by decreasing consumer surplus. By fabricating a monopoly, the predator limits the market's dynamic efficiency: the optimization of prices and quality for consumers in the long run (Gundlach & Moss, 2015: 93). The initial consumer surplus created by price cuts is irrelevant to the current consumers who are harmed during the recoupment period, facing the damages of an inefficient market (Leslie, 2013: 1742).

Even the initial consumers, appearing to benefit from the low prices, can be harmed by the inefficient effects of below-cost pricing. Below-cost pricing results in overconsumption of a good as consumers change consumption patterns based on erroneous beliefs of a good's scarcity and the market demand. This causes consumers to divert resources from more efficient allocations. Consumers may also be willing to adopt fixed costs to consume at these low prices if they assume the current price level will continue (Leslie, 2013: 1743). This can be seen as a damage to static efficiency: the optimal allocation and cost-effective

utilization of resources.

Below-cost prices of the predatory period and supracompetitive prices of the recoupment period both potentially harm consumers independent of the predator's ability to fully recoup losses. Thus, the recoupment criteria of PP policy can lead to uncharged, yet harmful predation. This represents a type II error in the current policy whereby predators who do not fully recoup losses can still harm consumer welfare.

VI. Conclusion

The current policy tradition of U.S courts inadequately addresses all forms of predatory pricing behavior. The cost and recoupment criteria both overlook predatory behavior that harms consumer welfare. Flaws are especially visible as today's firms increasingly engage in nonprice competition and operate in multiple markets. This demands a re-evaluation of what courts consider to be evidence of liable behavior. However, in this endeavor, it is important that courts avoid chilling legitimate competitive behavior by constricting the capabilities of efficient firms.

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Optimal Allocation of Cartel Fines

Kai Fischer, Junior Sophister

Also exploring anticompetitive behaviour is Kai Fischer, who investigates the optimal means of punishing collusion in a market. As Fischer notes in the introduction, both the number of cartels detected and the fines being given as sanctions for collusion have been increasing over the past 25 years in Europe. This can be attributed to a series of new measures being implemented by competition authorities, such as heavier fines and criminal charges for collusion as well as "leniency programmes" which grant immunity to those who confess to cartel membership. However, cartelism is still a problem at both a national and international level, thus evidently more needs to be done. There are two primary avenues that competition authorities can take: increasing the severity of sanctions or increasing detection rates. Both of these options incur wider economic consequences, and thus there is a fine balancing act to be done between maximising the level of deterrence and minimising cost. In other words, competition authorities need to seek out the most cost-efficient way of deterring collusion. Using the Lagrangian multiplier method, Fischer illustrates how competition authorities can approach this problem.

I. Introduction

Due to strengthening competition pressure in the market, companies will often try to find ways to stay profitable or to even increase their profit margins. Besides legal measures (e.g. improving efficiency, segmentation within a market), some companies consider collusion. In the following essay, I focus on how a competition authority (henceforth, CA) can react to cartel formation. In doing so, there will be a description of all fine-related tools which CAs can use. Furthermore, their reciprocal influence will be analysed. Finally, a cost-efficient allocation of the CAs' tools is examined. For that, focus will be especially laid on the role of the probability of conviction.

Cartels are a particularly damaging form of anti-competitive behaviour, greatly decreasing the overall surplus in a market. To increase cartel detection rate, CAs have begun to introduce "leniency programs", whereby members of cartels can confess to collusion in exchange for full or partial immunity from fines and criminal prosecutions. In Germany (where it has been possible to "blow the whistle" since 2000) and the European Union (EU) the number of cartels detected increased sharply (see Tables 1 and 2). In addition, the size of fines for collusion has risen sharply in recent years (see Table 3). This could indicate that CAs are operating a new strategy emphasising the importance of fines instead of increasing the probability of detection. Nevertheless, this essay shows that only adopting heavier fines without increasing the probability of cartel detection is insufficient for stamping out collusion completely.

Table 1: Collusion – EU Commission Cases since 1995 (EU Commission, 2018)

Time Period	1995-1999	2000-2004	2005-2009	2010-2014	Since 2015
EU Cases	10	30	33	30	22

Table 2: Collusion – German Federal Cartel Office (FCO) Cases since 1997 (Bundeskartellamt, 2018)

Time Period	1997-2000	2001-2004	2005-2008	2009-2012	2013-2017
EU Cases	11	6	15	49	38

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Table 3: Fines declared by EU Commission and FCO since 1995 [in millions of Euro] (Bundeskartellamt, 2018; EU Commission, 2018; Statista, 2016)

Time Period	1995-1999	2000-2004	2005-2009	2010-2014	Since 2015
EU Fines	292.8	3,462.4	9,414.0	7,917.2	6,837.9
FCO Fines	308.9	821.0	1,214.4	2,133.9	399.0

II. Literature and Collusion Theory

The literature extends back to Becker (1968) who first introduced the economics of crime. He states that crime can be avoided by finding an optimal allocation of all tools executive forces have to deter. Applied to collusion, he suggests that CAs can prevent collusion by selecting a suitable strategy. The following models extend his basic framework. Camilli (2006) adds the role of price elasticities. Miller (2009) argues that - besides fines - other instruments such as structural remedies should be used to sanction collusion. There is an ongoing debate whether current fines are too high or too low to secure effective deterrence as well as a cost-minimizing allocation at the same time. Connor and Lande (2006) recommend increasing fines, whereas Kobayashi (2001) emphasises problematic aspects of potential overdeterrence. Wils (2006) and Andreoni (1991) primarily work on the relationship between fines and the probability of detection.

Since collusion is a way to increase companies' overall profit, CAs have to find means which reduce the incentive to collude. To put the incentive to zero, profits gained due to collusion have to equal the expected fine a company has to face. The expected fine $S_{overall}$ is the product of the following three factors: the fine imposed by the cartel authority if a cartel is detected (S); the probability of detection (α), i.e. the share of cartels detected in relation to the population of all cartels existing; and the probability of conviction (β) which indicates the share of detected cartels which are finally punished. On the basis of these assumptions, the final equation emerges, where π^K is the additional profit the company is earning due to collusion:

$$\pi^K = S_{overall} = \alpha\beta S$$

Similar conditions are formulated by Harrington (2014) and Kaplow (2013). In the equation, it is highlighted that a high fine is not enough to secure effective deterrence, as α and β have to have at least a minimum level. That is why both probabilities influence cartel firms' behaviour and should be chosen carefully.

Nevertheless, CAs are not able to select a certain value for both probabilities. α cannot be measured due to missing information on the overall population of cartels. β is not under the control of most CAs. Whether a cartel firm is convicted or not depends on legal circumstances, e.g. the structure of the executive or behaviour of single judges. This essay is one of the first in which there is a distinction between α and β. In the extant literature, both probabilities are usually combined as a general probability variable. But, different factors influence both of these probabilities and CAs cannot influence each of them directly. To have a detailed view on the differences in comparison to those essays where there is a single overall probability, this essay will explain the differences of the probabilities and the final effect on the optimal allocation of CAs' tools in depth.

III. Competition Authorities' Tools

As the main opponent of any cartel, CAs have to ex-ante prevent, detect and ex-post sanction collusion. In doing so, the CA can influence two parameters: the probability of detection α and the actual fine S. Both parameters cannot be influenced directly but can be changed in the medium-term. For example, α can be increased by hiring more staff at a CA. The more people there are trying to detect cartels, the higher the probability of detection. Still, the process of employing new CA agents takes time. Changing S can be done by adapting law and legal circumstances, e.g. adopting the *Bußgeldleitlinien* of the FCO. To strengthen deterrence, CAs can increase α and S, so that firms do not have an incentive

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to collude anymore. Nevertheless, CAs should act efficiently – that is, they should offer effective deterrence at a low-cost level. For a minimum cost level CAs should allocate S and α in a way that they hit the minimum of the CAs' cost functions. To be able to argue this point, the cost function of a typical CA is framed in the following sections. Increasing S has a positive effect on the overall fine $S_{overall}$. Unfortunately, to increase S causes additional costs to the wider economy. Though it does not cost CAs a lot of money to change laws to adapt S[1] , companies which do not even engage in collusion fear being accidently affected by these new high fines. They invest in prevention measures in order to not have to pay high fines. Those expenditures can be interpreted as cost caused by increasing S. The higher the value of S, the higher the costs to the wider economy will rise.

Furthermore, the more CAs increase S, the higher the marginal costs are. Outside companies first do not fear increasing fines as much. But as soon as those fines can endanger companies' financial stability, precautionary measures and related expenditures will increase:

$$\delta C/\delta S > 0,\ \delta^2 C/\delta S^2 > 0 \quad \text{(Camilli, 2006)}$$

The cost structure of α is similar. Raising α is one possible strategy to increase the degree of deterrence. Nevertheless, costs emerge. In contrast to the proportional increase in the deterrence effect by changing α

$$(\delta S_{overall}/\delta\alpha > 0,\ \delta^2 S_{overall}/\delta\alpha^2 = 0),$$

costs increase over-proportionally:

$$\delta C/\delta\alpha > 0,\ \delta^2 C/\delta\alpha^2 > 0 \quad \text{(Camilli, 2006).}$$

1 Implementing new laws could cause first-copy-cost arising once at the beginning of the usage of the new law. Later on, it does not cost anything to use those new regulations.

Marginal costs of α increase due to the declining marginal productivity of labour and other input factors. When CAs hire more employees to detect more cartels, the first agent finds more undetected cartels than the tenth does. Therefore, marginal costs for an additional unit of α rise.

Since both input factors have increasing marginal costs, the cost-efficient allocation can only be found by optimizing both tools at the same time. This is done via the use of a Lagrangian cost minimisation function, as seen in the following section. Still, the important role of β has to be taken into consideration. β is not fixed by CAs directly, so this variable cannot be used to minimize the cost function in the Lagrangian model. Still, S has influence on β, so that CAs can indirectly have an impact on the probability of conviction. If CAs cause S to rise, β is expected to fall:

$$\delta\beta/\delta S < 0$$ (Andreoni, 1991; Snyder, 1990).

Judges tend to have stronger concerns about sentencing a company if S rises, because a false conviction has more drastic consequences. Therefore, high fines would cause judges to decrease the share of convicted companies. Thus, these are additional costs of increasing S.

IV. Single-Period Optimization of the Allocation of CAs' Tools

Firstly, all tools can be defined on certain intervals. E.g. $\alpha\beta \in [0,1]$, so that S cannot lie beneath a critical value of $S^*_u = S_{overall}$. Otherwise, deterrence would not be effective anymore. If there is a maximum fine (as is the case in most countries), there are minimum values for α and β, too. It follows:

$$\alpha \in [\alpha^*_u, 1] \text{ and } S \in [S^*_u, S^*_o]$$

with α_u as a minimum probability of detection and S^*_o as the maximum fine. Analysis results show that α and S are two input factors which increase the deterrence effect of CAs' measurements. Further analysis

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will show which combination of both is the cost-minimizing allocation[2] . By that, the allocation which maximises consumer surplus and overall surplus should be found. In the Lagrangian function beneath we assume that CAs aim at minimizing the cost functions by adapting α and S. In addition, the effect of S on β is included in the model.

$$\min_{\alpha,S} L = C(\alpha,S) - \lambda[\alpha\beta(S)S - \pi^K] \text{ with } \delta\beta/\delta S < 0$$

$$\alpha^* = \beta S^* C_S/(C_\alpha(\beta+\beta_S S^*))$$

$$S^* = \theta\beta_S/2 + \sqrt{\theta}\sqrt{(\theta\beta_S/2+\beta)}$$

$$\theta = \pi^K C_\alpha/(\beta^2 C_S) \text{ and}$$

$$\beta_S = \delta\beta/\delta S.$$

The stronger the effect of S in β, S and α change like this:

$$\delta\alpha^*/|\delta\beta_S| > 0 \text{ and } \delta S^*/|\delta\beta_S| < 0.$$

Due to the fact that β is endogenously influenced by S, there is an opposing effect to the increasing deterrence effect caused by an increasing S. Therefore, overall costs rise and CAs substitute from S to α. It is striking that the expected interval for α is far higher than current estimations of α are (Bryant & Eckard, 1991). This indicates that current antitrust policies are not efficient. Furthermore, in reality CAs tend to have higher fines than optimal from the theoretical point of view. This could be done to achieve cost-efficient deterrence because increasing fines can

2 In this essay, cost-minimisation is chosen as a basic assumption for an efficient CA. Public choice literature (e.g. Tollison, 1985), emphasises that in reality CAs do not act in a cost-minimizing fashion. Nevertheless, it is not gone in detail here, so that the strong assumption of cost-minimisation is made to find the theoretic efficient solution. This result can be compared to current strategies then. Otherwise, the role of all tools could not be analysed without having distortion in the results caused by further assumptions.

be seen directly, whereas increasing α and by that the effect on $S_{overall}$ cannot directly be recognized. Furthermore, the endogenous probability of conviction causes a shifting substitution relation between α and S in comparison to the case of an exogenous probability of conviction (often assumed in the literature):

$$S/\alpha = C_\alpha(\beta+\beta_S S)/C_S = C_\alpha/C_S + C_\alpha(\beta-1+\beta_S S)/C_S \qquad \text{with } \delta\beta/\delta S < 0.$$

Therefore, the exchange relationship is lower for the optimum case now. The additional component $C_\alpha(\beta-1+\beta_S S)/C_S < 0$ equals an additional cost component for S, so that overall costs rise as well.

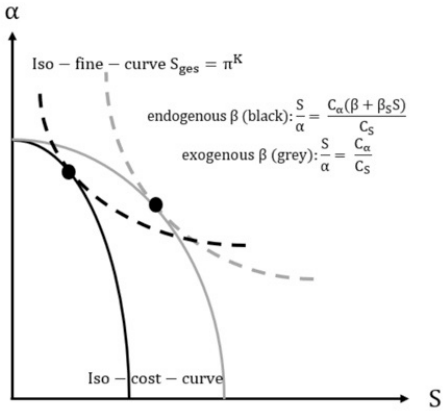

Fig. 1: Graphical Solution of Cost Minimization: exogenous and endogenous β

Iso-cost-curves (= CA's budget curve) are concave due to the second derivative. Optimal allocations are located where iso-cost-curves are tangential to iso-fine-curves. The iso-fine-curve turns inside when $|\beta_S|$ increases and the optimal allocation moves to including a higher α. Holding budget constant, that means that there is a lower overall fine for the case of an endogenous β (lower level of iso-fine-curve). The slope of the iso-fine-curves depends on β_S.

V. Implementation in Reality

This essay has a different perspective on cartel detection than is standard in the literature. It is not only focused on effective deterrence

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but on reciprocal influences among all tools and their role for a cost-efficient allocation. Nevertheless, the theoretical solution is not easy to implement in reality. For example, transparency problems can emerge. That can lead to S being used more than α because the effect of altering S can be seen easily. Furthermore, costs for S are indirectly caused and are not paid by the CAs, so adapting α could be neglected. Costs of new employees are easier to recognize and give an incentive to not change α for additional deterrence. Furthermore, the optimal allocation depends on other factors like demand elasticity and firms' behaviour. However, these are not addressed within the scope of this essay. Moreover, fines are individualised in this model, i.e. it is assumed that for each cartel case an optimal allocation can be found. Nevertheless, in reality CAs work with fine catalogues which do not allow as much flexibility in adapting fines as is assumed here.

Moreover, it is important to keep in mind that this model is a one-period model. In a multi-stage model, it is not necessary to have total deterrence, i.e. collusion is even allowed to be profitable. Firms with a high discount factor do not collude without fearing large fines (Harrington, 2014). Another potentially problematic aspect is that firms do not always behave rationally as it is assumed in this essay. It can often be the case that firms react less to an increasing α than to an increasing S because a rising α is not visible, whereas changes in S are directly visible given that they are announced by the CA. Therefore, in reality larger fines in theory could be cost-minimizing even if there are no changes in α (Bar-Ilan & Sacerdote, 2004). Additionally, it should be taken into consideration that the probability of conviction has a central effect on the optimal allocation of the CAs' tools. It depends on national circumstances how much influence a country's CA has on the probability of conviction. Therefore, it is difficult to generalise the results. Finally, in reality the budget constraint of CAs plays an important role. Consequently, in another model the budget constraint could be added as a second side constraint. Then, it would be possible to assess whether the theoretical optimal allocation is even affordable.

VI. Conclusion

The optimal design of fines for collusion requires a detailed and multi-dimensional analysis. In this essay, focus lies on efficiency and cost-minimisation. The model delivers results which suggest that CAs' current strategies have too low a probability of detection. This could cause an insufficient level of deterrence. Furthermore, most literature does not take the probability of conviction as a separate factor into consideration. The content of this essay could be improved by solving the weaknesses of the model (e.g. demand elasticity missing, strong rationality assumption) in subsequent essays. Nevertheless, it should be emphasised that fines are the basis of punishment but only one of several measurements CAs can use. Leniency programs, private damage claims, criminal sanctions and structural remedies can be employed as well. They represent potential complements to fines. Furthermore, this essay shows that only increasing fines is not cost efficient. If cartel profits rise, fines and the probability of detection both have to be adapted. Finally, it is important to keep in mind that this essay searches for cartel fines calculated on the basis of the cartel profits. But there are several countries which calculate fines in relation to firms' turnover. This could be added to an extended model as well.

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Neural Networks as an Option Pricing Method

Brendan Dowling, Senior Sophister

Since the bruising losses of the financial crisis over a decade ago, investors have sought out novel and complex ways to "beat the market", aiming to maximize returns and mitigate risk. Many have turned to computer-driven "systematic" investment strategies, which are freed from the shackles of human bias and slow reaction. In this paper, Brendan Dowling suggests the vast potential of neural networks to provide accurate derivative pricing. Derivative pricing has long been viewed as one of the most challenging tasks within financial mathematics, but this paper finds that artificial neural networks provide an excellent approach to this challenge. Traditionally, variations of the Black and Scholes model have been used, but these models rely on the user's ability to accurately model the stochastic process of the stock's price and are thus systematically flawed when faulty assumptions are made or the process is misspecified. Dowling finds that the non-linear relationship between an option's strike, time-to-expiry, and the underlying spot and price of a call option implied by the Black-Scholes model are all well captured by the artificial neural network and that human error is avoided. The paper then makes the case for the role of machine learning more broadly in derivative pricing within finance. Dowling's superb use of financial economic theory, mathematics, statistical modelling and knowledge of machine learning has earned "Neural Networks as an Option Pricing Method" the title of "Best Applied Essay" of the Student Economic Review XXXIV.

I.Introduction

The accurate pricing of derivatives is one of the most complex and challenging tasks in financial mathematics. In 1973, Black and Scholes published their breakthrough formula for pricing European options under a certain set of assumptions (Black, 1973). Since then, several variations of the Black-Scholes model have been devised and employed by investment banks and proprietary trading firms. These variations can potentially come in the form of incorporating jumps in stock prices (e.g. due to earnings releases) or modifying the assumption on the distribution of instantaneous stock returns (classically assumed to be log-normally distributed) (Wyse, 2019).

In all cases, however, the pricing formula relies on the parametric form of the underlying asset's price dynamics. Should one mis-specify or make faulty assumptions regarding the stochastic process for the underlying's price, one will yield a model which systematically mispric-es the contracts of interest. Such models are called parametric.

As more complex derivatives emerge and with the tremendous progress in computational power over the past few decades, there has been a marked increase in interest in using machine learning – data-driv-en approaches – for pricing such securities. Such models are called "non-parametric models" since they do not require any assumptions on the parametric form of the underlying's price dynamics.

These models have some key advantages over their parametric counterparts. First and foremost, they don't need to make any restric-tive parametric assumptions and don't suffer from mis-specification er-ror – this can, in theory, make them more accurate in markets for highly complex securities with non-closed form pricing formulas or non-stan-dard underlying dynamics. Second, they are more flexible, being able to change how they price a contract in the presence of market structure changes. Lastly, they're relatively trivial to implement and can be readily applied to highly differing securities.

The major drawback to such nonparametric methods is that they are extremely data-intensive – they require many months, if not years, of historic data in order to be well-trained. They are also computationally intensive and often require a significant time investment for hyperpa-rameter tuning. Furthermore, naive models which are trained off historic

prices will at best replicate the market's pricing model, which may itself be inaccurate. As such, significant work into determining the "correct" prices may need to undertaken before training. In addition, if the underlying asset's price dynamics are well understood and a closed form expression for the contract's price exists, then a parametric method will always outperform any nonparametric method. Nevertheless, there are certainly situations where such models can be more efficient or beneficial. In this paper, we focus on artificial neural networks – specifically multi-layer perceptrons – but there are several other non-parametric/data-driven modelling techniques which could similarly be employed.

II. Background

Pricing European Call Options

One of the most important findings in financial mathematics is the Black-Scholes equation. This partial differential equation describes the evolution of an option's price, *V,* over time (Black, 1973):

$$\frac{\partial V}{\partial t} + \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 V}{\partial S^2} + rS\frac{\partial V}{\partial S} - rV = 0$$

Applying the corresponding terminal and boundary conditions, we can yield the value of a European call on a non-dividend-paying stock:

$$C(S_t, t) = S_t\Phi(d_1) - Ke^{-r(T-t)}\Phi(d_2) = S_t\Phi(d_1) - PV(K)\Phi(d_2)$$
$$d_1 = \frac{1}{\sigma\sqrt{T-t}}\left[ln\left(\frac{S_t}{K}\right) + \left(r + \frac{\sigma^2}{2}\right)(T-t)\right]$$
$$d_2 = d_1 - \sigma\sqrt{T-t}$$

where Φ is the CDF of a standard normal, S_t is the spot price of the underlying asset, K is the strike price, *r* is the risk-free rate, σ is the volatility of returns of the underlying asset, and T-t is the time to maturity (in years).

The objective of our neural networks will be to recover this

pricing formula from *just* the data. If they are successful, then this will then suggest that neural networks can be used for closely approximating similar pricing formulae which mightn't have an analytic solution but are similarly of high non-linearity (Hutchinson et al., 1994: 3).

Artificial Neural Networks

Artificial neural networks (ANN) are prediction models based on the trends that have occurred in the past. They are inspired by biological neural networks like those found in our brains. They consist of a collection of connected "artificial neurons". These take inputs and produce an output, depending on the node's activation function. The connections/edges allow neurons to transmit signals (their outputs) to other neurons in other "layers" of the network. Typically, the network is composed of the input layer, several "hidden" layers, and the output layer. The nodes and edges have weights (and each layer has an added bias constant) which are adjusted during the learning process to minimize some loss function.

Multilayer perceptrons (MLP) are fully connected ANNs. That is, each neuron is connected to every neuron in the previous and subsequent layer. There are no "loops" in the network, meaning that the value of a neuron does not feed backwards into a neuron of a layer preceding it.

When training MLPs, the back-propagation algorithm is typically used. This uses stochastic gradient descent to recursively optimize the weights and biases on each neuron over random subsets of the data for each iteration. The objective of this algorithm is to find the values for the weights and biases which minimize some specified objective function. For regression, the standard is to minimize the root-mean-square-error (RMSE).

Typically, when training a model, we normalize the input variables to be between 0 and 1 or -1 and 1 (depending on the activation function). This prevents certain input variables from "dominating" the network initially and has been shown to drastically reduce the amount of time needed to adequately train the network.

One important property of neural networks with non-linear activation function is the universal approximation result. Cybenko (1988) and Hornik (1989) demonstrate that an MLP can represent to arbitrary precision almost any linear and nonlinear function with bounded inputs

and outputs (Hutchinson, et al., 1994: 3). As such, it is generally sufficient to only have one hidden layer in the network. When increasing the number of neurons in the hidden layer, there is a (non-linear) tradeoff then faced between model accuracy and computational cost (and risk of over-fitting).

III. Data Set

Simulated Stock Prices

For our first model, we simulate two stock prices independently according to the Black-Scholes assumption of geometric Brownian motion:

$$dS(t) = \mu S(t)dt + \sigma S(t)dW(t)$$

We take the number of trading days per year to be 252 and then draw 504 pseudorandom variates Z_t where

$$Z_1^{(j)}, \dots, Z_{504}^{(j)} \sim N\left(\frac{\mu}{252}, \frac{\sigma^2}{252}\right)$$

Then, via Ito's lemma, we have

$$S_j(t) = S(0)\, exp\left(\sum_{i=1}^{t} Z_i^{(j)}\right),\ t \geq 0$$

For both simulated stocks, we use a drift parameter of 10% per annum, a volatility parameter of 50% annualized, and a starting price of 2500. The result is two simulated 2-year price sequences, S_1 and S_2.

Historic S&P500 Index Prices

For our second model, we will use the historic price levels of the S&P500 market index. We take two years of historic data between January 1, 2017 and January 1, 2019. The resulting data frame has 502 observations. We find that the average annualized return volatility was 13%.

Synthesizing Option Chains

Unfortunately, historic option data is proprietary and expensive. So, we generate our own option chains around the price levels of both the simulated stocks and the real index.

We employ a rolling-window technique whereby for each observation in the three data sets, we create options at strikes between the current price minus 150 and the current price plus 150, in intervals of 10. For each strike, we then generate options with time to expiries between 1 and 50. We then use the Black-Scholes pricing formula to price each option. For the two simulated stocks, we just use their volatility parameter of 0.5 for σ. For the index, we use the average annualized return volatility of 0.13 for σ. For both, we take the risk-free rate, *r*, to be constant at 1%. This greatly simplifies the learning process since we don't need to model this as an extra variable. If the models can capture the relationship between the Black-Scholes price and the option's strike, time-to-expiry, and the current spot, then learning networks can readily capture the effects of the risk-free rate on the option's price [1].

For the first model, options on S_1 will be used for training and a random sample of options on S_2 will be used for testing. For the second model, we use an 80-20 training-test split of the synthesized options on the index. This is because we don't have another independent price series for which we can say the price dynamics are exactly equivalent.

There are several downsides to our methodology. First, while it is true that expected future volatility is constant for the simulated stocks, it is false for the index. Indeed, the stock market can enter periods of extreme turbulence during which expected future volatility until the option's maturity will vary wildly. Furthermore, expected future volatility is not constant as the time horizon increases. That is, options from the same day with the same strike but with differing time to expiries will generally not have the same implied volatilities. Summarizing these issues, in the real world the "correct" volatility parameter for the Black-Scholes price will be neither time-homogeneous nor independent of time to expiry.

In addition, though less important, this approach means that our neural networks will be trying to emulate the Black-Scholes model. This equivalently relates to our models not being able to capture the implied

1 See Hutchinson, Lo and Poggio (1994) for more details or note that a call's rho is a function of all variables.

volatility "smile" we often see from market prices. However, as mentioned earlier, if the models are successful, we can comfortably conclude that they will generalize to being able to price derivatives which do not quite follow the Black-Scholes formula but are likewise non-linear in parameters. However, it would have been far more desirable to have access to many months – or even years – of historical option data so we could both analyze the deviations from the Black-Scholes model implied by the market, and to confirm the notion that these models can be more general.

IV. Methodology

Independent Variables

The key input variables for the models will be the option's strike, spot price and time to expiry. Since, in all three data sets, we generate the option prices with constant volatility and risk-free rate parameters, we don't use these as independent variables. We again reiterate that including the historic risk-free rate in pricing the contracts at each stage of our rolling-window procedure would be largely superfluous in testing how well these machine learning techniques can reconstruct the Black-Scholes formula. However, if we had lots of actual historic *option* prices, we most certainly would have included both variables (using implied volatility as our volatility parameter [2]) as they are critical in accurately pricing the options.

The Neural Network

We use a standard network type – the multilayer perceptron (MLP) with the 3 input nodes, a hidden layer comprising of twelve[3] artificial neurons, and then a single output neuron. Adding additional hidden layers is likely superfluous, again noting the universal approximation result. Since this paper is concerned with the viability of these models as a pricing method, rather than building a functional predictive tool, we did not extensively tune the hyperparameters. The two models were trained using the Tensorflow2 library in R with 10 epochs.

2A discussion of how to get an accurate measure for σ independently is beyond the scope of this paper.

3 Chosen arbitrarily.

Our MLP has the following functional form:

$$\Upsilon(\vec{z}) = \sigma\left(\sum_{j=1}^{12}\left[w_2(j)\cdot\sigma\left(\sum_{i=1}^{3}[w_1(i,j)\cdot\vec{z}(i)]+b_1(j)\right)\right]+b_2\right)$$

where

- σ : Logistic transfer function, $\frac{1}{1+e^{-x}}$.
- $w_1(i,j)$: Weight between unit i of input layer and unit j of hidden layer.
- $w_2(j)$: Weight between unit j of hidden layer and the output neuron.
- $\vec{z}(i)$: Parameter i of input vector $\vec{z}$.
- $b_1(j)$: Bias applied to unit j of hidden layer.
- b_2 : Bias applied to output neuron.

We note here that the data (independent and dependent variables) was min-max normalized according to the following formula:

$$X_{ij}^{*} = \frac{X_{ij} - min(X_{.j})}{max(X_{.j}) - min(X_{.j})}$$

This was done so as to bound the inputs (and output) to be between 0 and 1 (since we are using logistic transfer function) to help with training. We convert the model predicted values into "real" prediction values by inverting the above process. It is these inverted values that we use in assessing model performance.

V. Results

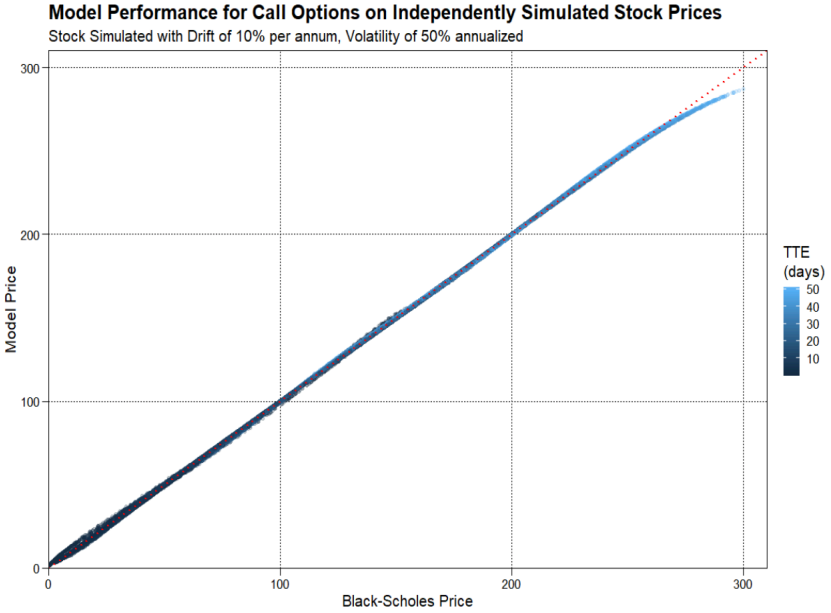
Simulated Stock Performance

The first neural network performed exceptionally well and predicted prices which were largely indistinguishable from the Black-Scholes prices. The following table gives the two key accuracy measures:

R-Squared	99.98
RMSE	0.81

Again, note that this neural network was tested on a data set of

options for a different stock to the one on which it was trained. Furthermore, the spot prices of the underlying stock for the test options were completely independent of the spot prices of the underlying for the training ones. This would suggest that our neural network can be flexibly applied to pricing options on other securities which have the same underlying price dynamics. We show here a plot of the Black-Scholes price of the synthesized options versus what the model predicted the price to be.



We see a near perfect fit/replication except for high priced options, for which our model *undervalues* them relative to the Black-Scholes model. The above graph shows that these tend to be options with high remaining time to expiries (a similar plot colored by "moneyness" showed that these also tend to be those which are deep ITM).

The most likely explanation for the shortcomings of the model at this extremity is that there were insufficient options of this variety in the training set (a byproduct of the option generation procedure). Hence at a macro level, the neural network was not able to perfectly `recon-

struct' the Black-Scholes formula. However, in neighborhoods for which there was a lot of data, the model did perform exceptionally well. This indicates that at the micro level, the neural network could near perfectly "reconstruct" the formula.

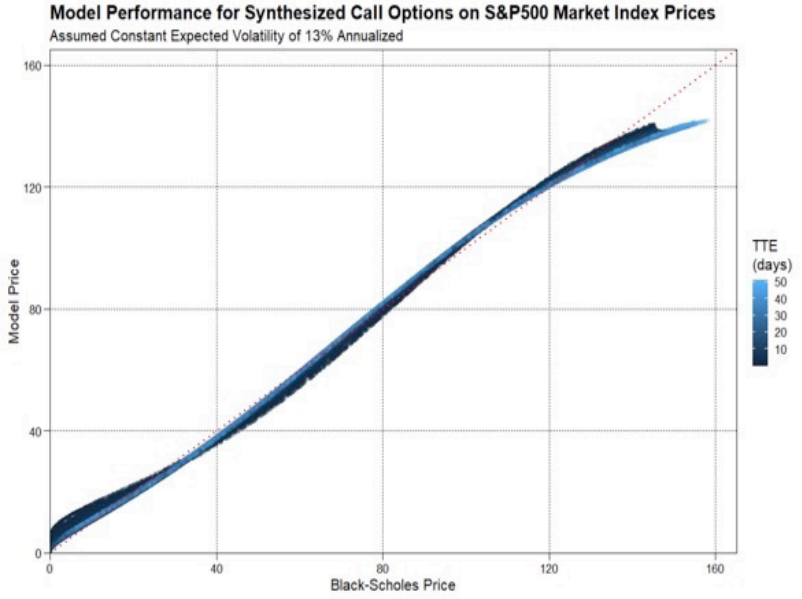
Historic Index Performance

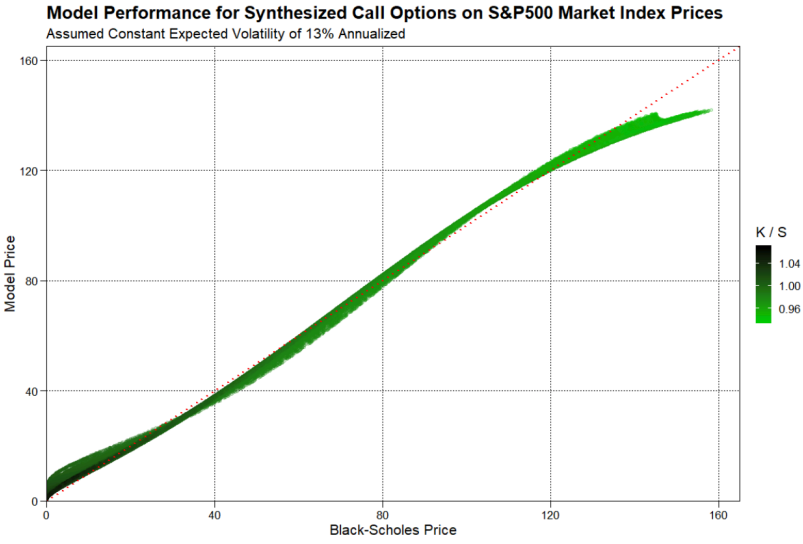
We now look at the second neural network's performance on the historic index derived data set. Again, due to not having a second independent price series with identical price dynamics, the test data set here was a subset of the synthesized option data. Importantly, the test data was not used in any stages of the network's training, so these performance measures are still independent. The following table gives the two key accuracy measures:

R-Squared	99.638
RMSE	2.54

Again, we see excellent fit with almost all variation in the option prices being explained by the model. The performance – particularly in terms of the RMSE – is lower than the first model, however. Before drawing any conclusions, we first look at a similar model performance plot.

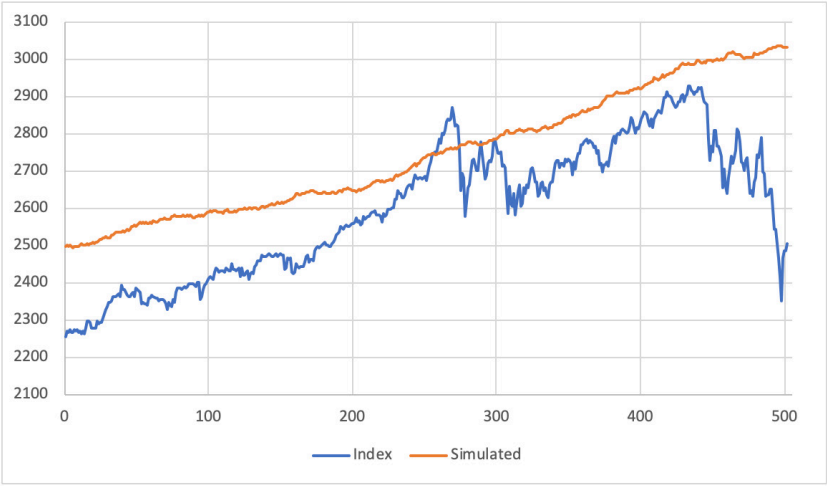
This plot is less straightforward. Firstly, we again see the broad underpricing of high-priced options. We also see the overpricing of cheap options with low time to expiries, followed by the underpricing of moderately priced low time to expiry options. To glean some potential insight, we'll plot the same figure but color the points based on their "moneyness".


Model Performance for Synthesized Call Options on S&P500 Market Index Prices
Assumed Constant Expected Volatility of 13% Annualized
Model Price
Black-Scholes Price
0
40
80
120
160
TTE
(days)
50
40
30
20
10


Model Performance for Synthesized Call Options on S&P500 Market Index Prices
Assumed Constant Expected Volatility of 13% Annualized
Model Price
Black-Scholes Price
0
40
80
120
160
K / S
1.04
1.00
0.96

On its own, this doesn't really tell us much beyond the obvious: the most expensive options are the ones which are furthest ITM. However, we do not to nearly the same degree pick up on the systematic mispricing of options with certain strike/spot ratios like we do in Graph 2 with certain time to expiries. We can infer, thus, that the neural network is not as ideally incorporating the time to expiry variable in its predictions as would be required to perfectly "reconstruct" the Black-Scholes formula.

This deviation could be the result of the more volatile nature of the S&P500 stock returns compared to that of the simulated ones. The below plot shows the spots of the underlying prices for the simulated training stock and the historic S&P500 prices.



We see that the returns are far less smooth with there being many more large drops compared to the simulated prices. This perhaps could have affected the option generation process.

More likely, however, is that the pattern is the result of under-training or from un-tuned hyperparameters. Had we spent time tuning the model's hyperparameters or given the network more time to learn, then we might perhaps achieve a better "global" optimization whereby these inconsistencies in the pricing would be smoothed out.

VI. Conclusion

The major takeaway from this paper is that artificial neural networks can adeptly capture the non-linear relationships between an option's strike, time-to-expiry, & the underlying's spot and the price of a call option implied by the Black-Scholes model. There are countless other "learning" methods which have similar universal approximation results like that of multi-layer perceptrons. Hence, it is reasonable to assume that these other methods will perform similarly or perhaps even better. Some such examples are epsilon-insensitive support vector regression, extreme gradient boosting machines, and projection pursuit regression (Hutchinson et al., 1994: 3). We could also introduce some Bayesian learning techniques to augment many of these methods (Pires, 2005).

The performance of our first network demonstrated to us that this method is flexible and applicable to options on different securities which have similar price dynamics. The performance of our second network indicated that our networks might not necessarily be perfect in capturing the relationship between the time to expiry and the option's price implied by the Black-Scholes model, though this could have been due to the way we synthesized the options.

While the accuracy of the predicted prices was the focus of the paper, we note that this alone is not sufficient to ensure the practical relevance of our approach. The ability to hedge an option position is equally important. Specifically, delta-hedging strategies require an accurate approximation of the partial derivative of the underlying pricing formula with respect to spot. This might be rectified by imposing some smoothness constraint via regularization. MLPs have analytic derivatives (Hermann & Narr, 1997) meaning that we can a *posteriori* always compute it, hence such regularization would be largely superfluous for this paper.

An immediate extension to this paper would be to use real historic option prices on a variety of assets for training and testing. A comparison of the aforementioned machine learning techniques' performances would also be quite interesting. Adding regularization terms to the models would be necessary for such a comparison (Hutchinson et al., 1994: 3).

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Financial Markets and Climate News: Evidence of Short-Termism?

John (Charlie) Walsh, Senior Sophister
Andrew O'Riordan, Senior Sophister

In another paper which stresses the idea that we have only twelve years remaining to avert climate disaster, Charlie Walsh and Andrew O'Riordan investigate whether or not investors are myopic in their assessments of the cost of climate change. The research includes an impressive event study analysis and contributes some incredibly interesting findings to both the research of short-termism in financial markets and the wider discourse around climate change. Walsh and O'Riordan suggest that investors are indeed hyperbolically discounting the future costs of climate change, illustrating this by showing that energy companies do not experience any abnormal returns beyond the market rate when disquieting information such as that contained within the IPCC report "Global Warming of 1.5°C" is published.

I. Introduction

Climate change is one of the most significant challenges facing humanity in generations. Whilst debate rages amongst the public and politicians, the message from the scientific community has been clear for many years. In their latest report, the IPCC indicated that we have until 2030 to make the necessary changes to prevent average global warming

of over 1.5°C above pre-industrialised times, the failure of which will have severe consequences. They have estimated that this will require over $13 trillion of investment (IPCC, 2018). However, this investment is required now to prevent costs that will not be fully realised for generations. Given the long-term nature of such investment, it is potentially exposed to a market inefficiency known as short-termism. This is a well-documented phenomenon whereby expected cashflows accruing at distant time horizons are irrationally discounted more highly than expected cashflows in the nearer future (Miles, 1993). This could lead to an underestimation of the potential future costs of climate change, or of the potential future benefits of swift action. Ultimately, this could lead businesses to underinvest in positive NPV projects that would make them more sustainable and lessen the future effects of climate change.

This paper aims to investigate whether investors display short-termism in their assessment of climate change. We do this by analysing the response of energy company stock returns to climate news. We use the market model to estimate the average abnormal return on all the stocks listed on the S&P 500 Energy index on the day of and the days surrounding the release of the IPCC special report entitled "Global Warming of 1.5°C ." If markets are efficient, any abnormal returns can be attributed to new information. Assuming there were no other news events impacting energy stocks in the period analysed, we can attribute any abnormal returns to the release of the IPCC report. A finding of no average abnormal returns on the day of the report's release would support the hypothesis that investors are excessively discounting the future costs of climate change.

II. Climate Risks and the IPCC

There are two important questions for this analysis. Firstly, does climate change impact the value of companies? Secondly, does the IPCC report contain information on climate change pertinent to investors? If the answer to either of these questions is no then we would not expect to see a response in stock markets to the release of the IPCC report.

Tackling the first question, climate change is a real threat to not only the human population but also to economic activity. For example, Tropical Storm Barry, which made landfall in the Gulf of Mexico on the

13th of July of 2019 (Adams, 2019), forced companies such as Chevron, Royal Dutch Shell and BP to evacuate non-essential personnel (Cunningham, 2019). The storm resulted in oil production shuttering for up to three days (Adams, 2019). These extreme weather events are only going to intensify, as has been recently evidenced by the Amazonian and Australian wildfires. Meanwhile, rising sea levels will destroy many companies' premises, whilst rising temperatures and changing climates could make large portions of land nonarable.

To tackle the second question we must understand what the IPCC is. The Intergovernmental Panel on Climate Change (IPCC) was formed in 1988 to "provide policymakers with regular scientific assessments on climate change" (IPCC, 2019). The IPCC determines the state of knowledge on climate change, assessing thousands of research papers and amalgamating them into a consensus view of climate change knowledge. Assessment reports are released approximately every 6 or 7 years, with special reports addressing particular issues released in the interim. We analyse the stock market response to the special report entitled "Global Warming of 1.5°C", released on October 8th, 2018. The report outlined the potential impact of global temperatures rising 1.5°C higher than pre-industrial times. Consequences highlighted include increased likelihood of flooding in some countries and droughts in others, an increase in tropical storms, and forced migration due to changing landscapes. Most importantly it outlined the major difference in the climate damage caused by 1.5°C vs 2°C of global warming. A stark example of this is that under 1.5°C of warming, there will be a sea-ice free Arctic summer once every century, under 2°C this increases to once every ten years (IPCC, 2018).

Some critics may argue that the contents of the report were not news to investors, so the information was already priced into markets and so we should not see a reaction in stock prices. In response to this, we have a number of remarks. Whilst the IPCC does not conduct its own research, its impact on the state of climate change knowledge is undeniable (Hulme & Mahony, 2010). The report in question contains over 6000 references and tens of thousands of comments (Cole, 2018). They are summarizing knowledge that is not available to the everyday public, either through scientific literacy boundaries or large access fees for research papers. The IPCC is renowned for its impact on general climate change knowledge, policy decisions and climate change discourse (Hulme &

Mahony 2010), and in 2007 won the Nobel Peace Prize for their efforts to accumulate and disseminate greater knowledge about man-made climate change. Moreover, the scientists who compiled the report said the difference caused by just half a degree came as a "revelation" (Watts, 2018). If this was a surprise to the expert compilers of the report, then it will likely have been news to investors and the general public.

III. Short-termism

If markets are efficient and investors are rational, we would expect to see a stock market reaction to the release of the IPCC report. However, humans are not rational agents. We often use cognitive rules of thumb in our decision making, which make us susceptible to systematic bias (Kahneman, 2011). The most relevant biases for this paper are those that cause short-termism, also known as myopia. This is the result of excessive discounting of long-term events above and beyond rational discounting levels. A rational individual will discount a future event accounting for the risk-free rate and the specific risk premium. However, the short-term individual will additionally discount for his own time preference. This is usually explained by a present bias, or a desire for immediate gratification. This excessive discounting of long-term events is well documented in the literature (Loewenstein & Thaler, 1989) and can lead to time inconsistent preferences. This leads to the rejection of actions with long term benefits that the individual feels desirable, over and above the usual effects of discounting (Sterman, 2011).

Whilst there is significant evidence of time inconsistent preferences at the individual level, the question is whether it extends to the aggregate level – i.e. do financial markets as a whole display short-termism? There have been a number of papers demonstrating that they do. Miles (1993) found excessive discounting above the rational level of 10% per annum. Davies et al. (2014) found no significant evidence of excessive discounting in the subperiod 1985-1994 but found a significant result of between 5% and 10% excessive discounting per annum in the period 1995-2004, indicating that the myopic tendencies of markets have worsened over time.

If markets display myopic tendencies, the obvious question to ask is what is causing them? At the individual level, time inconsistent prefer-

ences are explained by an internal preference for immediate gratification. There is evidence for this at the neurological level whereby functional magnetic resonance imaging of the brain have indicated that two separate systems are involved for decisions with an immediate reward and those with a time delay (McClure et al., 2004). However, in financial markets there could be additional factors making investors favour short-term returns at the expense of long-term ones. First is the rise in high-frequency trading in the stock market, whereby investors hold shares for a tenth of a millisecond, courtesy of high-tech trading computers (Davies et al., 2004). Since the algorithms that run these machines search for arbitrage opportunities and hold positions for such a small amount of time, long term sustainability doesn't come into their trading decisions. Moreover, the reward structures of institutional investors often directly encourage short-termism, as short-term performance is easier to measure than long-term performance.

The reasons above are the standard explanations of short-termism in financial markets. However we believe that in the context of considering climate change, there are additional reasons why investors would excessively discount its future costs. Firstly, many institutional investors are bound by fiduciary duty, whereby they have a duty of prudence and loyalty to their beneficiaries, on whose behalf they invest. Courts have often interpreted the duty of prudence to mean investing in the conventional way. Woods (2009) argues that this encourages fiduciaries to stick with the status quo, discouraging investment innovation by institutions. This precludes the consideration of climate change in investment strategies to the extent that it is unconventional practice.

Another explanation is investors and the public don't fully understand the complex dynamics of climate change and thus don't grasp the severity of its costs, even when they are clearly put to us. For example, Egan and Mullin (2012) conducted a survey of public opinion on climate change under a variety of weather conditions. They found that for every 3.5°F that local temperatures rose above normal, Americans became a percentage point more likely to agree that there is "solid evidence" that the earth is getting warmer. These climate change misconceptions are seen even amongst highly educated individuals (Sterman & Sweeney, 2007). If investors don't fully understand the implications of climate news, they will underestimate the scale of the future costs of climate

change and the scale of the benefits from swift action. Overall, this is an argument that on top of excessively discounting the future costs of climate change, investors don't understand, and thus underestimate those very same costs. This is in a sense a double shot whereby the true costs are underestimated, and those underestimated costs are discounted at an excessively high rate.

Most previous research has seen the cost of short-termism as the opportunity cost of foregone investment, since positive NPV investment projects with a long-term maturity, when appropriately discounted for both risk and time preference of investors, will often be rejected (Miles, 1993). However, in the context of ignoring the future costs of climate change, the implications of short-termism could be far more severe, namely preventing the businesses investment necessary to tackle climate change. This, combined with the extra susceptibility of climate costs to short-termism outlined above, makes this an extremely relevant issue and one that we must find solutions for.

IV. Data

We choose to study the response of energy company stock returns to the release of the IPCC report. These companies are the most likely to be affected by the contents of the reports and as such, should see the largest response in their share price. Specifically, we analyse those listed on the S&P 500 energy index, totalling 27 firms. We obtained their daily adjusted close prices from Yahoo Finance for all days inclusive 9th October 2017 to 10th October 2018, which we convert to daily returns. Additionally, we use the daily market return levels from the Kenneth R. French data library.

V. Empirical Methodology and Results

We want to measure the impact of the IPCC report's release on the returns of the sample energy companies. To do this we utilise the event study methodology which has become the standard method of measuring security price reaction to an announcement or event. This methodology uses the market model:

$$R_{it} = \underbrace{\alpha_i + \beta_i R_{mt}}_{\text{Expected return}} + \overbrace{\varepsilon_{it}}^{\text{Abnormal return}}$$

where R_{it} is the return of company i at time t; R_{mt} is the market return at time t; α_i is a constant term for each company i; β_i is the sensitivity of the stock's return to the market return; and ε_{it} is the error term. This model separates out the return of a stock into the normal/expected return caused by economy wide factors ($\alpha_i+\beta_i R_{mt}$) and abnormal/excess returns caused by new firm specific information (ε_{it}), such as the IPCC report release. Assuming markets are efficient, we can attribute any abnormal returns (ε_{it}) to the release of new information relevant to the firm.

The first step of an event study is to identify the estimation window, over which we estimate the above market model parameters (α_i, β_i) for each firm. It is standard in the literature to estimate these parameters using a years' worth of data prior to the event date of study. Second, we must identify the event window, over which we analyse the stock market reaction to the report. We choose ±2 days around the report's release date. This short event window is necessary due to the crucial assumption that no other news events relevant to the sample companies occurred over the event period. The longer the event window, the less confidence we can have in this assumption. We redefine time in our event window relative to the report's release and label it s. As such s=-2 is 2 days before the report's release and s=0 is the day of the report's release.

We estimate the parameters of this market model (α_i, β_i) for each firm using the daily stock and market return data over the estimation period. We then use these estimates to generate a predicted return for each sampled firm on each day of the event window, using the actual market return on each of these days. These predicted returns represent the expected/normal returns of the firm caused by economy wide factors. By subtracting the predicted return from the actual stock return on a day, we get the abnormal returns for that day. Assuming markets are efficient, and that the IPCC report was the only relevant event over the event period,

we can attribute these abnormal returns to the release of the IPCC report.

The average abnormal return in period s (AAR_s) for all energy firms in our sample is given by

$$AAR_s = \sum_{i=1}^{N} \frac{AR_{is}}{N_s}$$

where AR_{is} is the abnormal return of firm *i* in period *s*, and N is the number of firms in our sample. Figure 1 plots out the path of average abnormal returns over our event window. Our primary interest is in the average abnormal returns on the day of the report's release (AAR_0).

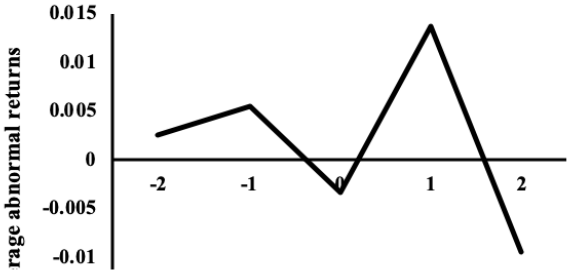

Figure 1. Average abnormal returns for all sampled energy stocks across a four-day event window around the release of the IPCC report

Looking at *Figure* 1 we see that there is a small negative effect on returns, however this is not statistically significantly different from zero. It is possible that the effect was simply dulled due to early leakage of information or that markets took some time to properly assimilate the information. As such, we also calculate the cumulative average abnormal return (CAAR) over the entire event window (±2 days around the report's release date):

$$CAAR = \sum_{s=-2}^{2} AAR_s$$

Table 1 shows that cumulative average returns over the event period were

actually positive (although statistically insignificant), thus providing no evidence that the report had any negative impact on returns over our event period. As such, there is no evidence that the returns of energy companies showed any reaction to the release of the IPCC report, either on the day of its release nor over a 5-day event window surrounding its release.

Table 1. Average and Cumulative average abnormal returns

AAR_0	-0.00337
	(-0.0023165)
CAAR	0.00857
	(-0.1660499)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VI. Discussion

These results provide evidence that financial markets display short-termism in their processing of climate change information. In this paper we have outlined many reasons why an efficient market should respond to climate change information, and why the IPCC reports constitute pertinent information to investors. Despite this, we see no reaction in the returns of energy companies to the report. We believe this is due to excessive discounting of the future costs of climate change i.e. short-termism.

Some may argue that investors are in fact rationally discounting but since the costs of climate change occur so far into the future, they simply have a minimal present value. Wagner and Weitzman (2015) have addressed this criticism. They note that there is currently a 10% probability of global warming of over 6°C, which would have catastrophic implications for life on this planet. This would incur near infinite costs. With the potential for near infinite costs, the argument that this has been appropriately discounted to minimal present value is unconvincing no matter what time horizon such events occur on.

These findings have significant implications for the fight against climate change. It has been estimated that we only have until 2030 to make the necessary investment of $13 trillion to prevent global warming of over 1.5°C (IPCC, 2018). With over 35% of all energy-related carbon dioxide and methane emissions worldwide since 1965 being attributable to the top 20 fossil fuel companies, much of this investment must come from businesses (Heede, 2019). Investors play a key role in mobilizing businesses to tackle climate change, and by extension, an equally large role in preventing them doing so. Davies et al. (2014) showed that if investors discount future returns excessively, a manager, looking to maximise the value of a firm, will prioritise short-term cash-flows over long term ones. This leads to companies prioritising dividend pay-outs over long-term investment in sustainable technologies and business practices. Thus, investors displaying short-termism with respect to climate change are directly worsening its effects by impeding the necessary investment in sustainable solutions.

VII. Conclusion

This paper adds to the literature on short-termism and to the literature on market inefficiencies more generally. Our research is unique in that we focus our analysis on the consequences of short-termism on the fight against climate change. Our empirical analysis has provided evidence that markets are myopic in the processing of climate change information. This is significant as this inefficiency could seriously impede the allocation of resources toward climate action that is currently needed on an exceptionally wide scale. We encourage further research on methods to mitigate short-termism and maximise investor consideration of climate issues in their investment strategies.

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Volatility Analysis of Boeing and the 737 Max Crashes

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Shauna Fitzmaurice and Róise McSorley analyse the impact of the two high-profile crashes of Boeing's 737 Max aircraft in October 2018 and March 2019 on the stock price of the company. They examine these crashes as exogenous shocks to Boeing's stock price and investigate whether the behaviour of Boeing's stock price was well captured by Autoregressive Conditional Heteroscedasticity (ARCH) models. Furthermore, they seek evidence of whether or not there was volatility clustering around the time of the shocks. The authors find that Boeing's stock price showed evidence of serial correlation following the second crash but not the first. The paper also illustrates how and why Boeing's stock price rapidly rebounded following both crashes, suggesting that Boeing recovered quickly due to the crashes occurring outside the EU or US and investor risk perceptions being largely unaffected.

I. Introduction

Despite 2017 being the safest year in the history of air travel, with zero crashes transpiring according to The Aviation Safety Network (2017), the aviation industry was hit with two fatal aircraft crashes within five months of each other in October 2018 and March 2019. The first of these crashes occurred with Lion Air on 29th October 2018 and the second crash was with Ethiopian Air on March 10th 2019, killing a combined total of 346 people. Notably, each crash involved one of Boeing's newly launched and highly anticipated 737 Max aircraft, and its non-disclosed

software flaw in its Manoeuvring Characteristics Augmentation System (MCAS). These two crashes can be examined as exogenous shocks to Boeing. As conditional heteroskedasticity features in many financial time series, we inspect if this was accurate for Boeing and whether any potential volatility clustering was visible when the shocks occurred.

To obtain insight into the volatility and its persistence for Boeing stock in response to shocks, we first propose using the Capital Asset Pricing Model (CAPM) to calculate the beta (β). The calculated β will aid in indicating if Boeing provides returns greater than the market return. While $\beta s < 1$ are expected for income stocks similar to Boeing, the aviation industry is inherently riskier than other industries. Fluctuating fuel costs as well as airlines facing high safety standards require that Boeing is fulfilling strict aviation regulation. Any potential airworthiness issues injure both the airline and the aircraft manufacturer. Considering that commercial orders from airlines worldwide make up the majority of Boeing's order books and projected profits, as well as the near substitutability of the aircraft products (e.g. Boeing's 737 Max is substitutable with the A320neo from rival Airbus), competition against its primary competitor Airbus intensifies risk. These orders are low in volume but are high revenue generating over a long delivery period, therefore neither company can afford any gaps in their order books.

By using the covariance/variance formula as well as confirming this by running a regression, a β of 1.13 is found for Boeing stock over a long run period. This involved use of monthly Boeing return data from January 2010 to November 2019 i.e. a near ten-year period of analysis. As this β is marginally greater than one, it suggests that Boeing is slightly riskier than the market, as proxied by the New York Stock Exchange (NYSE index). Hence, it enjoys marginally better returns than the NYSE index when markets are bullish and marginally worse returns when markets are bearish. While we calculated Boeing's β over the long run, it has been contended that it is statistically inefficient to focus on volatility measures that assume constant variance over the same period, when the series moves through time (Campbell et al., 1997). We believe that this long run β has not sufficiently accounted for the exogenous shocks faced by Boeing in relation to the two major 737 Max crashes as well as the inherent riskiness of the aviation industry itself. We wish to examine if Boeing's returns around the period of the two shocks were serially cor-

related. Our main motivation is to investigate the effect on volatility of specific aviation crash shocks to Boeing. This required daily data for a short run window of 123 stock trading days. The results hinted that over this window period, Boeing's returns experienced increased autocorrelation, ministering investors an element of predictability.

II. Methodology

To examine the full extent of the dynamics of the volatility impact of the two exogenous shocks to Boeing, we obtained daily data of Boeing and market returns beginning October 2018 and ending March 2019. This analysis window covers 123 stock trading days from the month of the first crash until the end of the month containing the second crash. This window was selected because it was the chief period of effect of the two exogenous shocks, which significantly had a similar nature (i.e. same aircraft model and MCAS flaw causing the crash).

A CAPM analysis to obtain the relevant window's β, coupled with an accompanying ARCH model, permitted detecting any reaction in the volatility dynamics of the shocks. Nevertheless, there is room for concern since the short analysis window may not provide a sufficient duration for a precise conclusion on volatility persistence. This stems from aircraft crashes requiring lengthy investigations which forces a time lag before perceptions are modified and recommendations can be implemented; e.g. the difficulty in resolving and upgrading a design defect in aircraft located world-wide. Hence, a lag may arise before dynamics fully account for any shock.

III. Results of CAPM and ARCH

The CAPM analysis of returns as per *Figure 3* in the Appendix calculated a β for this 123-day period of 1.48. It is noteworthy that this β is equivalent to the β that can be calculated for the time period exactly between the two crashes. As the window is of a marginally longer duration, by including daily data from the full month of the exogenous shocks, this further emphasises the absence of expectation of the crashes and the concealment of the MCAS software error from the market, thereby ensuring exogeneity. This β denotes higher riskiness than the market and exceeds

its long run β, which would be expected due to the crashes occurring.

Interestingly, the inclusion of time as an explanatory variable in the CAPM model is statistically significant at the 1% level and increases the R^2. Hence, Boeing's return is trending with time. Moreover, the small yet statistically significant negative coefficient associated with the trending variable accurately reflects the fact that Boeing's return is falling over the window period, as the impacts of the shock are realised and markets react. As the returns are of a relatively high frequency, often the daily changes can be small. Yet because of the shocks, this window period sees large variation in Boeing's return.

The window period focuses more on the bearings of the first crash, which occurred near the beginning of the window period (as opposed to the second crash which occurred towards the end of the window period) and led to increased daily volatility in returns. Much of this volatility forces downward pressure on Boeing's daily returns. Notably, the variation in returns reduces two months after the first crash marking the beginning of the 2019 market opening. From our calculation, Boeing's returns average slightly positive at 0.8% during this time.

With the occurrence of the second crash in early March, a dip in returns of -5.33% occurred, which is similar to, though smaller than the stock's reaction of -6.59% to the first crash. In contrast to the first crash, persistent high volatility is remarkably not induced after the second crash. This illustrates increased stability of the Boeing stock in response to a similar exogenous shock. Yet this stability occurs with the immediate global grounding of the 737 Max aircraft. The grounding would prevent further crashes and worsening financial implications.

Moreover, after the grounding occurred, the markets were expecting a rapid fixing of the MCAS error permitting the prompt return of the aircraft to the skies in a best-case scenario of a six to eight-week timeframe, according to Canaccord Genuity analysts (Barron's, 2019). Investors were not expecting the ensuing public relations crisis. Furthermore, Business Insider (2019) highlights the difficulty associated with an airline cancelling its 737 Max order (Boeing has 4,500 unfulfilled 737 Max orders) due to the duopoly nature of large commercial aircraft manufacturers as well as the financing/investment decisions undertaken by their multi-million dollar aircraft order and up to 30% prepayment. Thus, order revisions rather than pure cancellations are likely for Boe-

ing, with increased orders for older aircraft models, thereby positively contributing to Boeing's stability and outlook. Correspondingly, Airbus faces a similar backlog for its nearest substitute aircraft causing any new order to be placed at the back of the queue taking at least three years, as reported by the Financial Times (2019a).

Nevertheless, the higher β of 1.48 over this window period (which mainly comprises the impact of the first crash) hints that the increased riskiness of Boeing could be reflected in conditional variance, which we examined using the ARCH model (*Figure 4* in Appendix). Lamoureux and Lastrapes (1990) suggest that conditional heteroskedasticity may be due to a time dependence in the rate in which information arrives to the market. The conditional variance for the window period rarely deviates from 3, relative to its long run conditional variance of 27. Using the Lagrange Multiplier test on our ARCH model, we cannot reject the presence of ARCH at the 5% significance level. This is in contrast to Boeing's long run period where we rejected the presence of ARCH in our data, in line with the resulting ARCH alpha's (α) lack of statistical significance at the 5% level as well as its smaller absolute value. Hence, higher errors for the long run occur as compared to the window period.

In addition, evidence from the autocorrelation plot for Boeing's stock for the window suggest that there is increased positive autocorrelation over daily time lags. Notably, post second crash the autocorrelation is statistically significant. Hence, the returns are correlated with each other, allowing a degree of predictability for investors. As window returns move to match those of a lagging time series, we established a positive time trend for April 2019. This supports the more stable return that is low but positive directly after the second crash. Boeing's long run return surmounts the severity of the shocks caused by the crashes and a degree of persistence in the short run periods, that may in the long-term net out.

IV. Results in a Dynamic Context

Our results highlight the absence of volatility clustering, which would have been expected due to the exogenous shocks faced by Boeing. Therefore, rejection of the assumption of a constant variance of the error term (i.e. the innovation) occurs. Hence, the tendency of large changes followed by further large changes and vice versa is surprisingly not ap-

parent in our results. Generally, a shock ensues a continuous period of increased volatility which would be expected due to the severity of the nature of Boeing's shocks. Despite the peak in volatility to a conditional variance of 12 relative to 3 due to the first crash, our results find that this peak quickly wears off and returns to its average variance within two days.

By examining global volatility outlook through the Chicago Board Options Exchange (CBOE) Volatility Index (VIX index), we can confirm that there exists a detachment of Boeing's conditional variance plot from the market's volatility (proxied by the Standard & Poor's 500 index [S&P500]) as no co-movement is evident between their volatilities. Boeing's diverse portfolio, the duopoly nature of the market it operates in, and close relationship with the U.S. Administration and the U.S. Federal Aviation Administration (FAA), secures its position against adverse market changes. Therefore, the global volatility index was not pre-empting either shock to Boeing which fortifies the exogeneity of the shocks experienced.

Despite the large market capitalisation of Boeing ($194 billion), the impact of the exogenous shock of the 737 Max crashes did not result in increased global volatility (VIX fell by 8.4 in the week post-crash), further supporting the idea of the separation of Boeing and the market. Hence, this separation illustrates the idiosyncratic nature of the 737 Max crashes, with the shock of the 737 Max crash being inherent to the aviation industry rather than the wider market. However, our result contradicts the findings of Kaplanski and Levy (2010) who studied 39 American and European aviation disasters from 1990-2007. They revealed that on average, aviation accidents caused a spike in VIX, which contradicts our findings on Boeing. Our study may be an outlier possibly due to the rest-of-world locations (outside E.U. and U.S.) of the crashes as well as the recent timescale.

Dillon et al. (1999) highlight that out of the ten fatal aircraft accidents experienced by major US domestic airlines from 1990-97, only four experienced abnormal market responses. In the aviation industry, shareholder responses to an aircraft accident depend on its circumstances. Notably, shareholders will respond by altering their assessment of risk if the accident or the public response to it seems anomalous. This adjustment can originate from substantial problems with the firm's oper-

ating procedures and policies. Consequently, abnormal market responses will occur which can be defined as responses that are not consistent with the full-cost information of the accident.

This marginally abnormal response is supported by Boeing stock falling by 6% (amounting to $12 billion) which considerably exceeds the forecasted aggregated cost of the 737 Max accidents of under $5 billion according to the Wall Street Journal. Observing Boeing's market capitalisation of $194 billion, the effect of the small fall in its stock is marginal and not highly abnormal, highlighting that accident costs are usually small relative to market capitalisation. This is additionally supported by Kaplanski and Levy (2010) whose study featuring investor sentiment found that aviation disasters resulted in less than the average market loss (>$60 billion) for larger, less risky firms such as Boeing. In addition, their finding of the price reversal within two days holds for our results. Furthermore, they found that aviation disasters precede a rise in perceived volatility risk, with the implied volatility increasing after the disaster although actual volatility does not. Hence, investors are unlikely to have reached considerably different conclusions on Boeing's risk exposure than before the accident because of the lack of persistence of the Boeing stock response to shocks over the long run (e.g. re-evaluation of the probability of an accident occurring was unlikely after the first crash).

Remarkably, recent Boeing developments raise similarities to the Boeing 737 aircraft (an older model than the 737 Max) crashes with U.S. Air in 1991 and 1994, killing all passengers. These crashes resulted from a design flaw relating to the aircraft's rudders. No grounding ever occurred even when the lengthy FAA investigation was ongoing and this aircraft became one of Boeing's most successful, as reported by the Financial Times (2019b). Hence, many of the industry specialists believe that the 737 Max will survive its present problems once it gains recertification from regulators, as emphasized by the Financial Times (ibid.). This further relates to Boeing's quick recovery and increased stability seen post second crash. This has continued in the period after the window, with Boeing achieving a significant order of two-hundred 737 Max aircraft from International Airlines Group (parent company of British Airways), though at a discount, further marking a significant vote of confidence in the 737 Max aircraft (Financial Times, 2019c).

Moreover, owing to the fact that both 737 Max crashes occurred

outside the U.S. and E.U., where less stringent safety regulation prevails, there is evidence that aviation crashes outside these territories have less of an impact on US investors (Kaplanski & Levy, 2010). This arises from the reduced relevance to the US investor, deflating the impact/severity of these fatal crashes (Kaplanski & Levy, 2010). Remarkably, Lion Air was prohibited from the EU up until the year prior to its 737 Max crash due to failing to meet safety standards (Reuters, 2016). Hence, this redirected focus away from Boeing and the possible fault in the aircraft's manufacture/design. This is strengthened by the small 6% fall in Boeing's stock and its subsequent quick rebound. Following aviation accidents, sophisticated investors exploit the low market prices contributing to a price reversal (Shleifer et al., 1991). This supports our results of a mean-reverting reversal effect two days after the crash.

V. Summary

Our study utilised monthly data taken from the first day of every month, from January 2010 to November 2019 (almost a decade of monthly data). However, the long run conditional variance plot (*Figure 2* in Appendix) did not display spikes when the two crashes occurred. This arises from the lack of persistence in volatility in the long run. Using the first date of each month signifies that the impact of each crash has worn off by the time our data was sampled (i.e. we included data on 1st November, but the Lion Air crash occurred on 29th October). This supports the finding that true effects of an aviation crash only last about two days, before the price reverts to its mean. Hence, in the long run, the complete impact on volatility is not visible as the data collected includes dates that demonstrate a stock price that reflects a rebounding stock, which acts to stabilise volatility. In contrast, as we used the daily return for our window period, this shows every change from marginal predictable changes, to impacts of exogenous shocks as they happen. Hence, spikes in volatility are evident on the days of the crashes (*Figure 4* in Appendix) with a small degree of volatility persistence occurring after the second crash.

VI. Conclusion

To conclude, it is apparent that Boeing's return exhibits a degree of persistence in the short run window period which covers the two exogenous shocks. Serial correlation occurs with returns after the second crash, as autocorrelation increases with daily time lags over the window period. We failed to reject the ARCH model for this short run window period. Boeing's stock rebounded quickly after both shocks, aided by the 737 Max crashes occurring outside E.U. or U.S. territories, risk perceptions staying relatively constant and no resultant increase in implied global volatility as measured by the VIX index. Our results hint towards the lack of volatility clustering, yet we cannot give a precise conclusion on this, due to the high frequency of data and analysis over the short window period. Notwithstanding, Boeing's 123- day window period contrasts to its near 10-year, long run period. Boeing's long run data rejected the ARCH model demonstrating that no persistence in volatility was evident. Therefore, in the long run, Boeing stock is unpredictable. This stems from the dynamic context of the aviation industry and reliance on consumer demand for flying and economic cycles.

VII. References

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VIII. Appendix

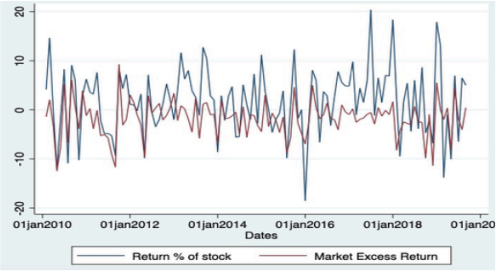

Figure 1: Boeing's % Monthly Return changes as compared with the NYSE Market % Monthly Return, illustrating Boeing's Long Run β of 1.13.

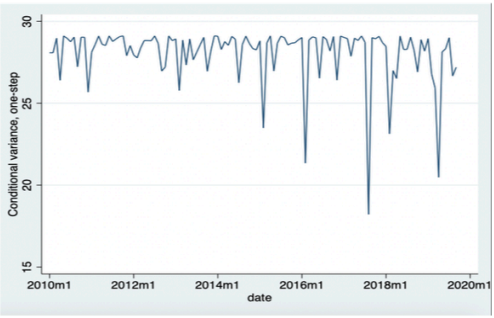

Figure 2: Boeing's long run ARCH plot. A Lagrange multiplier test rejects the presence of ARCH.

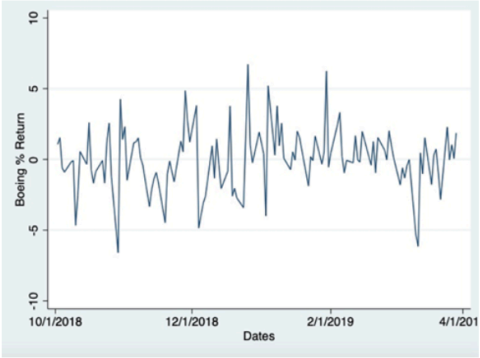

Figure 3: Boeing's % Daily Return over the short run window period of 123 stock trading days.*

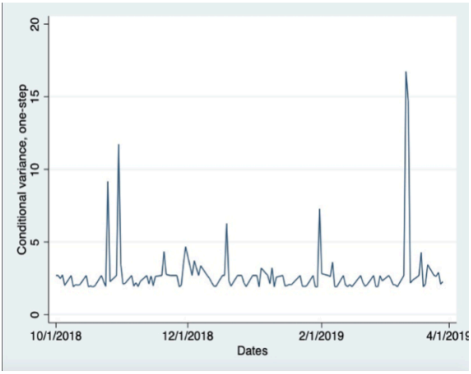

Figure 4*: Arch plot for the short-run (123-day) window. A Lagrange multiplier test fails to reject the presence of ARCH.

**Note: These dates are in the American date format of mm/dd/year.*

An Empirical Investigation into Speculative Bubbles in Ethereum's Price

Michaela Fricova, Senior Sophister
Jonathon McKeown, Senior Sophister

Cryptocurrencies have dramatically changed the way we think about money. With the rapid development of electronic payments around the globe, their popularity has skyrocketed over the past decade, and cryptocurrencies now occupy a considerable space in many investors' portfolios. With this increase in popularity has come a huge amount of price volatility, and consequently most of these currencies are prone to mildly explosive speculative bubbles. In this paper, Michaela Fricova and Jonathon McKeown seek to establish whether the Ethereum market reflects periodically collapsing speculation in its prices, using a recursive unit root procedure introduced by Phillips (2013a). Their results strongly support the hypothesis of multiple bubbles emerging in the series. They date-stamp 15 bubbles over the investigated time period, ranging from one day to 73 days in length. The longest bubble period, spanning between February 2, 2017 and April 17, 2017, is discussed with respect to price evolution in the Bitcoin market, as well as with regards to Ethereum software being adopted for commercial use.

I. Introduction

Since its introduction in early 2015, Ethereum has become the second largest cryptocurrency by total dollar market value (Beneki et al., 2019). By early 2017, market capitalization of the cryptocurrency surpassed $69 billion (Liu & Serletis, 2019). Ethereum was developed as a decentralized network of applications, eliminating third party institutions that tend to control crucial data by granting users their control over information (Ethereum Foundation, 2016). Ethereum's price has displayed high volatility (Catania et al., 2018). As shown in Figure 1, the several thousand percent surge in Ethereum prices since the beginning of 2017 has been accompanied by an increasing return in dispersion. As Phillips et al. (2015) point out, the history of financial markets tends to repeat itself. Therefore, accurate ex post identification of speculative bubbles might provide cryptocurrency investors with warning mechanisms to prevent losses on their current positions (Houbner, 2018).

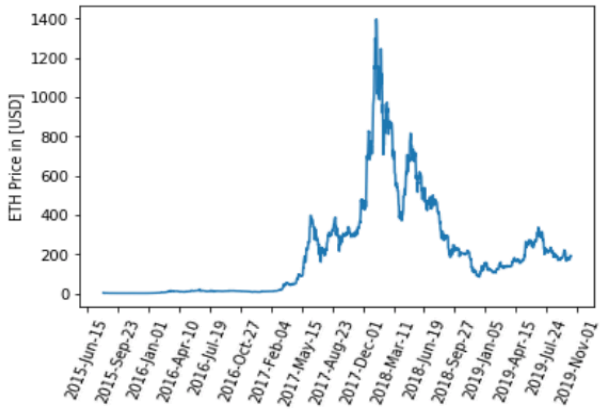

Figure 1. Crude USD Ethereum Prices between 8/2015 and 10/2019

II. Literature Review

The first attempt to describe a bubble in the financial markets can be attributed to Keynes (1973) who noted that "stock prices may not always be governed by an objective view of 'fundamentals' but by what average opinion expects the average opinion to be" (quoted in Cuthbertson & Nitzsche, 2004). However, such a definition makes it extreme-

ly difficult to quantify exuberance phenomena in the financial markets (Blanchard, 1982; Phillips, 2015).

A viable alternative has been proposed by Adam and Szafarz (1992) who define bubble as a scenario in which prices are driven up by the expectation of further growth. Consequently, market actors can be conceptualized as rational speculators[1] who bet on further price rises. The definition can be easily accommodated in the traditional Asset Pricing Approach to speculative bubbles, whereby exuberance constitutes the part of the market price which exceeds an asset's fundamental value. Detecting the existence of bubbles therefore entails determining the fundamental value of the underlying asset. This is usually performed by calculating the expected present value of the payoffs (including dividends) considering all relevant information and then subtracting this computed present value from the market price of the asset (Cuthbertson et al., 2004). A major problem with this approach for cryptocurrencies, however, is that they are hard to value as they do not have clearly identifiable cash flows (e.g. dividends) (Taipalu, 2012; Pesaran & Johnsson, 2018).

To circumvent the issue of fundamental value determination, Diba et al. (1988) devised a right-tailed unit root test, known as the conventional cointegration-based bubble test in the literature. However, simulations performed by Evans (1991) indicate that this technique produces a false positive result 25% of the time.

Phillips et al. (2011) build upon the idea developed by Diba et al. (1988), but instead of running a single test over the whole sample, they implement right-tailed Augmented Dickey-Fuller tests using subsets of the data incremented by one observation at each run. They name this method the Supremum Augmented Dickey Fuller test and show that it does not only result in much greater power - even in the presence of periodically collapsing bubbles - but also allows us to pinpoint the start and end date of the bubble with its backward date-stamping procedure. At its core, the technique assumes that the series satisfies the sub-martingale[2] property.

The sub-martingale definition of bubble time series, as outlined

1 Hence the terms "speculative" or "rational" bubble later in the text.

2 Asset prices adhere to martingale behaviour when successive price changes are unpredictable, although the variance of the price changes can be predicted from past variances under the martingale property (definition derived from Cuthbertson & Nitzsche, 2004). This is contrasted with a sub-martingale behaviour of a series whereby there is a widely anticipated direction of price-change in the asset market - the price changes have a strict lower bound during a run-up stage of a bubble. Refer to section "III. Methodology" for further details

in Phillips et al. (2011), has been more strongly supported in the research on financial market speculation (Biagini et al., 2013; Protter, 2013). Sub-martingale bubbles have also been advocated in the cryptocurrency literature - Cheung et al. (2015), for example, applied the Backward Supremum Augmented Dickey Fuller procedure to Mt. Gox Bitcoin prices. Their analysis discovered 33 time periods of exuberance in the Mt. Gox exchange between July 2010 and February 2014. To our knowledge, no paper has aimed at identifying speculative bubbles in Ethereum ex-post.

III. Methodology

This section introduces the Backward Supremum Augmented Dickey Fuller method[3] (as defined by Phillips et al., 2013a) and outlines how the procedure will be utilized for the purposes of our analysis.

At its core, the BSADF methodology is based on the assumption that during its bubble run-up period, asset prices exhibit sub-martingale behaviour. It is assumed that there is a widely anticipated direction of price-change in the asset market as opposed to a martingale behaviour of asset prices whereby the best forecast of all future values of the bubble depends only on its current value (Cuthbertson et al., 2004).

The aforementioned definition of a price evolution in a market with bubbles be illustrated via a standard Asset Pricing Model, as specified in Equations (1) and (2).

$$P_t = \sum_{i=0}^{\infty} \left(\frac{1}{1+r_f}\right)^i E_t(D_{t+i} + U_{t+i}) + B_t \quad (1)$$

$$E_t(B_{t+1}) = (1 + r_f)B_t \quad (2)$$

It is evident from (1) that if the bubble term B_t is equal to zero, then today's price of the asset is equal to the asset's discounted expected value, which can be further defined as a function of the expected dividend stream $D_{t+i,}$ unobserved fundamentals $U_{t+i,}$, and the risk-free interest rate r_f. In line with the martingale assumption, both $D_{t+i,}$ and $U_{t+i,}$ are assumed to be stationary or at most integrated to order one and, hence, the prices P_t follow a unit root process in the absence of a bubble. However, if the bubble term B_t, deviates from zero, the process is not a unit root anymore, but instead exhibits explosiveness over time. Such a solu-

3Later referred to as the BSADF method in the text.

tion can be easily derived from (2), whereby the evolution of the bubble term is explosive (under the assumption that the risk-free rate has a zero lower-bound, i.e. $r_f > 0$). Clearly, the Asset Pricing Model outlined in (1) does not allow for the presence of run-down periods after the bubble has reached its peak price, and hence lacks the required complexity to allow for multiple and periodically collapsing bubble periods.

Our method enriches the specification by allowing for the possibility of a time-varying risk-free interest rate (i.e. $r_f = f(t)$) into an Asset Pricing model (in line with Phillips & Yu, 2011). With such a non-constant discount factor, bubble periods can be mildly explosive, meaning that they can temporarily divert from the fundamentals but subsequently return to the discounted expected value[4] .

Repetitiveness aside, we anticipate the asset prices to follow a unit root process under the null hypothesis of no speculative bubbles in the market. In the BSADF testing literature, this unit root process is usually limited to a random walk (Phillips et al., 2011) or a random walk with an asymptotically negligible drift (Phillips et al., 2015). These two possible null hypotheses are outlined in Equations (3) and (4). It is clear from Equation (4) that the drift term d converges to zero as the sample size T approaches infinity under our assumption of $n>0.5$. Furthermore, these two null hypotheses are tested against the competing alternative of $\theta > 1$. Hence, unlike the standard ADF unit root method with left-tailed alternative hypothesis of stationarity, we are testing for the right-hand alternative hypothesis of explosive series.

$$y_t = \theta y_{t-1} + \varepsilon_t \qquad \text{with } \varepsilon_t \sim \text{iid}(0, \sigma^2), \theta=1 \qquad (3)$$

$$y_t = dT^{-n} + \theta y_{t-1} + \varepsilon_t \qquad \text{with } \varepsilon_t \sim \text{iid}(0, \sigma^2), \theta=1,\ n > 0.5 \qquad (4)$$

In addition, the BSADF testing procedure involves a sliding window regression applied recursively throughout the series. This allows for detecting multiple structural breaks, i.e. time series periods indicative of a bubble starts or ends (Enders, 2014). To put it more simply, BSADF specification is outlined via the differenced equation (5).

$$\Delta y_t = \hat{\alpha}_{r_1,r_2} + \hat{\beta}_{r_1,r_2} y_{t-1} + \sum_{i=0}^{k} \hat{\phi}^{i}_{r_1,r_2} \Delta y_t + \hat{\varepsilon}_t \qquad (5)$$

$$r_2 = r_\omega + r_1 \text{ with } r_\omega > 0 \qquad (6)$$

4 Phillips and Yu (2011) introduce the time-varying discount factor into the continuous time Gordon Growth Model [GGM].

In (5), the r_1 and r_2 correspond to the start and the end points of the sliding window regression, respectively. It must be pointed out that r_1 and r_2 are fractions of the overall dataset T and, therefore, the regression is performed on the data ranging from the r_1^{th} fraction of the sample till the r_2^{th} fraction of the sample. Furthermore, the fractional window size r_ω of the regressions is specified in Equation (6). It is evident from (6) that the higher the r_ω the lower the overall number of recursions performed. Consequently, the coefficient ω also determines the sample size of each regression, denoted by T_ω. The ADF statistic based on this sliding window regression can be specified as $ADF_{r_1}^{r_2}$

$$SADF(r_0) = sup\ ADF_{0.}^{r_2} \text{ with } r_2\,[r_0, 1] \qquad (7)$$

The Supremum in the BSADF stands for the $ADF_{r_1}^{r_2}$ statistic with a flexible window size. More specifically, in the traditional SADF test (depicted in Equation (7)), we allow for the fraction parameter r_2 to vary, while the parameter r_1 is still assumed to be fixed at r_1=0. As a result, the sample sequence r_ω varies in size, with the ADF statistic for the longest possible sample size being denoted by $ADF_{0.}^{r_2}$

In line with Phillips et al. (2015) who performed a simulation study on the optimal minimum window size selection, we select r_0 based on the lower bound of 1% of the full sample. The precise specification of r_0 for the purpose of our analysis is depicted in Equation (8).

$$r_0 = 0.01 + 1.8/\sqrt{T} \qquad (8)$$

Performing BSADF comprises of computing SADF on a backward expanding sample sequence. In such a case, the fraction parameter r_2 is fixed to 0, while r_1 is allowed to vary. As outlined in Equation (9), we let the r_1 parameter to take on any value between zero and r_2-r_0.

$$BSADF(r_0) = sup\ ADF_{r_1}^{r_2} \text{ with } r_1\,[0, r_2 - r_0] \qquad (9)$$

Having acquired the *BSADF* (r_0) statistic, we compute critical

values using Monte Carlo simulations[5] . During this stage, we follow Phillips et al. (2015) by setting the number of bootstrap replications to 200 and by not permitting multi-core computations. Finally, for inferring significance, we rely on the 99% confidence interval. Such decision boundary is in line with Cheung et al. (2015) who applied the same methodology to testing multiple bubbles in the Bitcoin cryptocurrency market.

IV. Data Set Overview

In our analysis, we consider daily closing prices of Ethereum over the time period 7 August 2015 to 11 October 2019. We only use the log value of weighted prices for further computations.

The dynamics of our data are outlined in Table 1. It is evident from the summary statistics that the series exhibits high deviations from the long-run mean. We also detect an upward trend in the data, with prices ranging between 0.416 USD in 2015 and 1397 USD during its all-time high in January 2018. The interquartile range of approximately 283 USD indicates that the data exhibits fat tails.

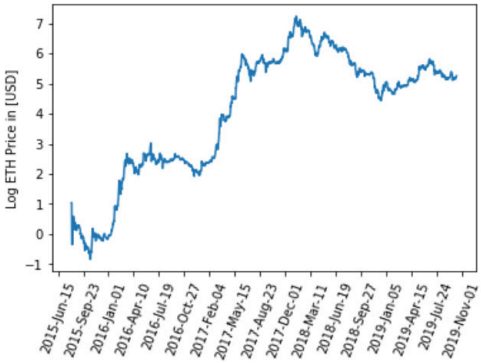

Figure 2. USD Ethereum Prices in log scale over the Sample Period.

Table 1. Summary Statistics

Variable	Obs.	Mean	SD	Min	Max	IQR	Skewness	Kurtosis
Ethereum P	1527	206.3718	249.5032	0.4316	1397.4800	283.0773	1.731618	6.145035

5 The asymptotic critical values are tabulated but in small samples these computations require Monte Carlo simulations as specified in Phillips et al. (2011).

Figure 2 also supports the possibility of non-constant volatility in the series, which could be indicative of conditional heteroskedasticity in returns. However, visual inspection of squared returns (procedure outlined in Diebold et al., 2019) does not support the conditional heteroskedasticity hypothesis. In addition, Monte Carlo simulations by Pedersen and Schütte (2017) assert minimal impact of heteroscedasticity on the BSADF procedure (i.e. no critical test statistic distortions). We, therefore, do not perform any additional diagnostic checks on the variance dynamics.

As for serial correlation in the data, the time series is highly persistent because its autocorrelation is close to 1 and significantly different from 0 for lags 1-100. Figure 3 depicts the autocorrelation for lags 0 through 20. As for the partial autocorrelation function, we see both the values lagged 1 and 2 periods to be significant in explaining today's Ethereum prices. Since our autocorrelation function results imply high persistence in the time series, it is important to determine whether the observed trend is deterministic or stochastic. To do so, we used the left-tailed Augmented Dickey-Fuller test. We applied the test to three specifications: (1) model without a constant; (2) model with a constant; and (3) model with a trend. In all cases, we failed to reject the null hypothesis of a unit root in the series[6] . This result supports a stochastic trend, i.e. the series to be integrated of order one. However, the test's critical region is limited to the left-tail and, hence, does not incorporate the possibility of explosive series. We consequently apply the BSADF test to investigate the presence of explosiveness in the prices.

6 We did not utilize the Bayesian information criterion (BIC) to decide on one of the three specifications, i.e. (1) model without a constant, (2) model with a constant and (3) model with a trend, as such an approach was criticized by Phillips et al. (2015)

LAG	AC	PAC	Q	Prob>Q	-1 0 1 [Autocorrelation]	-1 0 1 [Partial Autocor]
1	0.9977	0.9979	1522.9	0.0000		
2	0.9966	0.1768	3043.6	0.0000		
3	0.9949	0.0006	4560.1	0.0000		
4	0.9932	-0.0706	6072.2	0.0000		
5	0.9915	0.0529	7580.2	0.0000		
6	0.9897	-0.0010	9083.7	0.0000		
7	0.9879	-0.0601	10583	0.0000		
8	0.9863	-0.0430	12078	0.0000		
9	0.9847	-0.0078	13570	0.0000		
10	0.9832	0.0411	15057	0.0000		
11	0.9815	0.0032	16541	0.0000		
12	0.9796	-0.0504	18020	0.0000		
13	0.9779	0.0183	19495	0.0000		
14	0.9760	-0.0310	20965	0.0000		
15	0.9743	0.0139	22430	0.0000		
16	0.9725	-0.0439	23892	0.0000		
17	0.9706	-0.0400	25348	0.0000		
18	0.9686	-0.0265	26800	0.0000		
19	0.9665	-0.0122	28246	0.0000		
20	0.9644	-0.0389	29687	0.0000		

Figure 3. Autocorrelation Plot

Table 2: Augmented Dickey-Fuller test for unit root

Underlying DPS	# of lags included (p)	Test statistic	10% Significance Critical Values	5% Significance Critical Values	1% Significance Critical Values
ADF without a constant (Model 1)	0	0.585	-1.620	-1.950	-2.580
ADF with drift (Model 2)	0	-2.101	-2.570	-2.860	-3.430
ADF with drift (Model 2)	1	-1.415	-2.570	-2.860	-3.430
ADF with drift (Model 2)	2	-1.819	-2.570	-2.860	-3.430
ADF with trend (Model 3)	0	-1.185	-3.120	-3.410	-3.960
ADF with trend (Model 3)	1	-0.442	-3.120	-3.410	-3.960
ADF with trend (Model 3)	2	-0.655	-3.120	-3.410	-3.960

V. Results

This section reports the results of our analysis of whether the market prices of Ethereum exhibited speculative bubble behaviour between 7th August 2015 and 11th October 2019. As outlined in Figure 4, we find multiple bubble periods using the BSADF testing procedure. The test statistic, represented by the solid blue line, clearly shows that it exceeds its corresponding 99% critical value (denoted by the purple dotted line) 15 times over the sample period, which corresponds to the identification of 15 episodes of speculative bubbles in the data.

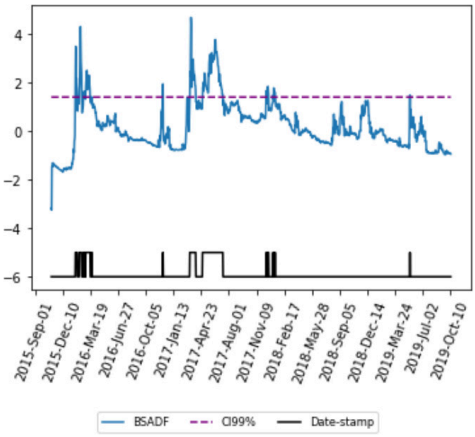

Figure 4. Backward Supremum Augmented Dickey Fuller Test.

In line with Katsiampa (2018), it might be argued that the ubiquity of bubble formation throughout 2016 be linked to DAO hacker attacks. This event undoubtedly would have spooked investors. Likewise, there were notable reasons for the prolific bubble periods of 2017 with the increasing media attention and legitimacy Ethereum was receiving from investors and politicians alike. For example, when Vatilak Buterin (Etherum's Founder) described the opportunities for using the technologies he developed in Russia, a statement released by the Kremlin in June 2017 stated that President Putin supported the idea of securing further Russian investment in Ethereum. Furthermore, eToro added Ethereum to its listings on February 23, 2017 when the cost of one coin was only $23. In May 2017 AVAT Trade added Ethereum to its listings at a time when one Ether coin was trading at $100. Moreover, in February 2017 large institutions, such as J.P Morgan Chase, Intel and Microsoft, began to use Ethereum's software (Crosby et al., 2016), and this credibility might have continued to fuel the bullish market.

VI. Limitations and Possible Extensions

Despite the clear-cut findings of our analysis, some caution is required with respect to the interpretation of the discovered bubble periods. Primarily, our results stem from the assumption that the underlying price series exhibits explosive behaviour during periods of speculative

bubbles. However, other specifications of speculative excess have also been outlined in the literature. For example, Monschang et al. (2019) define a rational bubble which follows a random walk. Therefore, more research and discussion are recommended as to which specification of cryptocurrency bubble is more suitable. This also brings up the problem of the very definition of speculative behaviour in the cryptocurrency market. As stressed in Pesaran et al. (2018), the BSADF test does not allow for the possibility that the detected periods of exuberance are not in fact bubbles but are rather signs of rapidly changing fundamentals in the cryptocurrency.

Another caveat of our research concerns findings recently published by Phillips et al. (2015). According to Monte Carlo simulations, the BSADF test has much lower detective capacity than a recently introduced generalized version of the test – the GSADF. The superior power of GSADF is particularly evident when multiple periods of market exuberance are present in the data. This suggests the direction of future research in Ethereum should include the usage of the GSADF instead.

VII. Conclusion

We found 15 periods of speculation within the price of Ethereum, with the most notable bubble period lasting from 3rd February 2017 to 17th April 2017. Thus, our results did support the hypothesis that Ethereum was in fact in a bubble for a significant period of time during its price highs. Our findings might be of interest to investors who are considering Ethereum's place within an investment portfolio. Also, the discovered exuberance might hold the attention of policy makers, particularly with respect to creating cryptocurrency legislation. While this paper focused on Ethereum, it is important to outline that there are numerous other cryptocurrencies, such as Bitcoin, Ripple and Litecoin, that have all experienced a similar price evolution to Ethereum and therefore, it does pose the question as to whether or not the market is a bubble in its entirety.

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Investigating how fluctuations in the USD/RMB exchange rate affect China's debt assets denominated in US dollars

Vivien Ehle, Senior Sophister
Charlotte Cooper, Senior Sophister

Last but by no means least, Vivien Ehle and Charlotte Cooper conclude the 34th Edition of the Student Economic Review with an investigation into how fluctuations in the USD/RMB exchange rate affect China's debt assets which are denominated in US dollars, with a special focus on the value changes that have occurred after the devaluation of the Chinese renminbi. Through the analysis of historic data sets of the exchange rate and US treasuries held by China, the authors find that there is a negative correlation between the net increase in US treasuries held by China and the strength of the Chinese currency. Over the 18-year period examined, China's per-unit external wealth has been reduced a result of currency fluctuations affecting its debt assets denominated in US dollars.

I. Introduction, background and motivation

This research paper addresses how fluctuations in the USD/RMB exchange rate affect China's debt assets denominated in US dollars. Evidently, the real value of China's debt assets denominated in US dollars has a large effect on its external wealth over time. The motivation for this research question stems from the fact that there is little research on this specific topic relative to its significance. Likewise, the ongoing tense relationship between China and the US has been very topical in recent months and years in terms of trade wars, currency wars and exchange rate fluctuations. In the current world economy with all of these aspects coming in to play, the USD/RMB exchange rate is highly volatile.

After the introduction of a fixed exchange rate system from 1994 to 2005, the Chinese Yuan was pegged to the US Dollar and although the nominal exchange rate was fixed, the real exchange rate was significantly devalued. In 2005, China moved to a "managed floating exchange rate system". It was no longer pegged to only the US dollar but to a basket of currencies including the Euro, the US Dollar, the Japanese Yen and Korean Won, with the weight of each currency remaining unknown (Wang, 2018). Since then, China has bought foreign currencies to intentionally keep the value of its currency artificially low. Consequently, Chinese exports are relatively cheaper compared to other countries, such as the United States (Myers, 2018). Recent trends have confirmed that the Chinese currency is indeed under depreciation pressures which sparks speculation that the Chinese government has been manipulating the exchange rate.

II. Literature review

In the paper "The Globalization of United States Debt: The Real Impact of China's Rise as a Creditor State", Michael R. Myers (2018) argues that China has strong bargaining power since it has the ability to sell off its US holdings and thereby collapse the value of the US dollar. At the same time, if China were to reduce its purchase of US assets, the RMB would appreciate relative to the dollar and therefore create significant costs on China's own economy. It is estimated that a ten percent appreciation in the value of the RMB results in a loss of approximately three percent of China's GDP in its foreign reserves (ibid.).

This research paper will examine how China's debt changes

when there is a change in the USD/RMB exchange rate. It will also examine the impacts this has on China's external wealth.

III. Empirical approach and methodology

In order to determine how the USD/RMB exchange rate behaves according to whether the Chinese Yuan is pegged to the US dollar or not, we collect different sets of data provided by the Federal Reserve Economic Data (FRED, 2019) and the US Department of the Treasury (Department of the Treasury, 2019). More specifically, FRED publishes the USD/RMB exchange rate on a monthly basis. Likewise, the US Department of Treasury publishes major foreign holders of treasury securities, including China.

We analyse those data sets using graphs to visualise the effect of exchange rate fluctuations over an 18-year period. Where necessary, we convert data expressed in nominal terms into real terms in order to determine the real effect of a variable. For example, we multiply the USD/RMB exchange rate by the number of US treasuries in order to obtain the true value in RMB of China's foreign debt assets.

IV. Description of data sets and empirical results

To approach this research question, some key data sets were required: the USD/RMB exchange rate history, historical measurements of China's buy/sell activity in US treasuries, which are denominated in US dollars, and the value in local currency (RMB) of China's investment in US treasuries.

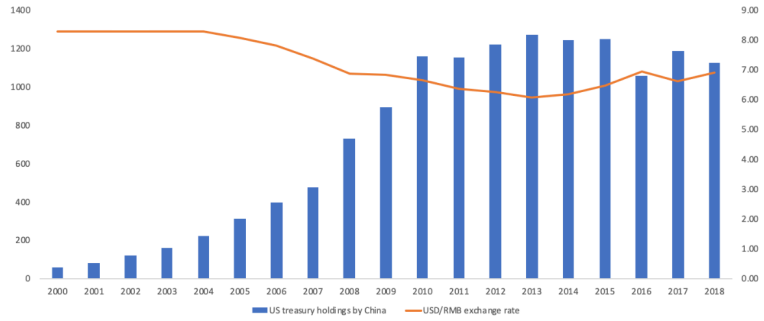

Figure 1: China's holdings of US treasuries (in billions of dollars) against the USD/RMB exchange rate (2000-2018). Source: FRED, US Department of the Treasury.

As depicted in *Figure 1,* there is a negative correlation between the net increase in US treasuries held by China and the strength of the Chinese currency. That is to say that when the Chinese Yuan appreciates relative to the US Dollar, China has more purchasing power with the same amount of local currency than before and therefore can afford to increase their treasury holdings. *Figure 1* reveals significant growth in treasury holdings after the removal of the currency peg in 2005, which led to the appreciation of the Renminbi relative to the US Dollar. Notably, in 2016, a significant drop in holdings was realised in response to the corresponding drop in RMB value, still only relative to the US dollar. This could be resulting from uncertainty in the exchange market due to the slow decrease in RMB value over the three preceding years or just to cash in from the currency value gain from the temporarily weakened exchange rate.

As a country with a largely positive trade balance, China reaps benefits from having a depreciated currency due to the fact that their investment in US treasuries converts to a higher real value in RMB but also due to increased international export demand. This is because Chinese goods are relatively cheaper because of the better exchange rate for US consumers in terms of Chinese imports.

Figure 2 and *Figure 3* attempt to draw closer to the conclusion of the effects that the exchange rate has on China's external wealth, solely focused on US treasuries for the purpose of this paper, by incorporating the real value of the owned US treasuries in local currency, the Chinese Yuan. This curve presents the key data addressing the research question of this paper: examining how exactly China's external wealth is affected by shifts in the relevant currency exchange.

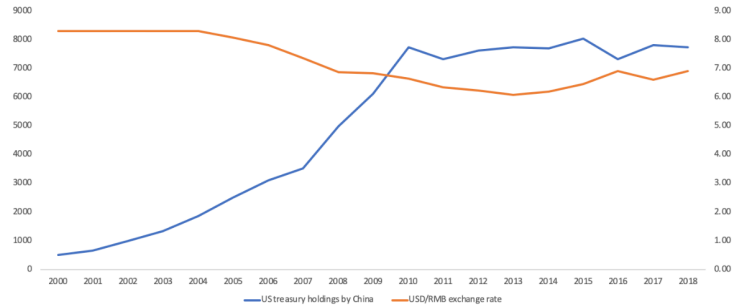

Figure 2: China's holdings of US treasuries (valued in RMB) against the USD/RMB exchange rate (2000-2018). Source: FRED, US Department of the Treasury

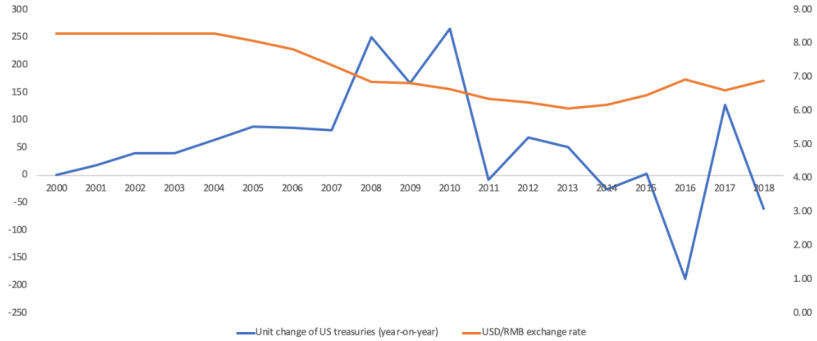

Figure 3: US treasuries bought/sold against the exchange rate (2000-2018). Source: FRED, US Department of the Treasury

As we can see from *Figure 3*, there is a strong inverse correlation between the exchange rate and the buy/sell reaction on US treasuries by China.

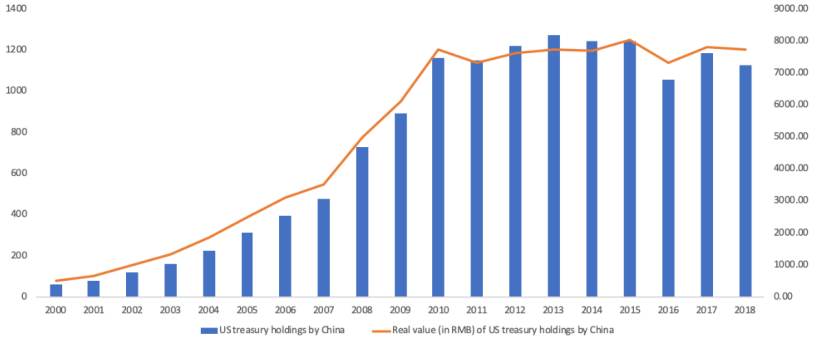

Figure 4: China's holding of US treasuries (in billions of dollars) denominated in USD vs. RMB (2000-2018). Source: FRED, US Department of the Treasury

In *Figure 4* above, the data shows the value of the treasuries in US dollars and renminbi over the time period 2000 to 2018. For the duration of the currency peg, prior to 2005, and until shortly afterwards the treasuries would have converted into local currency (RMB) at a pre-

mium profit because of the false currency trading rate induced by the peg. Shortly after, in 2008, the exchange rate returned to its natural level and, as depicted in *Figure 4*, the treasuries would have converted to RMB at face value. This is consistent with *Figure 1* where we can see the exchange rate abruptly plateau onto its natural rate again in 2008. Conversely, 2012-2014 shows a timeframe where the treasuries would have traded at a loss once exchanged into Renminbi.

Since *Figure 4* reveals the relative valuation of the treasuries in both USD and RMB directly, it acts as a buy/sell chart; ideally treasuries would be sold when the RMB curve is higher than the USD and treasuries would be purchased when the USD curve is equal to or higher than the RMB curve. This is true to the data to a great extent as we can see the purchasing of treasuries explode as soon as the US Dollar equals the Chinese Renminbi in 2008 on the graph in *Figure 2*.

Valuation effects and China's net external wealth

Fluctuations in the USD/RMB exchange rate have affected China's net external wealth. Changes occur because of financial flows and valuation effects as a result of asset trades and capital gains, respectively. Especially after the removal of the Chinese Yuan peg to the US Dollar in 2005, China's external wealth changed.

Theoretically, valuation effects are responsible for the generation of a difference in external wealth comparing two time periods. As a general rule, when the Chinese Yuan appreciates relative to the US dollar, Chinese treasury wealth goes down. In order to determine how China's external wealth has changed by 2018 compared to 2000, we can use a general formula for financial weights while accounting for valuation effects:

$$\frac{\partial VAL_{it}}{\partial E_{ijt}} = \omega_{ijt}^{F} * (A_{it-1} + L_{it-1}) \qquad (1)$$

where ω_{ijt}^{F} is the weight for the Renminbi (*i*) in 2018 in China's (*j*) net foreign assets (*F*) and A and L denote assets and liabilities, respectively. *Equation* (1) tells us what the effect of a change in the exchange rate has on debt (Bénétrix, 2019).

In this case, China's debt assets are denominated in US Dollars. After the Chinese Yuan appreciated in 2005 compared to levels prior to

that year, US treasuries held by China decreased in value, affecting its net external wealth negatively.

Year	USD/RMB exchange rate	US treasuries held by China in billions of dollars
2000	8.2771	-
2018	6.8827	1123.6

$$(6.8827 - 8.2771) \times \$1123.6 = -¥1565.62\text{bn} \qquad (2)$$

Comparing values from 2000 with data from 2018, we can conclude from *equation (2)* that China's net external wealth has decreased by ¥1565.62bn, holding treasuries over the 18-year period constant.

Speculation of changes in the value of US treasuries

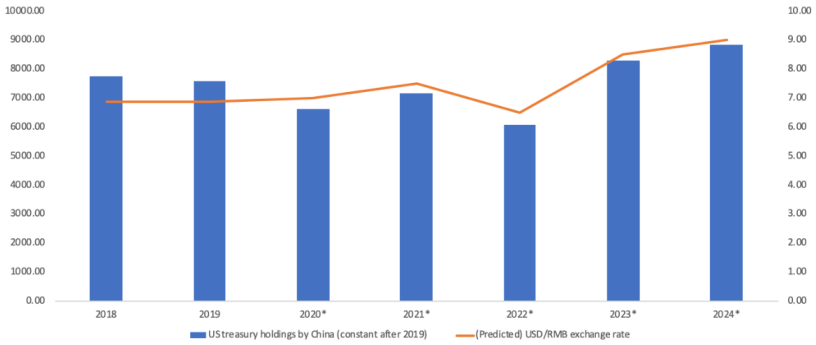

Figure 5: Predicted values of US treasuries' reaction in response to exchange rate fluctuations.

With ongoing tensions between China and the US regarding trade, the USD/RMB exchange rate has been greatly affected. The world's two largest economies officially entered a large-scale trade war in 2018 when they both imposed tariffs on each other's imports. Ever since the first tariffs were imposed by the US and China in July 2018, both countries were observed to be engaging in currency devaluation strategies: for

example, the People's Bank of China set the Dollar's reference rate 0.9 percent lower than prior to the war and thereby weakened it to its lowest level since 2016. After President Trump commented on the move, the dollar index immediately fell by more than one percent (CNBC, 2018). The US has accused China of manipulating its currency in order to benefit from the trade war. As a consequence, Trump has requested that the International Monetary Fund (IMF) intervenes and recognises China as a currency manipulator.

Since the energy recession in 2015-16, China has tightened its capital controls to have greater control over the Chinese Yuan. For instance, the Central Bank fixes the target for its daily exchange rate (Brown, 2019).

That being said, *Figure 5* reveals the predicted values of US treasuries' reaction in response to exchange rate fluctuations and more specifically a general depreciation over the time period, using 2020-2024 as an example. We obtain historical data for the years 2018 and 2019 and predict based upon the ongoing US/China trade war that there is a strong likelihood of an RMB depreciation in the future. We believe that this depreciation is likely to happen due to the fact that it is in China's interest to have a depreciated RMB in order to offset the US tariffs imposed on Chinese exports.

To illustrate this point, we forged a dramatic depreciation to test the reaction of the movement of treasuries. We also included a dramatic hypothetical appreciation in 2022 to show the opposite impact. This, in part, forecasts possible eventualities in light of current affairs. For simplicity, we hold the most recent value (2019) of US treasuries held by China constant.

As expected, *Figure 5* reveals that when the RMB depreciates, the real value of treasuries increases. Likewise, when the RMB appreciates (2022), the real value of treasuries decreases. This confirms our findings of the relationship between the USD/RMB exchange rate and the value of US treasuries.

V. Limitations

This paper has several limitations which impede its accuracy. The lack of data availability on China's behalf and the lack of data on US treasuries held by China prior to 2000 limit the ability to assess the values before the Chinese currency was pegged to the US dollar in 1994.

The availability of this data would add to the accuracy of this paper and be more inclusive of the historical data set.

There is ambiguity in the speculation with respect to the outcome of actual future fluctuations in the exchange rate on the value of US treasuries. The predicted values are solely based on extreme predictions for theory purposes only. In addition to this, there is further ambiguity on the value of treasuries as China has the power to sell treasuries which could result in an increase in the yield of the US treasuries and would hence result in a reduction of the value. Although this is a realistic assumption, China only holds a small percentage of overall US treasuries and would therefore not have a huge impact on the yield.

VI. Conclusion

The aim of this paper was to investigate how fluctuations in the USD/RMB exchange rate affect China's debt assets denominated in US dollars. Our key findings include the negative correlation between the net increase in US treasuries held by China and the strength of the Chinese currency and the negative correlation between the value of the RMB against the USD and the value of US treasuries. In the time period investigated, we showed that China's net external wealth decreased, holding US treasuries constant, resulting from an overall appreciation of the Chinese Yuan between 2000 and 2018.

We also showed that, if the Chinese Yuan were to depreciate over the next few years, the real value of US treasuries denominated in US dollars increases which is consistent with our findings of the relationship between the USD/RMB exchange rate and the value of US treasuries.

Going forward, the ongoing trade war is likely to evolve into a currency war and have a continued impact on the exchange rate and thus the value of US treasuries held by China. However, whether or not the value of US treasuries will increase or decrease over the coming years is ambiguous and highly unpredictable.

VII. References

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