GEOGRAPHY MATTERS FOR SMALL ADVANCED ECONOMIES: IMPLICATIONS FOR ECONOMIC STRATEGY

Caroline Saunders
Agribusiness and Economics Research Unit, Lincoln University, Lincoln 7647, New Zealand.

Paul Dalziel*
Agribusiness and Economics Research Unit, Lincoln University, Lincoln 7647, New Zealand. Email: paul.dalziel@lincoln.ac.nz

Andrew McCallum
Ministry of Business, Innovation and Employment, Wellington 6011, New Zealand.

*Corresponding author

ABSTRACT: New Zealand is a small advanced economy in the South Pacific Ocean. Policy advisors often compare New Zealand's economic performance with those of other successful small advanced economies. These comparisons generally recognise that New Zealand is uniquely distant from the world's largest and highest-income markets. Nevertheless, it has become commonplace for policy advisors to say "Geography is not destiny: New Zealand can do better". This paper draws on standard regional economic development analysis to conclude that geography matters for economic strategies. It draws on endogenous growth theory to explain how the properties of knowledge mean that knowledge can sustain increasing returns to scale and hence productivity growth. The paper draws on that theory to introduce a mission-oriented innovation research programme that has contributed to creating and capturing greater value from New Zealand food and fibre exports.

KEYWORDS: Aggregate productivity, endogenous growth, geographical remoteness, knowledge economics, small advanced economies.

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1. Introduction

Small advanced economies (SAEs) are defined by David Skilling as "IMF advanced economies, with populations above 1 million and below 20 million people; and with a per capita income above USD30,000" (Skilling, 2020, footnote 5, p. 6). Skilling identifies 13 economies that meet these criteria (World Bank abbreviations are in brackets): Austria (AUT); Belgium (BEL); Denmark (DNK); Finland (FIN); Hong Kong SAR, China (HKG); Ireland (IRL); Israel (ISR); Netherlands (NLD); New Zealand (NZL); Norway (NOR); Singapore (SGP); Sweden (SWE); and Switzerland (CHE). Figure 1 uses World Bank data to present real gross domestic product per capita for these economies over the two decades 2000 to 2019. Singapore is consistently the group's strong performer, joined by Ireland after 2015 (fuelled, at least in part, by international corporate tax avoidance strategies; see Regan and Brazys, 2018). New Zealand and Israel have languished below the others for the full twenty years.

Policy advisors in New Zealand have been concerned about productivity comparisons such as these for at least 35 years. The Treasury's briefing to the incoming government at the 1984 general election, for example, warned that New Zealand continued "to display one of the most lacklustre performances among any country in the developed world" (Treasury, 1984, p. 103). More recent briefings continue to observe that labour productivity performance has drifted downward relative to that of other advanced countries, so that "New Zealand's GDP per capita is about 30% below the average of the top half of the Organisation for Economic Co-operation and Development (OECD), where it has been since it settled in the mid-1990s" (Treasury, 2020, p. 3). The New Zealand Productivity Commission similarly describes poor productivity as a key characteristic of the economy, which "is like a car stuck in first gear, where faster growth comes from revving the engine rather that driving more efficiently" (Nolan *et al.*, 2019, p. 3). Consequently, "New Zealand's disappointing productivity performance has held back its standard of living, and wellbeing more generally, for many years" (New Zealand Productivity Commission (NZPC), 2021a, p. 1).

Skilling provided an early diagnosis of what is widely accepted as a major factor affecting New Zealand's economic performance. Writing for the Treasury's Economic Transformation Project in the early 2000s, Skilling (2001, p. 5) pointed out, "Although there are other small countries (Switzerland, the Scandinavian countries, Singapore) there are none that are so distant". He cited the remoteness measure of Frankel and Rose (2000,

p. 40), which is a GDP-weighted average of a country's log distance from all its trading partners. On this measure, New Zealand and Fiji are the most remote economies in the world.[1]

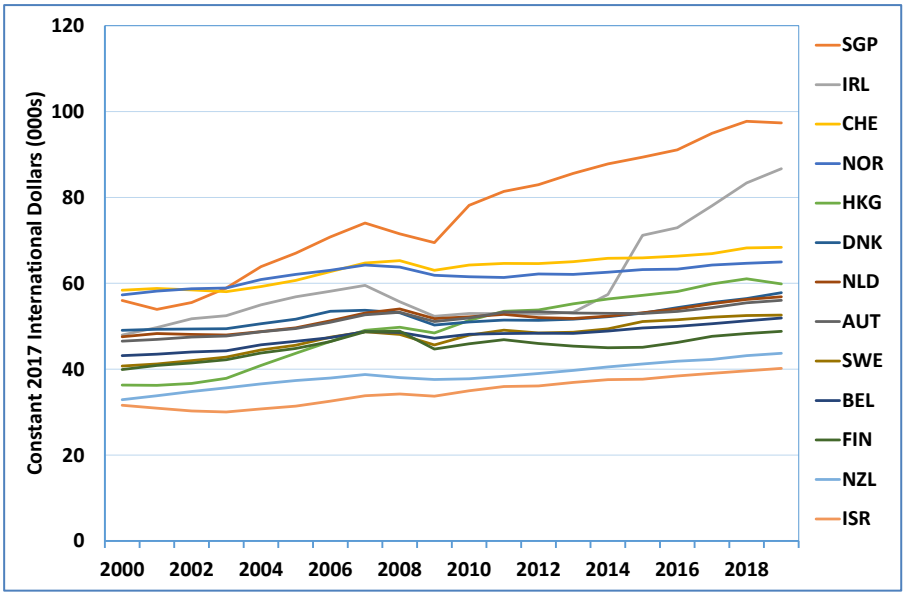

Figure 1. Real Gross Domestic Product Per Capita, Selected Small Advanced Economies, Constant 2017 International Dollars, 2000-2019. Source: World Bank (2021).

Subsequent studies have provided evidence in support of the hypothesis that distance to market explains a significant amount of New Zealand's poor performance compared to other OECD countries; see, for example, Boulhol *et al*. (2008) and de Serres *et al*. (2014). It is not hard to suggest reasons. Geographical remoteness imposes obvious disadvantages on domestic firms seeking to go global: "New Zealand can access about 1% of global output within a three and a half hour flight compared to 26% of global output from Paris, 25% from Chicago, and 32% from Hong Kong" (Skilling and Boven, 2006, pp. 6-7). The Productivity Commission adds that this makes it difficult for New Zealand firms to participate in high-value-added parts of global supply chains, contributing to a relatively small number of large, established and successful exporting firms, and to a low overall level of exports to GDP (NZPC, 2021a, p. 2).

Skilling also introduced what has become another consistent theme in this literature, finding room for optimism on the grounds that "although the effects of size and location are powerful, they are not deterministic" (Skilling, 2001, p. 17). Treasury (2014, p. 22) similarly emphasised that "geography is not destiny", since "countries can and have overcome the constraints associated with size and distance from market" (Dalziel and Saunders, 2018, offer further discussion on this point). The Productivity Commission's recent report on frontier firms devotes a section to the theme that "Geography is not destiny: New Zealand can do better". Indeed, its key finding F2.5 states: "Geography is not destiny. The existence of a few New Zealand firms at or close to the global frontier shows that it is possible to overcome the disadvantages of small domestic market and distant location" (NZPC, 2021a, p. 29).

Human agency means nothing is 'destiny', and so these statements are strictly accurate. This does not mean that the costs of distance are irrelevant for private enterprise or for public policy in New Zealand. Philip McCann (2009) addressed this issue in his analysis of New Zealand's situation using the lens of economic geography (summarised, for example, in the Nobel Prize lecture of Krugman, 2008). McCann concluded that "the small scale of New Zealand, its extreme isolation, and its low levels of output diversity all serve to greatly limit its national productivity potential" (McCann, 2009, p. 299). Indeed, McCann found nothing in the country's inherited structural features that would suggest New Zealand ought to have relatively high productivity. In short, geography matters.

The challenges created by distance are reflected in features of New Zealand enterprises recognised as frontier firms. The Productivity Commission reports that domestic frontier firms have four key characteristics (NZPC, 2021a, pp. 48-54): (1) they export more; (2) they invest heavily in innovation; (3) they have scale; and (4) they exhibit "dynamic capabilities" (following Teece, 2017, 2019). These characteristics suggest the relevance of another body of economic thought recently recognised with a Nobel Prize – endogenous growth theory.

Romer (1994) and Jones (2019) provide good overviews of this theory. It is relevant because it explains influences on the level and growth rate of economic productivity. It shares Krugman's attention to the role of increasing returns to scale in sustaining living standards growth, but emphasises the creation and utilisation of new knowledge, rather than agglomeration *per se* (agglomeration is one way to foster knowledge creation and utilisation). Knowledge in this theory is more than the creation of novel goods and services; it also refers to new ideas about how to deliver value to customers through innovative marketing and the use of emerging

technologies. As Teece (2017, pp. 698-699) explains, a firm's collective knowledge can be a valuable asset because it is scarce and often difficult to imitate. Endogenous growth theory, therefore, offers insights into how policy in a small advanced economy can foster public and private institutions for supporting growth in living standards through knowledge creation and dissemination.

The purpose of this paper is to explore the insights of endogenous growth theory with an application of mission-oriented innovation to the problem of generating and capturing greater value from New Zealand's food and fibre exports. Section 2 provides New Zealand context with three key graphs. These show that New Zealand's productivity paradox is not a matter of low *growth* compared to other SAEs, but of a relatively low *level*, which also features in regional productivity data within the country. Section 3 then introduces endogenous growth theory, beginning with a short summary of the neoclassical growth theory upon which it is based. This section then explains the properties of knowledge that mean it can sustain increasing returns to scale and, therefore, productivity growth. Section 4 draws on endogenous growth theory to introduce a mission-oriented innovation research programme that has contributed to creating and capturing greater value from New Zealand food and fibre exports. The paper finishes with a brief conclusion.

2. NEW ZEALAND CONTEXT

Figure 1 presented real per capita GDP data for the thirteen SAE economies analysed by Skilling (2020). Figure 2 calculates the average annual growth of that productivity measure for each SAE between 1999 and 2019. Ireland is the highest on the list, with an average annual growth rate of 3.4 per cent. The two Asian SAEs (Singapore and Hong Kong) follow, with average annual growth rates of 3.2 per cent and 2.9 per cent, respectively. The remaining ten SAEs have average growth rates between 0.8 and 1.5 per cent. New Zealand's growth rate is the highest of these ten economies.

On these data, the New Zealand economy over the last 20 years has not been a laggard in productivity *growth*, compared to other SAEs. It is clear that Ireland and the two Asian SAEs had strong growth. The other ten SAEs experienced an average annual growth rate well below the rates of

those three countries, but New Zealand was at the top end of those ten SAEs.

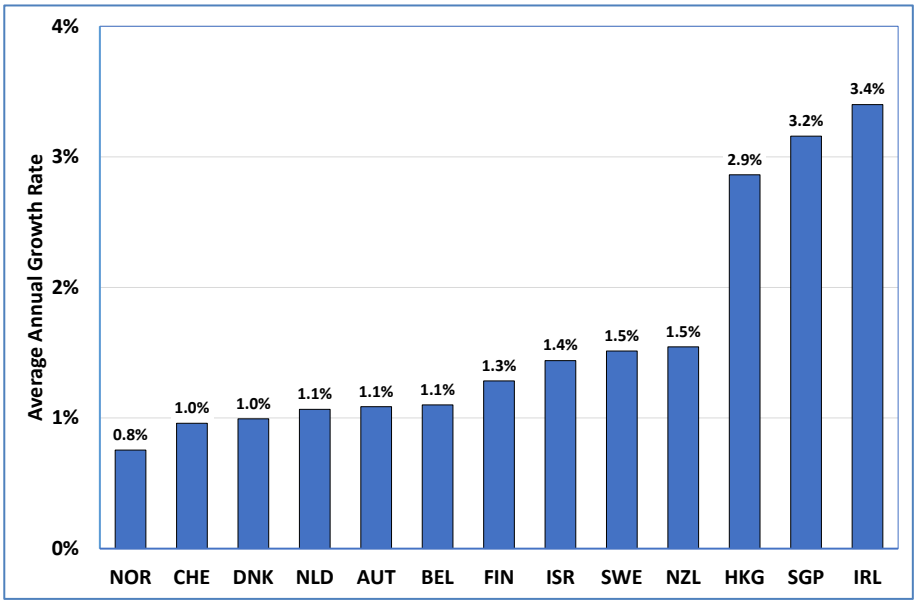

Figure 2. Average Annual Growth in Real Gross Domestic Product Per Capita, Selected Small Advanced Economies, Per Cent, 1999 to 2019.
Source: Authors' calculations from data in Figure 1.

Figure 3 recalculates the data to show a simple comparison between New Zealand and the average performance of the 12 other SAEs. This presentation contrasts the *level* of real GDP per capita for New Zealand with the average of that statistic for the other SAEs. New Zealand's productivity is between 70 per cent and 75 per cent of the average level in the other SAEs over the whole period. The gap of about 30 percentage points is a representative example of the productivity concerns expressed in New Zealand (NZPC, 2021a, p. 1).

Thus, understanding the New Zealand case requires a theory that can explain why two countries might experience similar *growth rates*, but different *levels*, of productivity, without the gap closing over an extended period. As the Nobel Prize Committee (2018, p. 10) explained, the standard neoclassical growth model of Solow (1956) struggles to explain this phenomenon, since it predicts "that *ceteris paribus*, poorer countries should grow faster and catch up with richer ones quite quickly".

Endogenous growth theory introduced by Romer (1986, 1990), however, can explain the pattern in Figure 3, as the following section will describe.

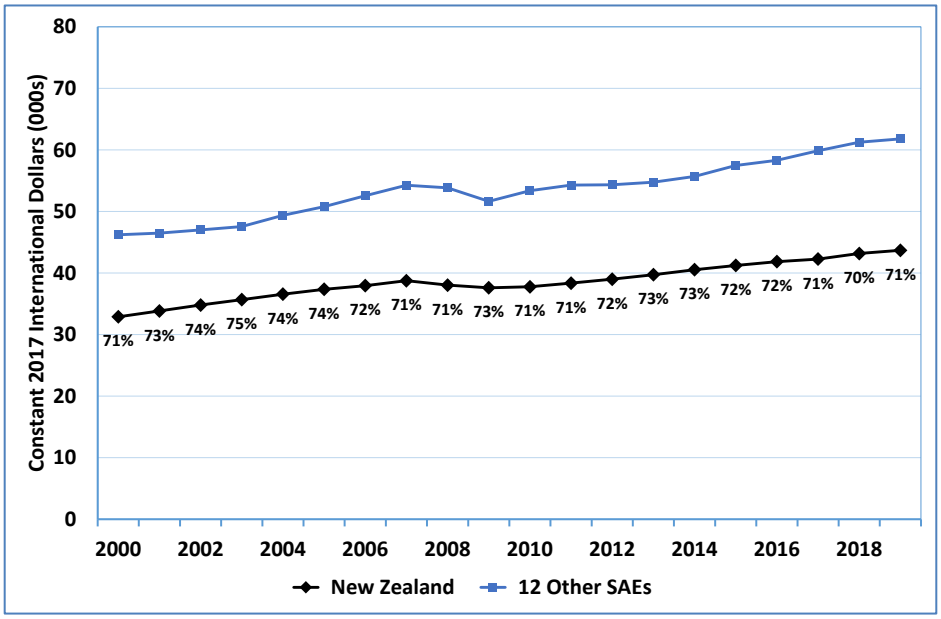

Figure 3. Real Gross Domestic Product Per Capita, New Zealand versus Average of 12 Selected SAEs, Constant 2017 International Dollars, 2000-2019. Source: Authors' calculations from data in Figure 1.

Before moving to that section, it is useful to note that the patterns in Figures 2 and 3 are not confined to comparisons between countries. Distance is an issue within New Zealand (McCann, 2003, p. 12). The distance between Auckland and Christchurch, for example, is similar to the distance between Paris and Berlin. This creates challenges for connections between local innovation systems, and for designing an integrated national innovation system. Nevertheless, Figure 4 presents time series of real GDP per capita from 2000 to 2019 for three New Zealand regions in close proximity to each other. It includes New Zealand's largest regional council by population (Auckland) and its neighbouring regions to the south (Waikato) and to the north (Northland). Despite its geographical proximity, Waikato's level of output per capita has been around 80 per cent of the level in the Auckland region for 20 years. Northland's level has been

around 65 per cent of Auckland's. These data illustrate the general observation that intra-country regions in close proximity to each other can experience different levels of productivity over extended periods.

A large regional science literature has explored endogenous regional development, as part of a wider shift in economics from Solow's neo-classical growth model to Romer's endogenous growth model (Stimson *et al.*, 2011, p. 4; Barca *et al.*, 2012, pp. 134-135). Indeed, the economic geography research used by McCann (2009) is part of the discipline's recognition of knowledge as "a driving endogenous self-reinforcing mechanism for regional development" (Stimson *et al.*, 2011, p. 5). This overlap between national strategies and regional studies is hardly surprising. A small country within the global economy is likely to face similar economic forces as a small region within its national economy. The following section, therefore, introduces endogenous growth theory as a framework for designing an economic strategy for small advanced economies like New Zealand.

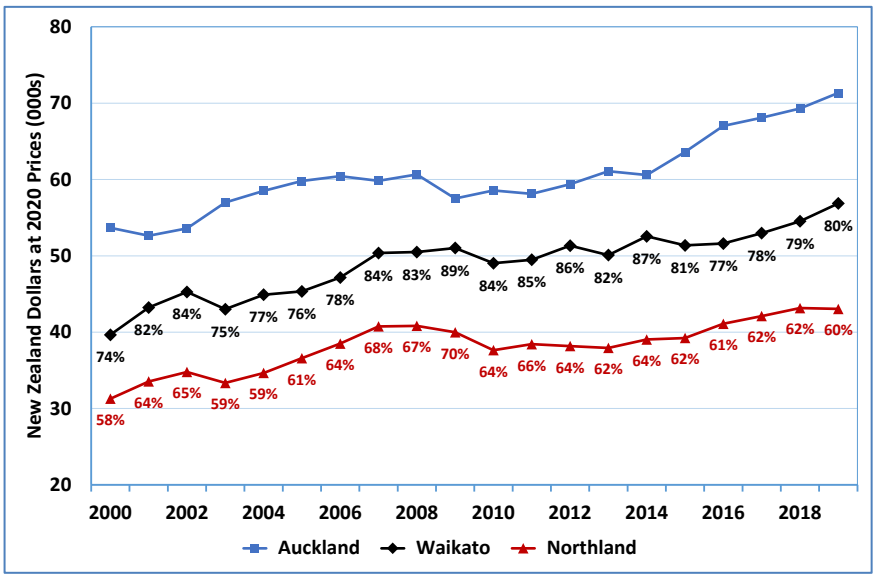

Figure 4. Real Gross Domestic Product Per Capita, Auckland, Waikato, Northland, New Zealand Dollars at 2020 Prices, 2000-2019.
Source: Stats NZ(2021a, 2021b).

3. ENDOGENOUS GROWTH

Endogenous growth theory builds on the neoclassical growth model introduced in Solow (1956), justly described as one of "the most influential and revered articles in economic theory" (McAdam and Allsopp, 2007).[2] A feature of Solow's model is the simplicity of its assumptions, and hence the generality of its theory. Let output be a concave function of labour and physical capital, scaled by the state of technological progress. For convenience only (Solow, 1994, p. 48), let the function be homogeneous of degree 1; that is, it exhibits constant returns to scale. This makes output per unit of labour a concave function of the capital-labour ratio, scaled by current technology. Assume the three exogenous variables increase as follows: the quantity of labour grows at the rate of population growth; the level of capital increases by the share of output devoted to capital goods production; and the state of technology grows at a fixed rate. Solow demonstrated that this model settles on a stable capital-labour ratio in equilibrium, with labour productivity growth at the rate of technological progress.

If all economies can access the current technology frontier, then the model predicts all economies will have the same equilibrium *growth* rate. Further, economies with similar population growth and investment ratios can expect to converge on a similar *level* of labour productivity – an implication known as the conditional convergence hypothesis (Galor, 1996).[3] Consequently, if an economy's per capita income is persistently below that of comparable countries, a plausible diagnosis is that domestic firms are not using up-to-date technologies, or there is some other adverse difference in the domestic country's institutions compared to other countries. This approach to productivity analysis is very influential in New Zealand (McLellan *et al.*, 2004; Drew, 2007; Conway, 2013; Treasury, 2014; OECD, 2017, chapter 1; Tax Working Group, 2018; NZPC, 2021a; and Fabling, 2021). It has produced important policy insights over a long period, although with no obvious improvement in New Zealand's relative productivity performance.

In Solow's model, the state of technology is exogenous, which means there is no need to invest economic resources to achieve technological progress. The passage of time is sufficient for productivity growth. This feature is reflected in projections of national comprehensive wealth that incorporate technological progress by extrapolating historical growth rates in total factor productivity (Arrow *et al.*, 2012; Pezzey *et al.*, 2006; Qasim

et al., 2020). It is also reflected in a comment by the New Zealand Productivity Commission that "lifting productivity is the closest thing to a free lunch there is" (NZPC, 2021b, p. 4). The lack of attention to economic costs of technological progress has implications for national economic strategy. If progress occurs exogenously on the world stage, the key policy issues for a low productivity economy become technology diffusion and resource allocation across firms (Conway, 2018, p. 44; NZPC, 2012b, Figure 22, p. 39). This overlooks the distinctive contributions that a country's public policy can make to enhanced domestic wellbeing by fostering the growth and use of knowledge (Dalziel *et al.*, 2018a, chapter 7).

The endogenous growth theory introduced by Romer (1986, 1990) opened up Solow's exogenous black box (Nobel Prize Committee, 2018, p. 10). In this model, technological progress is due to the creation and utilisation of ideas by knowledge workers engaged in research and development. This includes the creation of new products and services, but also includes new ideas about how to deliver value to customers through innovative marketing and use of emerging technologies.[4] Consequently, productivity growth in Romer's model has an opportunity cost; the knowledge workers are unavailable to participate in supplying goods and services in the neoclassical production function.

Jones (2019, p. 864) summarises three key insights in Romer's model:

1. it identifies the nonrivalry of ideas as crucial to economic growth;
2. it highlights the role of profit-maximizing entrepreneurs and imperfect competition;
3. it places the key AK linearity in the idea production function.

Moving through this list in reverse order, AK linearity refers to models in which creation of new knowledge is assumed proportional to the current stock of knowledge. If knowledge is written as K, and the proportionality parameter as A, then new knowledge is AK. This means the discovery of a new idea today has the positive externality of making possible further new ideas in the future. Romer's model assumed the process of discovery depends directly on the *number* of workers engaged in research and development, but that formulation is no longer accepted (Jones, 1995; Ang and Madsen, 2011). Instead, a second generation of endogenous growth models recognises some wasted effort in creating ideas, so that the effectiveness of research and development diminishes as knowledge workers increase in number. In these models, it is the *proportion* of the workforce engaged in research and development that is important (Young, 1998; Howitt, 1999; Ha and Howitt, 2007).[5]

The second insight comes from recognising that perfect competition has the property that payment to labour and capital at their marginal products exactly equals the value of output. Output price in a perfectly competitive firm equals the average cost of production. Hence, there is no surplus to fund searches for new ideas, and so "a pure perfectly competitive allocation cannot decentralize the optimal allocation of resources, and there is a role for institutions other than basic property rights and the potential for distortionary taxes to improve the allocation of resources" (Jones, 2019, p. 867). The solution in Romer's model is to allow successful innovators to patent new knowledge, or keep it a trade secret, for a period of time. This allows monopolistic profits to reward the entrepreneurial search for new ideas.

Jones argues that the first insight in the above list is Romer's fundamental contribution. Nonrivalry means an idea can be used simultaneously and repeatedly by different people. One person's use of current knowledge does not stop others from using the same knowledge (assuming it is economic for them to do so). This is in sharp contrast with physical objects and embodied services, where potential users compete to use an economic good. The major implication of nonrivalry is that a production function with knowledge as an input has the mathematical property of increasing returns to scale, which is a necessary condition for sustained growth in per capita output. This is why a national economic strategy aimed at sustained growth in living standards must pay attention to knowledge creation and utilisation (Dalziel, 2019a).

Within the discipline of regional science, these insights have been incorporated into theories of endogenous regional growth (Johansson *et al.*, 2001). Stimson *et al*. (2011, p. 6) observe "it is now seen as being crucial for a city or region to fully understand the nature of the geographical patterns of knowledge diffusion and the barriers to access to knowledge as they relate to creativity, innovation and entrepreneurship as being catalysts for employment and wealth generation". Barca *et al*. (2012, p. 149) argue for place-based policies that focus on mechanisms to "promote innovative ideas through the interaction of local and general knowledge and of endogenous and exogenous actors in the design and delivery of public policies"; see also Dalziel (2012) and Pugalis and Gray (2016). Beer *et al*. (2021) reinforce that argument with emphasis on agency-based approaches. Universities can be key actors in regional growth by acting as knowledge network coordinators (McCann and Ortega-Argilés, 2019; see also Dalziel *et al.*, 2009, Varga and Erdös, 2019, and Kempton *et al.*, 2021).

At the national level, a country is simply a region in the global economy. Consequently, lessons from the application of endogenous growth theory in regional science are relevant for designing national economic strategies. Accepting the insights of Romer (1986, 1990), the creation and utilisation of new knowledge is a necessary condition for sustained growth in living standards, but perfectly competitive markets cannot finance this process of innovation. Hence, well-designed public policy can support collaboration between commercial enterprises and knowledge workers with a mission to create and capture the wellbeing benefits that arise from the externalities of new knowledge (Blakeley *et al.*, 2005; Crawford, 2021).

4. MISSION-ORIENTED INNOVATION: A NEW ZEALAND EXAMPLE

Returning for a moment to neoclassical growth theory, if technological progress is modelled as an exogenous process taking place at the global level, then a key issue for policy is how to encourage "productivity-enhancing technologies to diffuse from firms operating at the global productivity frontier to firms operating at the domestic frontier and then to domestic laggards" (Conway, 2018, p. 43; see also OECD, 2015). This is termed innovation behind the frontier (New Zealand Government, 2019a, p. 28). It is reflected in statements such as the following sentence in New Zealand's draft research, science and innovation strategy: "This strategy focuses on how New Zealand can innovate towards the frontier – the leading edge of what the world knows and can do" (Ministry of Business, Innovation and Employment (MBIE), 2019, p. 6).

If, however, technological progress is an endogenous process contributing to growth in a nation's living standards, then a key policy issue is how to foster innovation ecosystems that are effective and focused (NZPC, 2021a, chapters 6 to 8). The New Zealand Productivity Commission has recently concluded that this is a domestic area of weakness (idem, p. 116):[6]

> New Zealand's past and present attempts at focused innovation policy have lacked enough scale, resources and durability to be effective. They have also tended to arise out of government-driven processes, whereas shared design and governance with multiple stakeholders would likely generate greater momentum and make better use of dispersed knowledge and capabilities. International examples demonstrate how governance of well-resourced initiatives can be devolved to independent multiple-stakeholder entities. The Government should take stock of its

current approach and draw lessons from New Zealand and international experience.

Mariana Mazzucato (2018, 2021) labels collaboration by different actors to attain major wellbeing goals as *mission-oriented innovation*. She explains that public policy has a distinctive role to play in fostering this collaboration: "To do this successfully, governments need to invest in their internal capabilities – building the competence and confidence to think boldly, partner with business and civil society, catalyse new forms of collaboration across sectors, and deploy instruments that reward actors willing to engage with the difficulties" (Mazzucato, 2021, p. 206). This section describes an example of mission-oriented innovation, drawing on Saunders (2018, 2019).

From its earliest years as a British colony, food and fibre have made up the largest share of New Zealand exports. In 1883, wool, agricultural produce, frozen meat, butter and cheese accounted for 68.8 per cent of total exports by value (*New Zealand Official Yearbook*, Volume 1, published in 1893). In 2019, the last year before the COVID-19 outbreak, total export revenue from primary industries was $46.4 billion (Ministry for Primary Industries (MPI), 2020a, p. 4), which was 77.5 per cent of total merchandise exports and re-exports of $59.9 billion (Stats NZ, 2021c). Innovations in science and technology have played important roles in the development of New Zealand's food and fibre sectors (Saunders *et al*, 2016a, chapter 3).[7] By the beginning of this century, however, it became increasingly clear that environmental constraints will restrict the ability of New Zealand to continue growing the volume of primary sector production (Callaghan, 2009, p. 10; Hendy and Callaghan, 2013, pp. 199-200).

Consequently, the Agribusiness and Research Unit (AERU) at Lincoln University took the view that New Zealand's economic strategy needed to shift from quantity-based growth to value-added growth (Dalziel and Saunders, 2014, pp. 118-125). This idea came to be expressed in the government's economic plan as an objective for the economy to move from volume to value (New Zealand Government, 2019b, p. 10). Private sector leaders were also promoting that vision. In 2012, for example, John Brakenridge founded the industry movement, Te Hono, with an explicit vision to make the transformation from volume to value. He later wrote, "New Zealand *must* challenge the status quo, blow apart the traditional price-take mentality and move to a market-shaping model, one where we forgo a volume mentality for a value mindset" (Brakenridge, 2016, p. 27).

This requires innovation based on sound knowledge of consumer values in distant markets (Dalziel *et al.*, 2018b).

Creating knowledge of consumer values in distant markets is a major challenge for both the private and public sector. As McCallum and Sharman (2010, p. 5) observe:

> Being on the periphery means that while New Zealand firms have less knowledge of market opportunities than available to competitors close to the centre, government in New Zealand knows commensurately *even less* about the dynamics of the global market than governments in other countries. The lack of a robust information base militates against coordination of effort, as each entity is working off different and probably incomplete data.

Endogenous growth theory offers insights into this problem. Firms operating in perfectly competitive markets do not have the economic resources to fund knowledge development, including knowledge about marketing to distant consumers. The economic externalities that come from the nonrivalry properties of knowledge (in the present and in the future) justify public investment. A mission-oriented innovation approach creates a partnership among science, industry and policy leaders to meet a specific need such as the one identified here.

Further, it is useful to repeat that knowledge is not constrained to producing a new product or service. It includes what some scholars have labelled knowledge-intensive business services (KIBS; see, for example, Muller and Doloreux, 2009) providing knowledge on items such as market trends, price points, consumer preferences, competitor threats, industry dynamics, business models, technological options, management requirements and the like. This is consistent with David Teece's capability theory of the firm, which emphasises the importance of firms developing the dynamic capability of sensing technological opportunities in relationship to consumer needs in order to create knowledge as a foundation for enduring competitive advantage (Teece, 2017, 2019).

Consistent with that approach, the AERU initiated a Sustainable Credence Attributes Pilot Study in 2012. This involved on-line panel surveys of just over 2,000 consumers of lamb products in China, India and the United Kingdom (Tait *et al.*, 2016). A choice experiment in each survey produced willingness-to-pay estimates for lamb products certified for food safety, animal welfare and environmental sustainability. The results demonstrated that consumers in emerging economies can be influenced by food production processes that incorporate environmental sustainability. This evidence suggested science can help New Zealand producers create

greater value for their distant consumers, by delivering knowledge on how to identify and reach international market segments where consumers are willing to pay a premium for New Zealand exports with highly valued credence attributes.

Mission-oriented innovation requires collaboration between industry, policy and science. Following the successful pilot study, the AERU created an Advisory Board of industry and policy representatives, who have met twice a year since the Board's first formal meeting on 1 July 2014. The initial 13 members have grown to 20 by 2021, including the paper's third author, who has participated from the beginning. The Board offers advice and feedback on the science, both during planning and in preparation for dissemination. Working with individual members of the Advisory Board in 2013, the AERU formulated three scientific hypotheses for testing in its first public programme, *Maximising Export Returns* (funded by the Ministry of Business, Innovation and Employment):

> *Hypothesis 1*: Middle-class consumers in different international markets are willing to pay premiums for products acknowledged as having particular credence attributes, with different markets having different understandings and valuations of these credence attributes.
>
> *Hypothesis 2*: Given Hypothesis 1, using tailored credence attributes in different international markets can generate high levels of increased market returns to New Zealand producers and the New Zealand value chain.
>
> *Hypothesis 3*: Given Hypothesis 1 and Hypothesis 2, New Zealand businesses in the biological industries can use modern technologies and can develop key messages that will communicate credence attributes to consumers and gatekeepers in key international markets to capture increased market returns.

This research took place between 2013 and 2016. The list of credence attributes included environmental condition, social responsibility, animal welfare, animal health and traditional cultures. The research team undertook on-line panel surveys of 1,000 middle-class consumers in each of five markets, extended to include Indonesia and Japan (see Dalziel *et al.*, 2018b). Each survey again included a choice experiment to estimate willingness-to-pay for credence attributes. These estimates were used as inputs in the Lincoln Trade and Environment Model (see Saunders and Çağatay, 2004, and Kaye-Blake *et al.*, 2008) to assess potential impacts on New Zealand producer returns. The study concluded (Dalziel *et al.*, 2018b, pp. 498-499):

> Contrary to some views in New Zealand, this research found that consumers in developing countries tend to value credence attributes more than consumers in developed countries, perhaps because of lower trust in the local regulatory environment. The choice experiment and trade modelling analysis shows that meeting this demand for credence attributes could increase producer returns in New Zealand (even if other countries obtained the same premiums for their products), thus providing a reward for responsible innovation in a setting where consumers are distant from producers.

In 2017, the Ministry of Business, Innovation and Employment funded a further five-year programme led by the AERU, called *Unlocking Export Prosperity*. This programme is delivering new knowledge to help build New Zealand's global profile as a quality country-of-origin for high value agri-food products with distinctive physical, credence and cultural attributes. It addresses the science question: How can local enterprises achieve higher returns by ensuring their global consumers understand the distinctive qualities of the physical, credence and cultural attributes of agri-food products made in New Zealand?

The programme is funding 16 consumer surveys in international markets, as well as a three-year time series to monitor consistency over time. Roger Harker (Plant and Food Research) is completing two studies on consumer responses to physical attributes when presented with different claims about credence attributes. John Reid (Ngāi Tahu Research Centre at the University of Canterbury) is leading research on Māori understandings and use of credence attributes associated with food and beverages. Peter Cammock (The Leadership Lab) is leading six case studies of outstanding leaders who have created and captured value from profiling the attributes of agri-food products that are made in New Zealand.

The above programmes provide evidence on potential premiums that can be captured by targeting international market segments that value physical, credence and cultural attributes associated with New Zealand production systems of food and fibres. Distance is an important consideration in creating and capturing greater value from these market segments. In order to increase domestic producer returns, global value chains must be designed and governed that ensure: (1) the values embedded in New Zealand production systems are visible to distant consumers; and (2) the resulting premiums are shared with the domestic producers creating that value. The problem of designing and governing effective value chains over long distances became a key project of the Our Land and Water National Science Challenge (OLW).

Our Land and Water is one of eleven National Science Challenges established by the Government to tackle New Zealand's biggest science-based issues and opportunities. Thus, each Challenge aims to achieve mission-orientated innovation. The mission of OLW is "to preserve the most fundamental treasures of Aotearoa – its land and water – while producing value from those same treasures" (https://ourlandandwater.nz/). This means, among other things, ensuring that New Zealand's primary producers are rewarded for producing high-value products in sustainable ways. Consequently, OLW commissioned a white paper on how global value chains can share value and incentivise land use practices (Saunders *et al.*, 2016b). That white paper was accepted by the AERU Advisory Board, and was further tested in a national workshop of research providers and end users hosted by OLW on 29 September 2016.

Following that validation, OLW has funded two sequential research programmes called *Integrating Value Chains* (2017-2019) and *Rewarding Sustainable Practices* (2019-2022). The first programme involved five case studies of *existing* agri-food value chains to identify characteristics of successful governance (Dalziel, 2019b, Table 1, drawing on McIntyre *et al.*, 2019). It also undertook two consumer studies in California and two consumer studies in Shanghai (see, for example, Tait *et al.*, 2019). The second programme involves four case studies of *emerging* agri-food value chains, in order to test the validity of the findings from the first programme against the possibility of survivor bias. The results of this research, and a summary of all nine case studies (five of which involve Māori-owned enterprises) are scheduled to be published by June 2022.

Table 1 lists the five research programmes in this mission-oriented innovation project. It is a substantial investment of time (ten years) and financial resources (total public funding for the programmes is NZ$8.7 million). Consequently, the research teams have sought to make its research as accessible as possible to end users. All reports are published on-line under a Creative Commons Attribution 3.0 New Zealand licence. A short Research Update is sent regularly to an email distribution list maintained for that purpose. The AERU created an on-line consumer data portal where users can freely access anonymous data from the international surveys with some capacity to select respondents by characteristics such as age, education and income. Researchers have accepted invitations to speak to industry and policy groups, and to present at relevant conferences. They participate in preparing articles and interviews for print and digital media. They serve on advisory groups, working parties, official committees and

commercial boards to provide their expertise to initiatives promoting the vision of the programmes.

Table 1. Five Research Programmes, with their Dates, Funders and Research Team. Source: the Authors.

Name	Years	Funder	Research Team
Sustainable Credence Attributes Pilot Study	2012	AERU	AERU.
Maximising Export Returns	2013-2016	MBIE	AERU; Landcare Research; Lincoln University; The Agribusiness Group.
Unlocking Export Prosperity	2017-2022	MBIE	AERU; Plant and Food Research; The Leadership Lab.
Integrating Value Chains	2017-2019	OLW	AERU; GNS Science; J D Reid Ltd; PWC New Zealand; Massey University; Scion; The Agribusiness Group; Thought Strategy Ltd; University of Auckland.
Rewarding Sustainable Practices	2019-2022	OLW	AERU; J D Reid Ltd; SCION.
Notes: MBIE is Ministry of Business, Innovation and Employment; OLW is the Our Land and Water National Science Challenge; AERU is Agribusiness and Economics Research Unit at Lincoln University.			

Two examples illustrate the importance of engagement with end-users to achieve impact. In early 2016, Beef+Lamb New Zealand (B+LNZ) invited the AERU to assist in creating a country-of-origin brand. This paper's first author presented to the first stakeholder meeting on 4 May 2016, and was subsequently invited to be a member of the B+LNZ Economics and Insight Advisory Board, which meets quarterly. The second author attended the second stakeholder meeting on 31 August 2017. B+LNZ then commissioned the AERU to deliver six surveys of target markets in the United States and China, using the methodology developed in the research programmes. Based on this and other work undertaken by B+LNZ, a proposal was put to levy payers to increase levy payments by $4.1 million, of which $2.7 million was earmarked for investment in the Taste Pure Nature country-of-origin brand. The brand was launched in California in March 2019, and in China in May 2020.

In April 2018, the Minister of Agriculture established the Primary Sector Council (PSC) to advise on issues, opportunities and challenges facing the primary industries. A major task was to prepare a sector-wide vision for New Zealand food and fibres. The PSC approached the AERU to prepare a situational analysis for the sector, drawing on research in the above programmes. The AERU report was finalised in 2018 (Dalziel *et al.*, 2018c). This was the only report commissioned by the PSC before the

Prime Minister launched its vision, *Fit for a Better World*, at Lincoln University in December 2019. That vision was explored further in two reports the following year (Primary Sector Council, 2020, and Howard *et al.*, 2020). All of that work then fed into the Government's 2020 roadmap for accelerating the potential of the primary sector, with the food and fibres sector anticipated to be at the forefront of New Zealand's export-led recovery following the COVID-19 crisis (MPI, 2020b).

Following these and other engagement successes, the OLW National Science Challenge selected the *Rewarding Sustainable Practices* programme to pilot efforts for amplified impact from the Challenge's mission-oriented innovation. OLW commissioned KPMG to report on how to increase science engagement with Māori enterprises, corporate small to medium-sized enterprises (SMEs), farmer grower SMEs, large enterprises, and industry bodies (Keeys *et al.*, 2020). OLW has commissioned a specialist in science communication to assist the research team implement key messages from that report over the remainder of the programme, with an initial focus on engagement with SMEs.

5. CONCLUSION

This paper began with the longstanding concern among New Zealand policy advisors that the country's labour productivity level has languished below that of other small advanced economies. The paper's introduction acknowledged the widely accepted diagnosis that an important contributor is New Zealand's unique distance from large, high-income markets, but did not agree with the optimism of analysts who have argued that New Zealand can do better since geography is not destiny (Skilling, 2001; Treasury, 2014; NZPC, 2021a). Instead, the paper agrees with McCann (2009) that the country's inherited structural features do not suggest New Zealand ought to be a relatively high productivity economy. Regional disparities in productivity performance can be sustained for long periods. Indeed, section 2 presented New Zealand regional data from Northland, Auckland and Waikato to illustrate that even regions in close proximity to each other can experience persistent gaps in levels of per capita gross domestic product.

Consequently, section 3 of the paper introduced endogenous growth theory (Romer, 1986, 1990, 1994) as a useful framework for understanding the phenomenon of persistent productivity gaps. Following the assessment of Jones (2019), the fundamental contribution of that theory is its insight

that the non-rival property of knowledge means knowledge as an input of production can sustain increasing returns to scale, which is a necessary condition for sustained growth in per capita output. This theory has been incorporated into theories of endogenous regional growth, but is also important for designers of national economic strategy. Consistent with that argument, section 4 drew on the concept of mission-oriented innovation (Mazzucato, 2018, 2021) to introduce a New Zealand research programme that has contributed to creating and capturing greater value from food and fibre exports.

The lesson from that research programme is that New Zealand is able to look to its own domestic capabilities for mission-oriented innovation. Of course, local innovation draws on the global stock of knowledge, but searching for relevant and reliable knowledge is itself a costly process (Dalziel, 2019a). There is no free lunch in achieving productivity growth. Further, endogenous growth theory explains that firms in perfect competition do not have a financial surplus to fund searches for new knowledge. This provides a rationale for well-designed public policy to fund programmes that create and disseminate reliable knowledge for private sector firms to utilise, which requires governments to invest in their internal capabilities for fostering innovation (Mazzucato, 2021, p. 206). The authors suggest this is important for all small advanced economies, but particularly for the small advanced economy that is the most distant from the world's largest markets.

Notes

[1] Gary Hawke had noted this feature in his authoritative economic history of the country: "If the world is divided into two hemispheres so as to have as much land as possible in one and as little as possible in the other, then New Zealand would be almost in the centre of the latter" (Hawke, 1985, p. 2).

[2] As Solow (2007, p. 3) acknowledges, an article published independently by Trevor Swan (1956) contained "the essentials of the basic neoclassical model of economic growth".

[3] The neoclassical growth literature has identified other important parameters influencing productivity levels, most notably the level of human capital embodied in labour through investments in education (Mankiw *et al.*, 1992) and health (Knowles and Owen, 1995). Note that factor mobility tends to equalise capital-labour ratios, promoting levels

convergence, at least in theory (Lucas, 1988, pp. 16-17). Some versions of the neoclassical growth model exhibit multiple equilibria, however, so that initial endowments can result in different 'clubs' among economies (Galor, 1996).

[4] MBIE (2013, p. 100), for example, quotes a venture capitalist from the United States who had been invited to visit New Zealand high tech businesses. He praised the product innovation taking place, but warned 'you've got no idea how to take this to market'.

[5] Jones (2019, p. 879) concludes that "the shape of the idea production function remains an intriguing subject of study". For readers interested in the mathematics of endogenous growth theory, Jones and Vollrath (2013) is a good textbook.

[6] Hendy and Callaghan (2013) came to similar conclusions nearly a decade earlier.

[7] James Belich argues that 'recolonisation' links between Britain and New Zealand was an important part of this history, "to the point where 12,000 miles of distance were transcended and New Zealand became in many respects a virtual Scotland" (Belich, 2001, p. 11).

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