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email: econz@otago.ac.nz

A MAGAZINE ABOUT CONTEMPORARY ECONOMIC ISSUES FOR EVERYONE

FROM THE EDITOR

The first issue of *EcoNZ@Otago* was released in July 1998. Since then, bi-annual editions of this contemporary issues magazine have reached out to New Zealand students, professionals and policymakers to expose them to the problems that we economists investigate in our research. While my team of industrious contributors continues to work on bringing these issues to you, I have decided to celebrate the 30th issue of *EcoNZ@Otago* by making this edition 'Editor's Choice': a compilation of thought-provoking topics that have landed on my desk since I took up the post in 2009. The articles that appear are written in the same short-but-sweet style as the *Highlights* (short commentaries on economic matters) I write for *EcoNZ@Otago*. We will return to the usual format in issue #31.

To request previous issues of *EcoNZ@Otago* please contact us at the address below or visit us online at www.business.otago.ac.nz/econ/econz. The Department of Economics at Otago University is now on Facebook. Search for us at www.facebook.com and get connected!

DAN FARHAT
EcoNZ@Otago
University of Otago – Department of Economics
PO Box 56
Dunedin 9054
econz@otago.ac.nz

IN THIS ISSUE

The rise and fall of 'economics'

Can we quantify popularity? These days, yes we can. Advances in the digitisation of information have allowed us to create massive databanks capable of recording our language and ideas as they evolve over time. This data collection, which represents the human experience, is being used by researchers to examine culture and society quantitatively. This field of study is known as *culturomics*.

In 2010, a group of researchers from Harvard University and MIT teamed up with Google, Houghton Mifflin Harcourt and Encyclopedia Britannica to construct a searchable database of digitised books: the Google Books Ngram Viewer (books.google.com/ngrams). The database consists of 8 million texts (about 6% of all books ever printed) and contains close to 500 billion words (and that's just the English ones). Users can search for keywords (or n-grams – combinations of n numbers of words) to see how often those terms appear in the database in each year (1800 – 2008). The data are plotted relative to the total number of congruent n-grams appearing in each year recorded by the database. For example, suppose you were to search for the 3-gram "in the city" with the hopes of finding out how popular this phrase was in 1913.

The Ngram Viewer will produce the number 0.0021%, meaning that of all the 3-grams recorded in the database from books published in 1913, the number of references to "in the city" comprises 0.0021% of them. Use of this phrase slumped significantly after 1913, reaching a low of 0.0012% in 1956. Mild resurgences occured from 1960 to 1971 (to 0.0014%), then again from 1985 until 2008 (to 0.0013%), but "in the city" never returned to its former glory.

By identifying trends in grammar and language, this tool can provide insights into what occupied the minds of humanity (as represented by writers) over time. Figure 1 appears if you search for the term 'war' in the Ngram Viewer. Distinct peaks occur in 1761, 1779, 1918, and 1944. These four dates roughly correspond to four large-scale conflicts (the Seven Years War, 1756–63; the American Revolution, 1775–83; World War I, 1914–18; and World War II, 1939–45). This indicates that authors (unsurprisingly) tend to use the word 'war' more often during times of war. Given this tendency, Figure 1 raises interesting questions. What spurred the marked increase in 'war' usage from 1700 to 1760? Why was usage so stable from 1790 to 1910 despite several wars occuring during this period? These are topics that researchers can investigate in further analyses.

If you search for the term 'economics' in the Ngram Viewer, Figure 2 appears. Figure 3 appears if you search for the three core fields within the economics discipline: 'microeconomics', 'macroeconomics' and 'econometrics'. The trends show that 'economics', in general, experienced dramatic growth in popularity from 1880 onwards, through WW1 and the Great Depression. Economics lost its edge during WW2, perhaps due to the effect that the war had on the availability of paper (and authors). In the post-war era, its fame grew at a mild rate until the early 1990s. In the core subjects, authors tended to prefer writing texts devoted to macroeconomic topics (and preferred microeconomics the least). Note, however, that this is a relatively recent phenomenon – it was econometrics that dominated from 1945 to 1980.

Currently, we seem to be in the midst of an 'economics' depression: the share of 1-grams recently devoted to 'economics' has been falling (with similar trends for 'microeconomics', 'macroeconomics' and 'econometrics'). Before becoming too concerned, it should be noted that similar trends emerge in other fields (see Figure 4 for a comparison of select disciplines). This may be due to shifts in popular writing towards fiction. The curious reader can visit the Ngram Viewer and compare 'economics' with 'witches', 'zombies' and 'vampires'. For the moment we seem to be holding our own, but use of these terms is on the rise. It is also possible that economics publishing has shifted away from books and towards journals and online media (a practice other disciplines have followed as well, which perhaps explains the trends shown in Figure 4).

Nonetheless, with easy access to this type of data, we can better evaluate whether our discipline continues to captivate audiences. Although the Ngram Viewer represents only a small fraction of the types of media that economists interact with, it points to further work in a new field: the Culturomics of Economics.

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Figure 1 – Google Books Ngram Viewer Search: 'war', 1700 – 2008

Figure 2 – Google Books Ngram Viewer Search for 'economics', 1880 – 2008

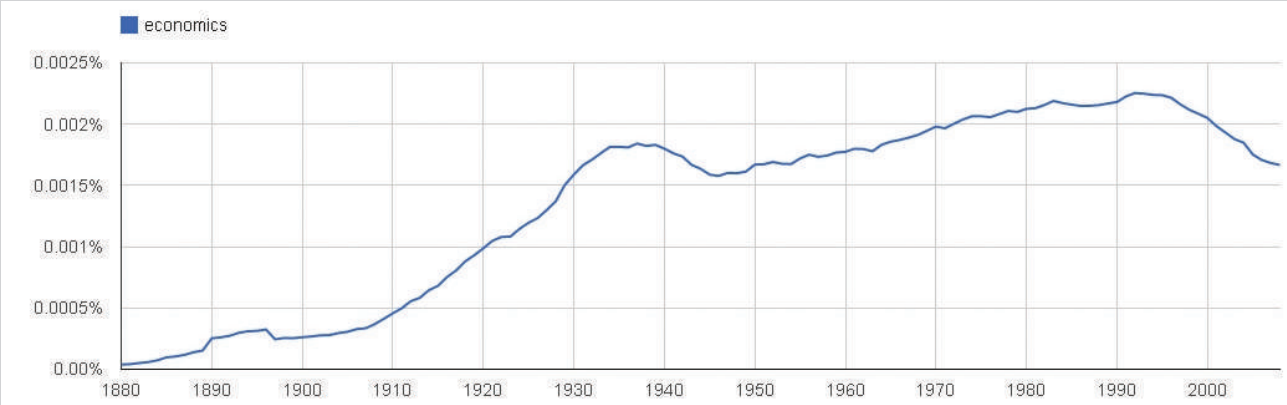


Figure 3 – Google Books Ngram Viewer Search for 'microeconomics', 'macroeconomics', and 'econometrics', 1920 – 2008

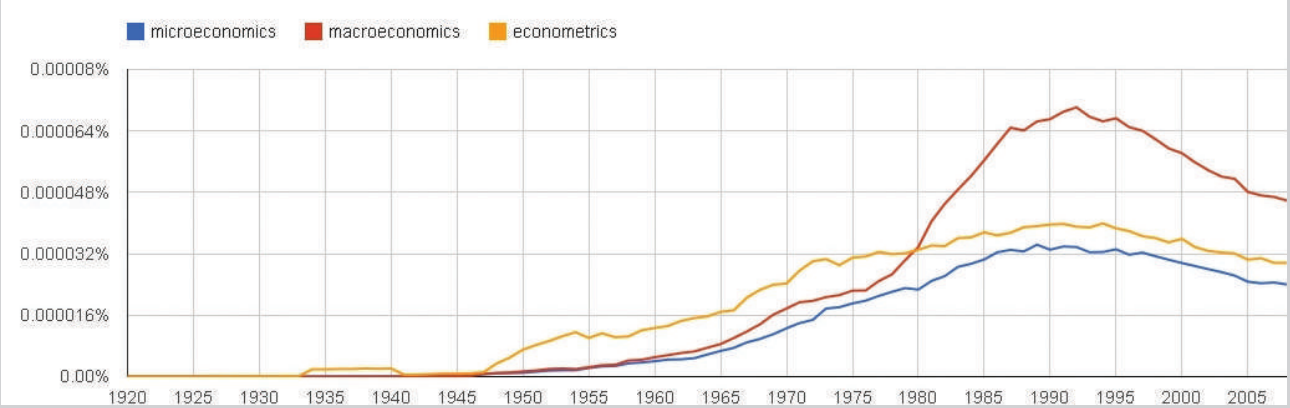
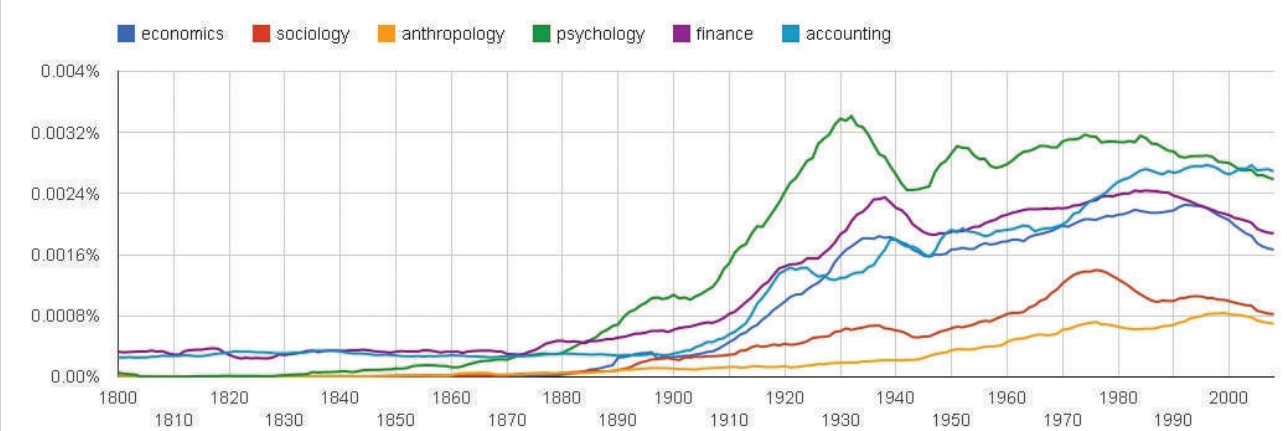


Figure 4 – Google Trends Search Volume for 'economics, 'sociology', 'anthropology', 'psychology', 'finance', 'accounting', Monthly Averages, 2004 – 2012



Sources: Google Ngram Viewer (http://books.google.com/ngrams)

Who wants to be a criminal?

'The market for crime' has been studied since the time of Adam Smith. Renewed interest in the subject emerged in the 1960s as economists began to use modern economic theory to explain criminal activity (see Becker (1968) for the earliest example). At the time, it was unpopular to use such an approach to address social ills. Issues related to public safety were generally left in the hands of criminologists, psychologists and sociologists. An economic approach, however, can generate interesting and unique ideas about the *supply* of criminal activity. Many of these ideas are relevant to policymakers.

In economic theory, people are assumed to make rational decisions. An activity is undertaken only if its benefits outweigh its costs. For bandits, the benefit of a crime is its *expected payoff* (or potential loot, L). This depends on the amount of money a victim carries (in the case of robbery), the type of valuables in a house or car (in the case of theft and burglary), the price of narcotics (in the case of drug trafficking) or the amount of wealth that can be extracted from a mark (in the case of fraud). The costs of committing a crime can be quite considerable. First, criminals must forego the income they could have earned from legal employment (W). They must also acquire the necessary inputs (I) for the misdeed (guns, knives, drugs, etc.). If they are caught, they must pay prescribed penalties (C) which include set legal fees and prison terms. Denoting the probability of being caught as p, the expected net payoff from crime can be easily computed as: L – W – I – p x C. If the expected net payoff is negative, it is simply not worth the effort to commit the crime. Several implications arising from this equation can be evaluated using data.

First, those with the potential to earn low legal incomes should be more likely to commit crime. In a 2001 survey of prison inmates conducted by the New Zealand Department of Corrections (NZDC), 77% of respondents left school with no qualification. Because educational attainment tends to be positively related to employment and earnings, this group of individuals would earn low wages in legal markets. Additional crime data from Statistics New Zealand coupled with statistics on real minimum wages also support the predicted relationship between income and crime rates. The minimum wage is the lowest legal wage that can be earned in the economy. Those deciding whether or not to supplement their income through illegal means likely face a legal wage close to the minimum wage. As economists would predict, per-capita instances of unlawful entry, theft, fraud, and drug trafficking do fall as real earnings for minimum-wage workers rise (see Figure 1).[1]

Although these statistics imply that 'rational criminals' do respond to changes in lawful income, other data refute it. For example, the survey by NZDC showed that only 4% of prison inmates are women. Women traditionally earn less than men in legal labour markets, so why don't more women turn to crime?[2] Further, the data in Figure 1 show that robberies per capita rise with real minimum wages. Robbery differs from theft, burglary and fraud in that it involves a threat of violence (e.g. armed robbery). Why would there be more robberies but fewer other types of felonies when incomes for low-wage earners rise?

Second, the expected net payoff formula, L – W – I – p x C, suggests that a rise in either the probability of getting caught (p) or the penalty from conviction (C) should deter the rational criminal from crime. One intriguing way to assess this implication is to look at the age of first offence for apprehended criminals. Judges are typically lenient with young first offenders, doling out harsher penalties for older lawbreakers. The rational criminal should take his or her age into account when considering whether or not to enter the crime market; younger individuals should enter more often. This reasoning is supported by the NZDC survey, which shows that 49.6% of inmates were aged 17-19 when they committed their first crime.

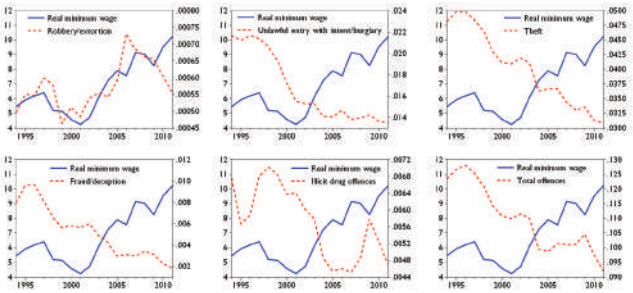


Figure 1 – Real minimum wages (US$, PPP) [left scale] and New Zealand crimes per capita [right scale], 1994-2001.

Sources: StatsNZ (2012), OECD (2012)

All crime-deterring policies can be expensive to implement and determining how much to invest in crime control can be tricky. Appealing to the rational side of would-be criminals plays a relevant role in many of the policies currently being implemented. Most policies focus on the relationship between criminal activities, the risks of apprehension and the penalties of conviction. Some policies aim to reduce the availability of tools used in crimes (e.g. gun control). Other programmes focus on raising the potential lawful income of would-be criminals (e.g. job placement or training programmes). Are there other ways of changing the decisions of criminals inspired by economic thinking? Work is ongoing.

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[1] Of course, there are dangers associated with simple bivariate comparisons. Although raw data support the economist's way of thinking, more rigorous analysis is needed.

[2] This argument is fairly weak. Note that respondents to the survey were already incarcerated. Women may commit more crime than men, but are just better at not getting caught.

Zapped by the Death Star

On January 17th 2001, a series of rolling blackouts hit Northern California. Some economists explained these electricity disruptions as the unintended product of a mixture of policies designed to improve competition in the electricity market. Energy production requires extraordinary fixed costs and a series of network investments. Because it is inefficient for a large number of companies to make such investments, many US states have allowed just a few electricity companies to hold monopolies in local areas (known as *natural monopolies*). These companies are tightly regulated by the state to ensure that everyone gets the electricity they need at a fair price. Managing public monopolies, however, can be complicated and expensive. In the late 1990s, California decided to end this practice and allowed the free market to take over.

To deregulate the energy market, California required previously-regulated producers to sell off the majority of their power generation facilities to independent owners – a process known as *divestiture*. These companies maintained ownership of the power lines and continued to supply energy to homes and businesses, but purchased the electricity from a newly created 'spot market' instead of producing it themselves. Knowing that distributors (the *demanders* in the spot market) were required to satisfy customer demand, new power plant owners (the *suppliers* to the spot market) discovered that they could cut energy production to raise spot market prices for wholesale electricity. Since the government continued to fix the price of electricity sold to consumers, distributors incurred huge financial losses. Many commentators believed that the rolling blackouts which occurred in Northern California were an attempt by energy distributors to mitigate the operating losses resulting from curbed energy production.[1] However, a much more sinister cause of these energy interruptions lurks within the operational structure of electricity markets.

Electricity is not a good that can be produced and then stored for use later. Once it is generated, electricity flows through the transmission network to the place where it is needed. Because the transmission network has specific capacity constraints, companies must schedule energy transmissions in advance to prevent overloading the system and damaging the network. In California, these schedules are maintained by the Independent System Operator (ISO) which uses a computer program (called CONG) to monitor congestion in the network. Congestion is avoided using a congestion fee system. When congestion appears imminent, the program calculates an appropriate level of payments to make to generators to encourage them to adjust their scheduled transmissions. Note that these fees are calculated and paid based on *schedules* and not on actual transfers of electricity. In other words, if an electricity producer schedules an energy transmission during a busy period, the ISO may offer them a payment to cut back. If the system appears to be overloading in spite of this mechanism, operators will order temporary blackouts.

In late 2000, the Enron Corporation manipulated the California ISO's scheduling regime using a strategy known as 'Death Star'. By over-scheduling transmission time, they created artificial congestion over critical power connections within California (Path 15, which links Northern California and Southern California) and between California and Oregon (the California-Oregon intertie). The ISO's automated program issued congestion payments to induce Enron and its counterparties to reduce this imaginary schedule. From this strategy, Enron extracted profits from the ISO while simultaneously elevating electricity prices across the state.

Is there evidence of this manipulation? The rolling blackouts of January 17th were linked to the inability of the ISO to transfer energy from Southern California to Northern California along Path 15 because of high congestion. But did this congestion actually exist? Although data on actual transmissions across Path 15 are unavailable, data for the California-Oregon intertie show below-capacity usage on January 17th. This suggests that energy inflows at the time of the electricity shortage could have occurred (i.e. California could have imported energy from Oregon to avoid the blackouts), but the ISO was unable to schedule them due to 'phantom' congestion. Although the deregulation process was ultimately to blame for the 2001 California Energy Crisis, the institutional structure of the electricity market played a pivotal role in its 'dark side'.

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[1] Reduced production occurred both from market manipulation by energy producers and from an unusually dry summer. A large amount of electricity in California is produced by hydroelectric power plants which are sensitive to drought conditions.

Little orphan antidote

Producing pharmaceuticals is expensive and time-consuming. In 2010, members of the Pharmaceutical Research and Manufacturers of America (PhRMA), a consortium of leading drug producers in the US, spent US$ 50.7 billion on research and development of new therapies. For a single drug, the R&D process takes on average 10 – 15 years: 3 – 6 years for drug discovery and preclinical tests, 6 – 7 years for clinical trials, and 1 – 2 years for review by the US Food and Drug Administration (FDA). Luckily, because most people place a high value on their health, revenues earned from new pharmaceuticals often more than offset their production costs (in 2010, PhRMA members earned US$ 291.2 billion in sales). However, if a disease is exceedingly uncommon (fewer than 5 cases per 10,000 people in Europe, fewer than 7 cases per 10,000 people in the US, fewer than 2.5 cases per 10,000 people in Japan), manufacturers of treatments cannot easily recoup their R&D costs through sales. As a result, there is little incentive for firms to develop drugs that treat very rare conditions. Such pharmaceuticals are known as *orphan drugs*.

A variety of economic and ethics issues are tied to the production and sale of orphan drugs. Most countries put patient care first and have enacted policies that provide financial assistance to firms developing treatments for rare conditions. One such policy in the United States, the 1983 US Orphan Drug Act, resulted in 1,892 orphan drug designations being granted by the US FDA with 326 drugs approved over a 25 year period (1983 – 2008). A similar policy implemented in Europe in 2000 resulted in 805 designations and 61 authorisations by 2011. These policies grant the manufacturer sole proprietorship *(a monopoly)* over a commodity that consumers highly value. Hence, the retail price of these drugs is often quite high.

There are several economic arguments as to why using taxpayer dollars to fund the development of orphan drugs may be wasteful. First, it is not easy to prove that new drugs created to treat rare conditions are more effective than existing therapies. The number of people with such conditions is so small that it is difficult to perform thorough clinical trials. Also, there is an opportunity cost to spending R&D dollars on orphan drug research: spending R&D dollars on cures for widespread illnesses. Transferring $1 of R&D funding from orphan drug development to treatments for frequently-occurring conditions may harm a very small number of patients with rare diseases, but could benefit a large number of patients with common ones. A similar argument exists for providing reimbursements to hospitals and patients who could not otherwise afford medicines for rare diseases: by supplementing the large expenses for orphan drugs (which may or may not be effective), less support is available for patients with common afflictions.

Persuasive counterarguments (both economic and ethical) exist. Many orphan drugs treat life-threatening illnesses for which there is no alternative treatment. Even if the drug offers only temporary or very mild easing of symptoms, the quality of life for a patient might be substantially improved compared to no treatment. Patients with common ailments may have many alternatives to choose from. Hence, $1 of R&D funding for orphan drug development might greatly benefit a very small number, whereas $1 of R&D funding for widespread illness may provide only meagre benefits for the masses. The opportunity cost of making orphan drugs more affordable to patients (by funding reimbursements) is also not severe. ***Total*** spending on treating rare diseases is miniscule (even if the cost of a single treatment is extremely high) compared to overall spending on medical care since there are so few sufferers.

The justifications for supporting orphan drug research and offsetting the costs of supplying them to patients are persuasive enough to drive policy in the US and Europe. It just goes to show that you can't put a price on good health.

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A picture is worth a thousand words

The funding for academic research frequently comes from public sources. As a result, scientists in many disciplines often want to engage the public and encourage them to participate in academic discussions (so they know their money is well-spent). Reaching out to the community is easier now than ever before, thanks in no small part to the internet. In 2011, it was estimated that approximately 35% of the global population had online access (up from just 18% in 2006) to the vast amount of information that has been created or replicated digitally (= 1.8 zettabytes, or 1.8 trillion gigabytes, in that same year). However, effectively communicating research outcomes to an increasingly diverse population is difficult. Gaps in the public's scientific knowledge become more common as audience diversity rises. Also, attention spans shorten as the amount of new information to explore increases. As a result, scientists must be 'short-and-sweet' to get their messages across.

Many scientists (including economists) rely heavily on empirical analysis in their research. Overwhelming the public with statistics can be a big turn-off. Journalists (and others) have found a way to make empirics more appealing: the information graphic, or *infographic*. Infographics combine data with visual appeal (via artwork and design). In doing so, scientists can take advantage of a variety of 'mental shortcuts' used by the general public to identify patterns, to assign meaning to information, and to retain knowledge.

Visualisations contain particular characteristics, known as *preattentive attributes*, which the human brain can interpret very quickly. Colour, for example, can be used to draw attention or isolate outliers (see Figure 1). Colour can also transmit meaning. Think of the daily weather map as an example: cool regions are coloured blue and warm regions are coloured red. As people associate these colours with cold and hot temperature, viewers can get a sense of what the weather will be like by just looking at the map and not noticing the exact temperatures. Size and placement can be used to establish significance, with larger, central, and forward objects indicating more importance (see Figure 2). Symbols can be used to form visual narratives or metaphors which can give viewers hints as to the meaning behind the images (see Figure 3). By combining visual elements with textual explanations, meaningful and memorable messages can be disseminated faster than with text alone.

Infographics have been around for some time – as far back as cave paintings, in fact. Today, the sort of infographics that convey research findings frequently appear in magazines and newspapers such as *The Economist, Popular Science, NewsWeek, USAToday* and *The Wall Street Journal*. Some of the most interesting and visually impressive infographics are available online, where there are fewer limitations to their physical size and scope. Often, these are produced by laypeople who compile the information and design the graphic out of personal interest in the subject matter. General interest readers can look at www.dailyinfographic.com or www.graphs.net for examples, while those interested in economics can see the imagery that *The Economist* has to offer at www.economist.com/blogs/graphicdetail.

As presenting information visually becomes more commonplace, issues related to semiotics (the study of what symbols mean) and ethics emerge: are people interpreting the images correctly, and do the researcher's aesthetic choices in presenting their work affect its underlying value? Though these questions are up for debate, I've decided to try my hand at creating an infographic (see the following pages). If presenting data in this fashion can convey ideas more efficiently to a larger and increasingly diverse population, perhaps it is worthwhile to learn how to produce them sooner rather than later.

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Figure 1
Find the sad face

Figure 2
Which element matters most?

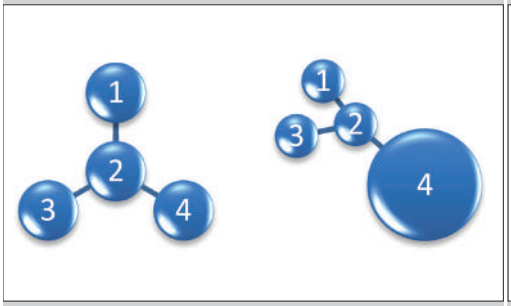


Figure 3
What is represented

The Economics Career Path

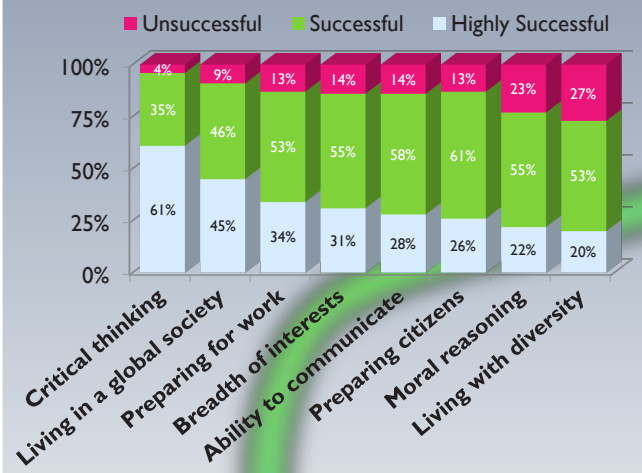
High School

Young would-be economists emerge from secondary schools after learning a bit about the Economics major from university websites (see the University of Otago Department of Economics website at www.business.otago.ac.nz/econ) or elsewhere online (like NoMajorDrama.co.nz). Taking economics classes in high school is beneficial, but not required for success in Economics at university.

University

The Economics major provides an excellent liberal arts education which benefits graduates both personally and professionally. At university, young economists learn what they need not only to survive in a changing business environment, but also for global citizenship.

How Economics Contributes to the Goals of a Liberal Arts Education?[3]



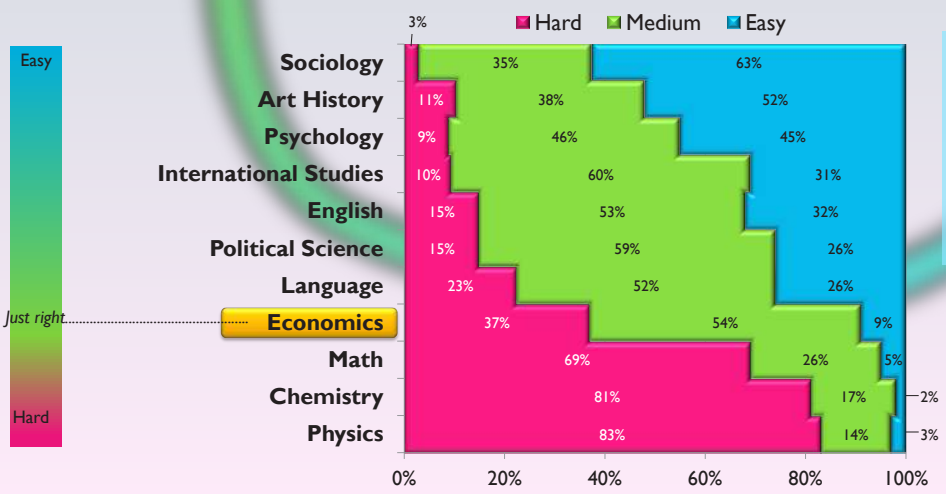
Something for Everyone

A variety of topics within the economics discipline means there is always an appealing paper on offer. Fields include:

- Agricultural Economics
- Behavioural Economics
- Computational Economics
- Decision Analysis
- Development Economics
- Econometrics
- Economic Growth
- Economic History
- Economic Methodology
- Energy Economics
- Health Economics
- International Macroeconomics
- International Trade
- Labour Economics
- Macroeconomics
- Microeconomics
- Money and Banking
- Natural Resource Economics
- Political Economy
- Population Economics
- Sports Economics
- Urban and Regional Economics

and more...

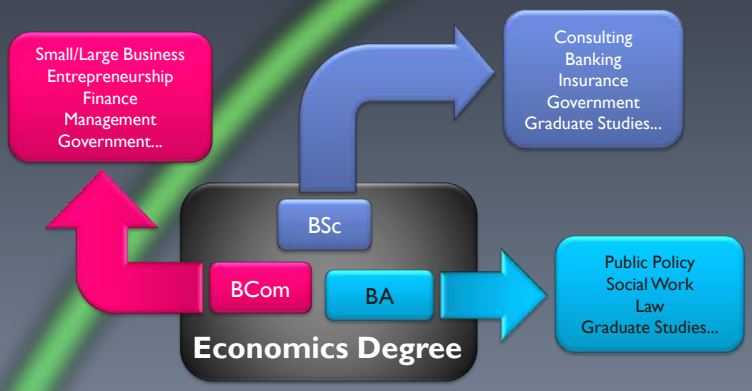
How Difficult is the Economics Major?[3]



Economics coursework balances conceptual and analytical thinking. Students learn important economic vocabulary, history and ideas, but also the tools needed to undertake economic research (including model-making and statistical analysis).

Employment

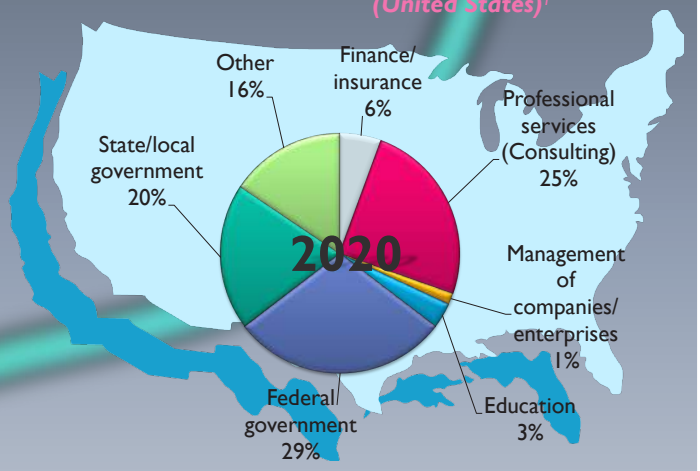
Using the Economics Degree



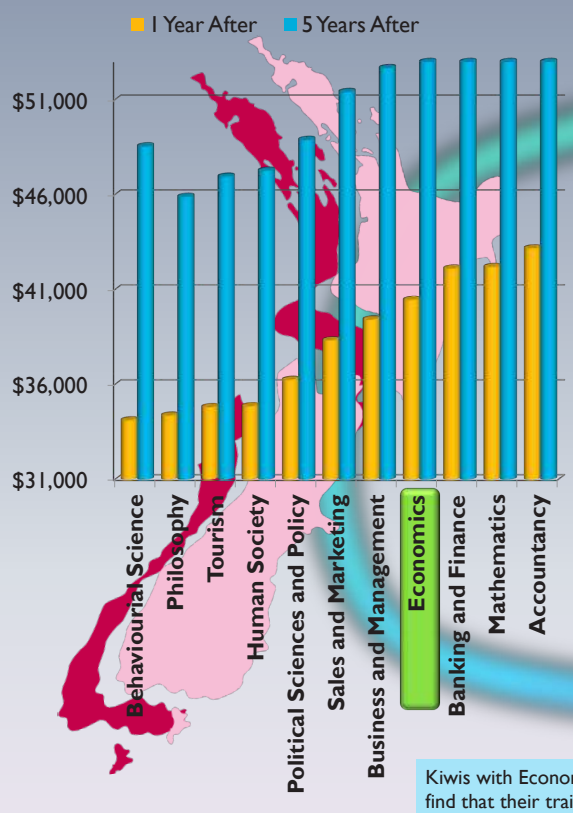
New graduates successfully fend for themselves after university. Many find jobs in the public sector, but a growing number are exploring private opportunities. A recent survey[3] of American Economics students in their final year of study suggested:

- 43% expect to work in business
- 10% expect to work for the government or a NPO
- 14% intend to go to professional school (LAW/MBA)
- 11% intend to pursue graduate studies in Economics

2020 Projected Employment by Industry (United States)[1]

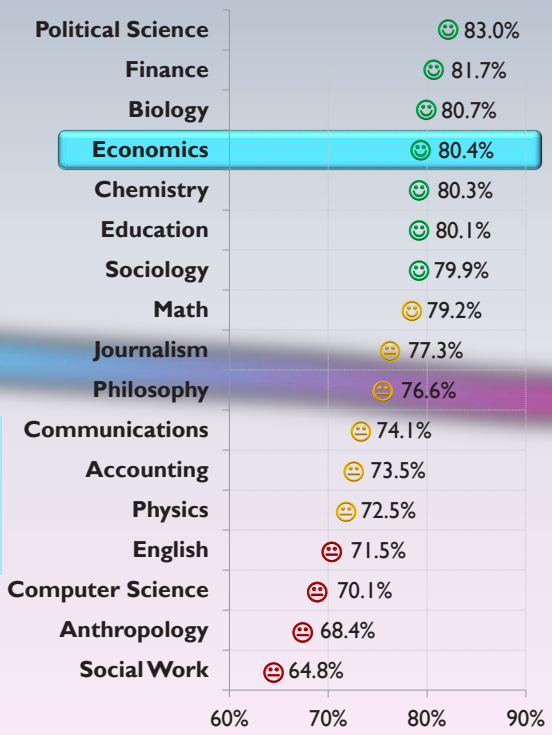


2009 Earnings for Young New Zealanders After Completing a Bachelor's Degree[4]



Kiwis with Economics degrees find that their training has a high market value. Most Economics majors in general are satisfied with their employment outcomes.

% Satisfied with Job*[5]



* From survey data

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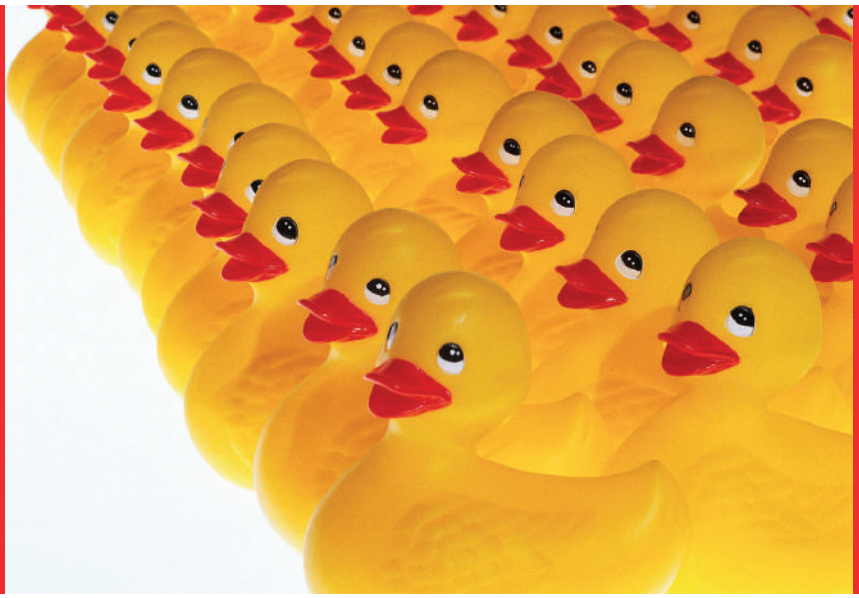
Rubber duckie, you're the one

On January 10th 1992, a severe storm overtook a shipping vessel crossing the Pacific Ocean en route from Hong Kong to Tacoma. During the storm, several shipping containers were washed overboard, spilling 29,000 plastic bathtub toys into the sea. Over the next 15 years, beachcombers around the world occasionally stumbled upon a sun-bleached First Year's Inc bathtub toy that had washed ashore. They would report the date and location of their find to researchers who then used the data to study ocean currents.



Knowing that there is a flotilla of rubber ducks traveling across the globe makes us wonder exactly how much plastic debris is in the ocean (and where it might be heading). Somewhere in the North Pacific, circulating ocean currents known as the North Pacific Gyre have pulled in and trapped a staggering amount of plastic pollution from Asia and North America into what is now referred to as the Great Pacific Garbage Patch. The existence of this patch was predicted in the 1980s by the National Oceanic and Atmospheric Administration (NOAA) of the United States and was confirmed in the 1990s by vessels traveling through the Gyre. The size of the patch is anywhere from 700,000 km^2 (0.4% of the Pacific Ocean) to 15 million km^2 (8% of the Pacific Ocean). The patch itself is virtually invisible. When plastic is exposed to sunlight, it begins to break down via a process known as *photodegradation*. So whereas some large pieces of plastic can be seen, much of the plastic making up the patch is in the form of small particles floating just below the surface. This makes it difficult to measure the exact size of the patch and thus the quantity of plastic it contains.

Plastic pollution in the ocean, both large and particulate, causes misfortune for those who played no part in producing it (in economics, this is referred to as an *externality*). Fish, turtles and seabirds are the first to feel the effects. They mistake larger plastic fragments for food, eat it or get tangled in it, and perish. Some marine life adheres to floating plastic and is carried to other ecosystems where it then invades. When it comes to particulate plastics, small marine animals ingest the debris and are then eaten by larger animals. Plastic particles and the toxins they contain, including polychlorinated biphenyls (PCBs, a chemical used in coolants) and dichlorodiphenyltrichloroethane (DDT, a synthetic pesticide), enter the food chain. Although humans may not be directly exposed to the harmful effects of this sort of pollution yet, our time is surely on its way as tainted seafood finds its way to supermarket shelves.

So what can be done? One clear solution is to take more careful measures to ensure that plastics stay out of our waterways. A global effort is required since many countries have access to the ocean and incentives to pollute it. Unfortunately, monitoring and enforcing these types of initiatives can be difficult. International agreements for the reduction of air pollutants, such as the Montreal Protocol for chlorofluorocarbons or the Kyoto Protocol for greenhouse gas emissions, gives us hope that it can be done. We can also expect that awareness of the problem will lead to research into new technology that can aid in cleaning up our oceans. To help with the clean-up of oil spills, for example, researchers at AeroClay Inc have developed Aerogel, a sponge-like substance that can soak up oil and leave the water behind. Whether we prevent plastics from reaching our oceans or try to remove what does get there, considerable effort on our part will be necessary. We share the ocean and therefore we share the costs of – and responsibility for – keeping it clean.

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Tuition conspiracies

Before selecting which university to go to, many graduating high school students take overall cost of attendence into consideration. Some colleges in the United States use financial aid packages to set different attendance prices for different types of applicants. This sort of *price discrimination* is implemented using a system of 'yield management' or, in this case, 'enrolment management'. It is a similar system to the one used in the airline industry to determine ticket prices and seat availability for different types of passengers. The university collects financial, demographic and performance data from the applicant along with other personal information (e.g. intended course of study). They create a formula using the student's personal information and historical data from previous applicant pools to calculate a financial aid package that is just high enough to induce the student to accept an offer of admission.

The formula can be adjusted so that different types of students receive different levels of aid to meet an enrolment target or social goal set by the university. For example, if a university has a shortage of students in humanities but an excess of students in engineering, it may offer applicants with interests in anthropology more generous financial aid packages and be stingy with applicants interested in computer science. Alternatively, if the university wishes to increase access to education for those with low incomes, it can offer more generous financial aid packages to applicants from particular minority groups (since ethnicity has historically been correlated with income in the US).

Some argue that this kind of price discrimination raises the cost of education for some and increases university revenues unfairly. Clearly, by determining the minimum amount of aid to give to a student which ensures he or she accepts an offer of admission, a university can maximise the tuition paid by the student. But are these practices really all that bad? Perhaps not. With a growing interest in college coupled with a decline in public subsidies for education, universities with limited budgets for financial aid must allocate their funds carefully. By minimising the discounts that students receive to the level that ensures their enrolment, funds are made available to other students who would otherwise receive too little financial assistance (or none at all). Furthermore, by managing the size of different departments through offering students different financial aid packages based on their intended course of study, administrators can enhance the quality of education by preventing overcrowding in a particular division. This frees up access to educational resources for students.

Can universities go too far when purposely setting different prices for different students? Since the 1950s, select prestigious universities in the US (specifically Ivy League colleges) have met to discuss the financial needs of students who had applied to two or more of the schools (known as *overlap applicants*). As a result of these meetings, similar financial aid packages are offered to overlap applicants. Many believed this practice was an attempt to limit competition for star students and raise net revenues from tuition, in which case those who participate in such meetings effectively establish an education *cartel* (an illegal practice in the US under section 1 of the Sherman Act).

In the early 1990s, the US Department of Justice opened an investigation into the pricing practices of eight Ivy League schools along with MIT to determine if anti-competitive price fixing was taking place. The schools argued that the overlap meetings were an effort to optimise the use of financial aid funds so that more students in need received assistance. Data suggested that participation in the overlap meetings was positively correlated with an increase in the enrolment of black students from 3% of the entering class to 5%. Assuming race is a rough proxy for average income, collusion may have been increasing access to education as the schools claimed. In 1992, the US government passed the Higher Education Act which allowed colleges to engage in certain cooperative conduct and by 1993 had dropped its investigations into the anti-competitive behaviour of several universities.

Today, many universities continue to rely on enrolment management techniques to manage their financial aid budgets and to control the size of different divisions. Is it fair? Is it efficient? Perhaps more study is required.

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Virtual economics: Not quite there?

During the last 30 years, computers (specifically, desktops and laptops) have become much cheaper and much more user-friendly. As a result, there has been a huge increase in the number and variety of applications they offer (for both work and play). Likewise, ever-advancing computer technology has significantly changed the way we perform economic research. Theorists program computers to solve mathematical models of markets that are too difficult or too time-consuming to solve by hand. Empiricists upload vast amounts of data into one of several software packages and analyse it with complicated statistical techniques that are impossible with pencil and paper. With computers, economists can work on more complicated projects and can complete them faster than ever before.

Using computers to solve equations or execute statistical algorithms is just the tip of a very large iceberg. In the 1990s, a diverse group of social scientists (including economists) started to work with computational methods in another novel way ... by creating artificial societies.

In this method, the researcher constructs a virtual environment populated by unique *(heterogeneous)* individuals, each with their own information and objectives to achieve. The agents interact with each other and the environment itself according to user-defined behavioural rules. As they do so, the state of the world starts to change and aggregate patterns begin to emerge. In many of these environments, the behavioural rules followed by the agents also begin to change in response to continued peer-interaction and changes in the virtual world. The end result is an *evolving* computational ecosystem built upon the activities of individuals. The researcher can observe the activities of the artificial community through simulation. This approach, known as *agent-based modelling* (ABM), is a 'bottom-up' approach to understanding aggregate phenomena.

Agent-based modelling is a systemic method: it focuses on *how* phenomena come to be. This notion turns out to be quite a bit different from the approaches usually taken in economics. Often, economic models are purely mathematical in nature and feature two (or more) forces attempting to come to a consensus (or *equilibrium*). You can think of the quintessential model of 'supply-and-demand' for a good: the objective is to find the price at which the quantity supplied by firms equals the quantity demanded by consumers. Testable implications come from looking at what happens to this consensus when something changes (e.g. what happens to the price of a good when consumer income rises), an exercise known as *comparative statics*.

Frequently, unrealistic assumptions about humanity (e.g. that people are perfectly rational) and over-simplifications of the economic environment (e.g. by limiting the number of inputs a firm uses for production) are necessary for the model to be solvable or for the derived equilibria to exhibit unique, testable properties. Further, the comparative statics approach relies on *artificial coordination*. We compute then compare equilibria as if markets move from one to another instantaneously. How the equilibria are reached and the potentially lengthy or complex process which moves us from one equilibrium to another is overlooked.

Agent-based modelling, however, is a *generative* method (Epstein, 1999) that focuses on the structure of economic systems and how they function. There are many benefits to this sort of approach. Often, activity in the virtual environment produces patterns which are more complex than the actions prescribed to individual agents would suggest (a feature known as *emergence*). Computational economies serve as a means for researchers to conduct experiments: by making small changes to the program, alternative realities are created and compared. With this, policies that have not been implemented yet or events that have not yet occurred can be studied. The computational environment is fully observable to the programmer; statistics on virtual outcomes can be easily collected and analysed. Researchers have a great deal of flexibility in adding realism, dynamics and complexity to their models and can therefore explore a greater variety of phenomena.

There are many insightful agent-based economic models out there. Here are just a few examples:

- ***Hash-and-Beans*** (Tesfatsion, 2006; Tesfatsion, 2007). In a decentralised virtual economy where agents produce and trade hash[4] and beans, Tesfatsion explores the relationship between consumers and firms. Individual firms each have start-up funds, production capacities for either hash or beans, and cost functions. They have little information about consumers or one another. Consumers each have a cache of income, a portfolio of shares in the firms, a measure of preference for beans and hash, and subsistence needs. Like firms, they have little information about others. Firms and consumers then engage in trade: firms offer quantities of their wares at select prices and consumers send orders (demand) to the firms offering the best deals. To survive and prosper in this world, individual consumers and firms must successfully (and autonomously) coordinate their activities. Over time, firms learn what the best prices to offer are and consumers learn how to spend their limited funds. Those who don't learn face extinction.
- ***The Santa Fe Artificial Stock Market*** (Santa Fe Institute). This model is designed to study how asset trading strategies develop and evolve. LeBaron (2002) provides a description of the market. There are two types of assets: a riskless bond paying a fixed interest rate and a risky stock that pays an uncertain dividend. Risk-averse agents are born with an endowment of cash and a fixed amount of the risky stocks. The agents must decide how much of their wealth to keep in bonds and how many stocks to purchase based on how they expect the stock to perform. These forecasts are derived using trading rules. After computing how many assets to buy or sell, agents send their orders to a virtual specialist who attempts to derive a stock price that clears the market. Data for trades and stock prices are then analysed. Agents learn what rules are best and even evolve to form new, better rules. Researchers can use this model to explore how expectations are formed and how they impact asset prices. Simulation results are shown to be similar to actual financial data.
- ***ASPEN*** (Basu, Pryor and Quint, 1998). The ASPEN model of the US economy pulls together different types of agents into different markets. The model has markets for food, housing, and automobiles where consumers interact with firms. There are financial markets where consumers and firms save or borrow. There is a financial regulator (a central bank) and a government sector that levies taxes and manages public spending. The agent-based macroeconomic model is used to explore how monetary policy affects the artificial financial and goods markets (i.e. the impact on interest rates, GDP and consumer prices) and produces predictions similar to those in standard macroeconomic theory. Though the model may not be quite ready for practical applications, it shows how agent-based economies can complement standard methods.
- ***Sugarscape*** (Epstein and Axtell, 1997). Epstein and Axtell show how notions of physical space can be incorporated into our understanding of economic development. An artificial farming community is created and distributed over a grid. Each location on the grid is capable of producing a different amount of sugar, a renewable resource. Each member of the community has a different subsistence need to consume sugar. Agents search around their local areas for the most lucrative sources of sugar. Different rules govern how agents reproduce, trade, form tribes, communicate culture or politics, transfer diseases, etc. The model produces wealth distributions (similar to those in agrarian economies) as a product of agents' sugar-farming decisions and interactions with each other.

With all it has to offer, social simulation still has a fair way to go as a research tool in economics. Like any new technology, the skills needed to create computer-aided simulations take time to learn. There are several user-friendly tools (including NETLOGO and SWARM) that can help researchers create agent-based models quickly, but exploring the different features of these programs and choosing the best one to use can be time-consuming. Furthermore, researchers have quite a lot of freedom to choose the features of the virtual world and the behaviours of their agents – almost too much freedom! In some cases it is hard to know where to start when building an agent-based economy, and making decisions based on trial-and-error can be cumbersome. Critics can always find something missing that they feel should be included, or something included they feel is wrong. Researchers are forced to spend more time forming careful arguments about a model's features.

How these models compare to real economies is a difficult philosophical issue. In some cases, more than one framework can produce the same stylised fact. In other cases, a framework can match a stylised fact in one simulation but not in the next. Scientists hesitate to analyse artificial data (especially when real data are available) which slows the rate at which this method spreads across the research community. Agent-based modelling remains a fledgling methodology in economics for understanding market activities, but its possibilities are great.

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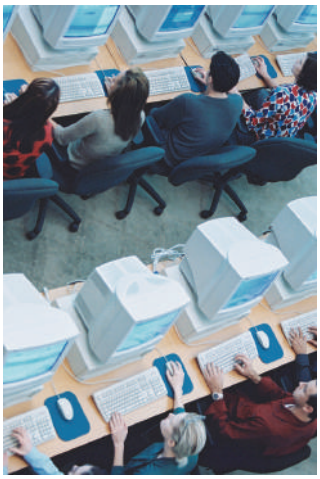
[4] A dish containing chopped meat, potatoes and spices.

Prosumers to the left



In markets, firms produce goods and services and consumers buy them (see Figure 1). This is the underlying set-up embodied in many economic models. Most of the time, the buyer-seller dichotomy is an accurate representation of market activity. Since the early 1990s, however, another paradigm has emerged. The advent of the internet has allowed some industries to assign a stronger role in the production of goods and services to those who purchase them (see Figure 2). Consumers are becoming *prosumers* and firms are benefiting (immensely) by consumer-led marketing and design.

A key feature of prosumers is that they are not paid for the work that they do. Every time you post a review about a product online, for example, you are either doing marketing for the firm (in the case of good reviews) or providing them with information about their product's shortcomings which they can use to improve their wares (i.e. quality control, in the case of bad reviews). The firm pays you nothing for this. In some cases, prosumers work for the firm without even knowing it. Some websites monitor the buying activities of other users so they can suggest products to you based on the goods in your shopping cart. By simply buying online, you help the firm cross-sell products to others in the future.

But there is an even stronger role in the production process for prosumers! Occasionally, prosumers will take it upon themselves to build products from scratch and share them with other prosumers (see Figure 3). One example of this is the production of *open-source software*. In the 1980s, such software was made available under General Public Licensing (also known as *copylefting*), a licensing procedure developed by the Free Software Foundation. Anyone is allowed to use and modify copylefted software under the conditions that: (1) they do not attempt to impose licensing restrictions on others, and (2) all enhancements to the code are licensed on the same terms. This means that any programmer who makes alterations to the code can claim 'bragging rights' for their work, but they cannot charge others to use it.

The most famous example of copylefted software is *Linux*: an open-source operating system developed by Linus Torvalds in 1991. Torvalds, who created the software out of personal curiosity, made his system available to other programmers who might be interested in modifying the program. The number of users grew rapidly, reaching approximately a half a million by 1994. This brings to light an interesting question: why would programmers spend time working on open-source projects when they do not get paid for it? Perhaps programmers can improve their skills or keep up with modern coding trends by working on these programs (they build *human capital*, which earns them higher pay in the future). Maybe their open-source achievements provide a signal to employers about their quality, increasing the number of job offers they get or their chances of promotion. Or perhaps there are hidden benefits: the joy of working on a cool project, recognition and peer-esteem from solving a complex problem, satisfaction from crusading against large software conglomerates and providing a good that undermines their profits, etc. Many of these incentives are strikingly similar to those that drive academics to produce scientific knowledge: we won't charge you for it, but please cite us!

If we were to agglomerate the decentralised production of open-source software, would we see anything that looks remotely like a bricks-and-mortar firm? Probably not. Industries dominated by the prosumer need not be concerned with *efficiency;* because nobody is paid, there is no need to be cost-effective. Efficacy, quality and ease of use are the only things that matter; these can be enhanced by allowing a diverse population to contribute to the design of a product (so-called *wikinomics*).

Much remains unknown about this new market paradigm. Further research on prosumer behaviour, both at the individual and aggregate level, is required. Perhaps prosumers will provide the answers themselves.

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Figure 1

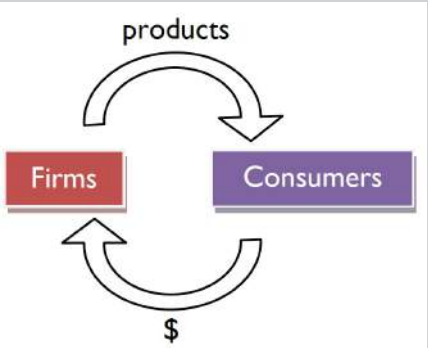


Figure 2

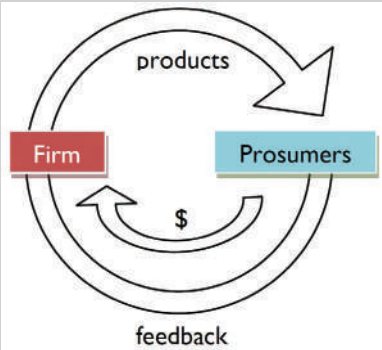
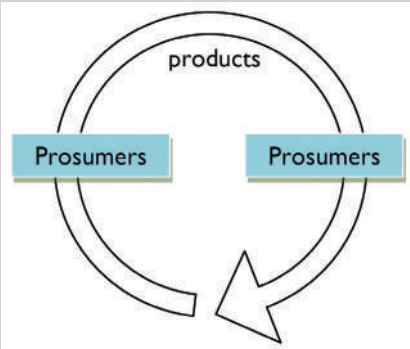


Figure 3



Commentary on the New Zealand economy

Alan King
alan.king@otago.ac.nz

	Dec 2012	Sep 2012	Jun 2012	Mar 2012	Dec 2011
GDP (real, annual growth rate, %)	n.a.	2.5	2.4	1.9	1.4
Consumption (real, annual growth rate, %)	n.a.	1.9	2.4	2.3	2.0
Investment (real, annual growth rate, %)	n.a.	2.7	6.9	7.9	5.9
Employment: full-time (000s)	1707	1700	1713	1702	1704
Employment: part-time (000s)	486	517	512	528	520
Unemployment (% of labour force)	6.9	7.3	6.8	6.7	6.4
Consumer Price Inflation (annual rate, %)	0.9	0.8	1.0	1.6	1.8
Food Price Inflation (annual rate, %)	-0.5	-0.9	-0.4	0.6	1.7
Producer Price Inflation (outputs, annual rate, %)	-0.8	-0.6	0.5	1.6	3.4
Producer Price Inflation (inputs, annual rate, %)	-0.5	0.3	1.9	2.3	4.2
Salary and Wage Rates (annual growth rate, %)	1.8	1.9	2.0	2.0	2.0
Narrow Money Supply (M1, annual growth rate, %)	7.0	5.2	7.3	4.4	8.0
Broad Money Supply (M3, annual growth rate, %)	6.0	6.6	5.9	5.1	6.5
Interest rates (90-day bank bills, %)	2.65	2.64	2.61	2.74	2.69
Exchange rate (TWI, June 1979 = 100)	74.3	72.8	70.8	73.0	68.6
Exports (fob, $m, year to date)	46,027	46,748	46,688	47,468	47,702
Imports (cif, $m, year to date)	47,234	47,640	47,451	47,201	46,896
Exports (volume, seas. adj.)	1301	1307	1190	1198	1202
Imports (volume, seas. adj.)	1680	1718	1704	1759	1672
Terms of Trade (June 2002 = 1000)	1154	1170	1209	1240	1269
Current Account Balance (% of GDP, year to date)	n.a.	-4.7	-4.8	-4.4	-4.0

Sources: Statistics New Zealand (www.stats.govt.nz), Reserve Bank of New Zealand (www.rbnz.govt.nz)

After almost three years of merchandise trade surpluses, New Zealand has reverted to its pre-Financial Crisis habit of spending more on imports than it earns from exports over the last 12 months. The current trade deficit is still far below its 2008 level, but what are its prospects for 2013?

The trade balance is the difference between the value of exports and imports, and each may be thought of as the product of their respective average price and quantity. In the immediate aftermath of the Lehman Brothers collapse in September 2008, the quantity imported (especially of durable items like cars and machinery) fell sharply, as did some import prices (especially oil). Export prices were also hit hard – so much so that New Zealand's terms of trade (ToT, the ratio of export to import prices) fell sharply – but export volumes managed to rise after early 2009 (due to the recovery in agricultural production from the 2007/08 drought and the relatively robust health of two important export markets, Australia and China). Consequently, the value of imports fell more sharply than that of exports and the $5 billion trade deficit of 2008 had disappeared by early 2010.

Many of these changes, however, were short-lived. Oil prices rebounded, but so did global food prices and so the ToT more than regained its lost ground by late 2010. Import volumes quickly recovered also, but export volumes managed to hold onto their gains and this helped sustain the trade surplus.

Over the last year, however, concern over the situation in Europe and the short-term prospects for the Chinese economy has dampened commodity prices and the ToT slipped back somewhat, tipping the trade balance back into deficit. So, where to from here?

Import prices have remained relatively flat over the last three years and there is little reason to expect this to change in the near term. The 2012 drought in the US, however, has lifted dairy prices and so a partial recovery of the ToT is expected.

The rapid recovery of import volumes ended in early 2011 and subsequent growth has been muted (i.e., 'normal'). This should continue through 2013, perhaps at a slightly faster rate as the economy continues its slow recovery. The outlook for export volumes is less bright. New Zealand's dry summer has hurt dairy production (though the lambing season was a reasonably good one), so export volumes for early 2013 at least will be down. The outlook for the Australian economy is getting weaker, which will make life even more difficult for exporters of manufactured goods who are already struggling against the strong dollar. So, the trade deficits is back to stay and will grow in size, but it is unlikely to get too large too soon.

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Department of Economics

University of Otago

PO Box 56

Dunedin

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