
Carbon crisis

Systemic risk of carbon emission liabilities



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Technical report

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Contents

Key points	2
Summary	3
Context	3
Systemic crisis	4
Probability of a systemic crisis	5
Australia's carbon emission liabilities	7
Domestic emissions liability	8
Export emissions liability	9
General economic risk factors	10
Low global growth (RF1)	10
Reversal of post GFC monetary policy (RF2)	10
Geopolitical risk (RF3)	11
Discussion	11
Carbon emission liability risk factors	12
Emissions intensive exports (RF4)	12
Domestic emissions penalty (RF5)	12
Discussion	13
Insights	14

Key points

2

The Australian economy is susceptible to a systemic crisis.

Stress tests have been applied to the economy for five risk factors identified over the next 25 years:

1. Lower world growth than expected
2. Reversal of post Global Financial Crisis monetary policy causing an emerging market crisis
3. Geopolitical risk in the China Seas region leading to a fracturing of trade
4. Declining emissions-intensive exports as a result of global climate change mitigation policies
5. Imposition of a penalty for excessive domestic greenhouse gas emissions

Australia is on track to be the source of 16 per cent of the global carbon budget by 2050.

Australia has one of the highest rates of per person greenhouse gas emissions in the world, the highest of advanced economies in the OECD. A high proportion of Australia's exports are also emissions-intensive. Current policies expect emissions from exports to increase from 160 per cent of domestic emissions to between 270 and 330 per cent in the next twenty years. As carbon constraints grow tighter, this exposure to carbon emissions will be an increasing liability.

General economic risks in the near term cannot be controlled by domestic policies. Medium term carbon liability risks can be reduced by pro-active domestic efforts.

Domestic policies and actions will have only minor influence on global economic under-performance and instability risk factors. Investing in renewable energy and clean technology will reduce Australia's carbon emission liability risks.

Australia has a greater than 50 per cent chance of a systemic crisis as a result of global action to limit climate change.

The current emissions-intensive structure of the Australian economy is the source for this vulnerability. International trading partners such as India and China have already signalled there will be a significant drop in their demand for Australian coal. With a weakened global economy, losses from declining emissions-intensive exports are more likely than not (**greater than 50 per cent**) to cause a systemic crisis in Australia.

As the world becomes more carbon constrained, punitive measures could be imposed on nations not pulling their weight. Australia is on track to consume its fair share of the global carbon budget in the next 10-17 years. Waiting until penalties are imposed before accelerating abatement is more likely than not to cause a systemic crisis in Australia (**greater than 50 per cent**).

Combined, these factors are almost certain to cause a systemic crisis.

A transition takes time. The earlier change takes place, the lower the likelihood of carbon liability risks resulting in a crisis.

Investment in alternative industries and infrastructure take time before they result in significant emission reductions. Delaying investment towards a zero emission transition prolongs uncertainty, increases the potential for stranded assets, and increases the burden for future generations. Early action to reduce emissions will reduce the likelihood of a crisis to a low level.

Summary

There is a growing recognition of carbon-related risks for investors. This study, *Carbon crisis: Systemic risk of carbon emission liabilities*, evaluates these risks to the Australian economy, currently heavily invested in emissions-intensive activities. Detailed analysis and methods can be found in the accompanying technical report prepared by the National Institute for Economic and Industrial Research (NIEIR).

Australia's emission intensive economy and trade portfolio represent a growing liability which is not being recognised. Avoidable risks are mounting as a result, presenting a greater than 50 per cent chance of systemic crisis over the medium term; meaning more likely than not.

Australia is more vulnerable now to global economic shocks than it has been in the past; since the economy was configured for export led growth in the early stages of the boom. The strength of global growth impacts on export revenues. The stability of the global financial system impacts on Australia's increasing needs for foreign capital. Currently, both of these elements are deteriorating which present near-term risks of systemic crisis for Australia. These are forces beyond the influence of Australia's domestic policy actions.

Australia stands a good chance of averting a crisis from these global shocks but will still be somewhat weakend. As a result, Australia will have less capacity for avoiding subsequent shocks.

The impacts of Australia's increasing carbon emission liabilities are expected to materialise in the medium term. Decreasing demand for emissions-intensive exports, and penalties for excessive domestic emissions will be substantial shocks in isolation. Taken together, or following the weakening from a global economic shock, a crisis becomes more likely than not.

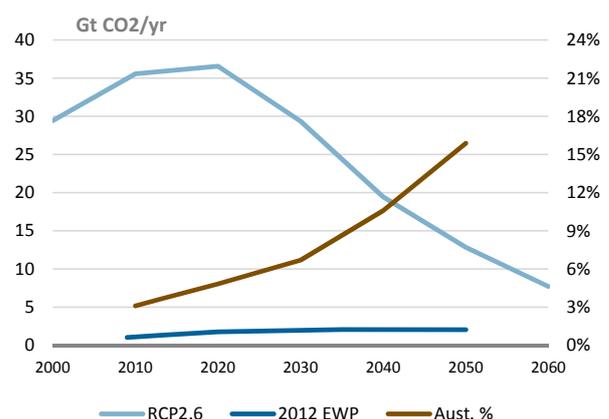
The risk associated with Australia's carbon emission liabilities is influenced by domestic policies and actions. The inertia associated with emission reductions require proactive change. This will reduce the risk of a systemic crisis to a low level.

While decarbonising presents its own challenges and risks, proceeding with business-as-usual entails its won range of risks. We must consider the risks on both sides of the argument and decide which risks are worth taking.

Context

Australia is one of the most emissions-intensive economies in the world. Current expectations for Australia's emissions-intensive activities will result in Australia being the source of 16 per cent of the global carbon budget by 2050 (Figure 1).

FIGURE 1 Australian combined domestic and export emissions compared with IPCC recommended carbon budget.



It is incredulous to expect that this increasing prominence will not face pressure. With climate change being a global issue, actions to address the underlying causes for global warming will materialise in the international transactions integral to the modern global economy. Climate-related policies are gaining international prominence, and Australia's emission intensity is becoming a growing liability for the country. This carbon emission liability will be increasingly realised as other nations undertake the challenging task of transitioning their own economies to clean energy.

4

Declining revenue from emissions-intensive exports, carbon related tariffs on traded goods, or international carbon permit purchase obligations are all real possibilities. At the present time the Australian economy is ill-prepared for such outcomes. Structural changes introduced to the Australian economy during the resource boom make the nation far more vulnerable to carbon emission liabilities than we have ever been. Australia's national debt has surged during the boom period, and has been underwritten by foreign capital to a large degree. This was accepted at the time with the expectation that Australia's export revenue would also surge, supporting these international obligations. The surge in export revenue is uncertain.

International circumstances currently present systemic risks to Australia as a result of this introduced imbalance. Low global growth is lowering the demand for Australia's export commodities. International financial system volatility is bringing uncertainty to debt and equity availability. Geopolitical events in Eastern Europe, the Middle East and potentially in the South China Sea region can destabilise trade arrangements and investments – not to mention the detrimental human costs of conflict. Australia has little to no influence on these events but must deal with their consequences if and when they occur. Each of these risks will test the resilience of the Australian economy.

In addition to international economic risks, which are beyond the influence of our actions, are Australia's carbon emission liabilities. Losses in revenue from emissions-intensive exports and penalties for excessive domestic CO₂ emissions will also put significant strain on Australia's balance of payments. These are risk factors which Australian domestic policy can influence by reducing exposure to greenhouse gases. If we think we are immune to a systemic crisis we should think again.

Systemic crisis

Since 1970, there have been at least 60 episodes of systemic crisis. The term 'systemic crisis' does not mean a recession where GDP may fall a few percentage points. It is a crisis which is triggered by an exchange rate crisis. That is, a rapid fall in the currency that undermines confidence of foreign and domestic investors to the extent that net outflow of capital from the country is significantly greater than foreign credit available at plausible interest rate settings. This forces the country to:

- default on its international obligations or, at the very least, mandate the timing of the repayment of its debt; and
- in this context, negotiate large loans from the International Monetary Fund or other international agencies or countries.

If the banking sector has been active as a transmission mechanism for foreign loans and has significant foreign liabilities on its balance sheets, the exchange rate/balance of payments crisis will be associated with a banking crisis. A severe contraction in the availability of credit would require a public sector bail-out of one or more major banks.

Once a crisis is triggered, the peak-to-trough fall in GDP can be between 10 and 25 per cent, as has been recently experienced by the Greek economy. Indeed, some crises have occurred multiple times in the same country (e.g. Argentina).

These types of crises are designated as systemic because once they occur, the future direction of the economy both in the short and longer terms, is fundamentally changed from what would have happened if trends before the crisis had been maintained. For example, for many years after the crisis, other than major loans from the IMF or supporting foreign governments, no major new sources of foreign capital may be available. The country's level of economic activity will be totally determined by the exporting and import-replacement capacity of the country.

In short, systemic risk relates to crises likely to be associated with:

- a significant decline in a peak-to-trough GDP of up to 25 per cent of GDP;
- a lengthy period of three to eight years before the previous GDP peak is regained;

- when growth is resumed it is likely to be below the trend rate of growth that was experienced before the crisis. There is likely to be a “lost generation” of jobless people; and;
- structural change with the potential to fundamentally alter the economic structure and policy processes of the country.

The objective of this study is to assess the risks that the Australian economy will be subject to such a crisis over the next quarter century. The International Monetary Fund has already established that if countries have a net foreign liabilities ratio greater than 50 per cent of GDP, their risk of crisis “increases sharply”. As at June Quarter 2014, Australia’s net foreign liabilities stood at 54 per cent of GDP. In addition, the Australian exchange rate is currently over-valued and a significant downward adjustment towards an exchange rate of 70 cents to the US dollar can be expected over the next two to three years. At this exchange rate, relative costs of production between the United States and Australia would be similar. However, because of the high share of Australian foreign obligations denominated in foreign currency, such an adjustment would substantially increase the net foreign obligations ratio to GDP, all else unchanged.

Though high net foreign obligations are a necessary condition for a systemic crisis to be realised, a number of other indicators contribute to the probability of a crisis occurring. These indicators include, among others, the current account deficit as a percentage of GDP, world financial volatility, and the extent of under- or over-valuation of the currency. These factors are taken into account in a model developed by the International Monetary Fund to predict systemic crises.

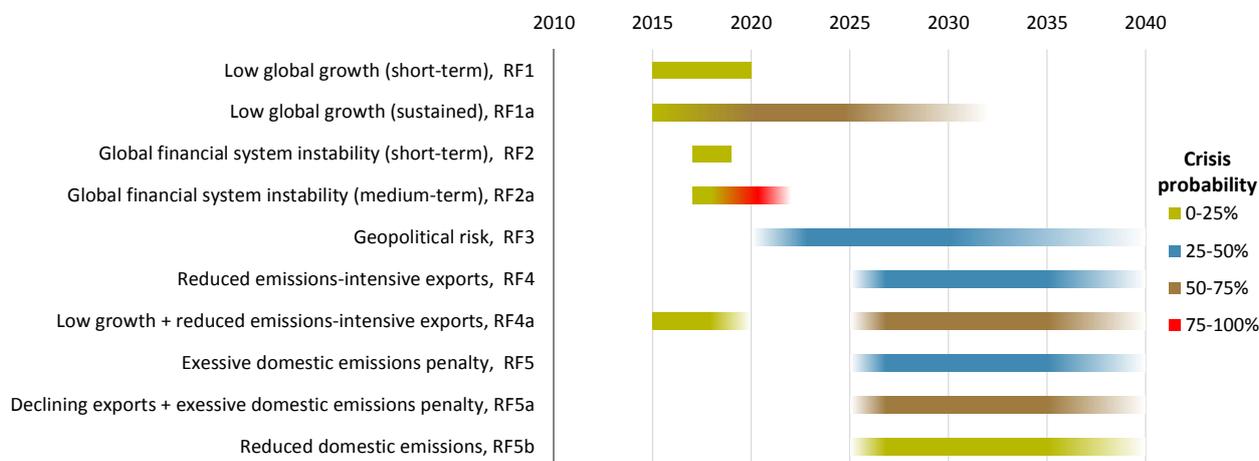
Probability of a systemic crisis

The study undertakes a number of “stress test” alternatives to a steady baseline of the Australian economy. Five risk factors (RF) were identified, and stress test scenarios designed, to evaluate their probability of precipitating a crisis. The five risk factors are:

- (RF1) Lower world growth than expected, that is, world growth in the 2.5 to 3.0 per cent range
- (RF2) Emerging economy crisis, global financial instability and a second Global Financial Crisis
- (RF3) Geopolitical risk in the form of potential or realised conflict in the China Seas leading to a fracturing of regional trade
- (RF4) The vulnerability of Australia’s emissions-intensive exports as a result of global climate change mitigation policies
- (RF5) Imposition of a penalty for excessive domestic greenhouse gas emissions

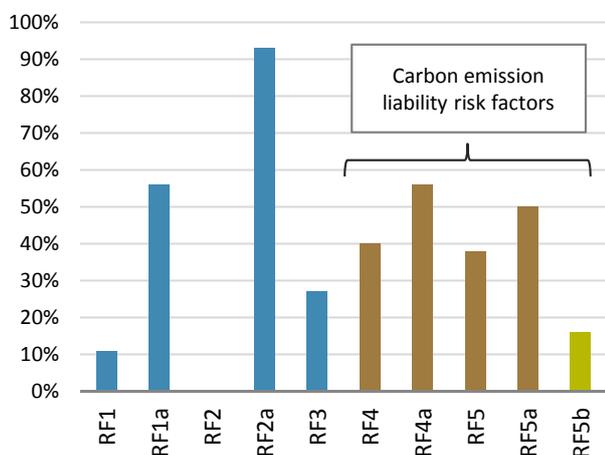
Risk factors one to three entail general economic risk events which are beyond the influence of Australia’s domestic policy. Risk factors four and five are carbon emission liability risks which can be influenced by Australia’s domestic policy. A number of derivative stress tests were also applied to evaluate the effect of more durable shocks, as well as sequential events. Each stress test case is briefly described in later sections. Figure 2 indicates the approximate timing and duration for all stress tests which have been evaluated. Also indicated in the figure is the severity of each event.

FIGURE 2 Timeline of evaluated systemic risk factor stress tests.



The resulting probability of at least one crisis occurring is shown in Figure 3 for each stress test scenario.

FIGURE 3 Probability of systemic crisis for each risk factor stress test.



The direct impact on the current account deficit is the critical effect in causing a crisis.

In the near term, the most important risk is that of global financial system instability, leading to an emerging market crisis (RF2). The risk of a crisis over the next 10 years would become very high if RF1 and RF2 combined. An important consideration is whether or not the event is temporary or sustained. The longer an event endures, the higher will be the probability of at least one crisis.

There will be a crisis if the geopolitical risk event occurs (RF3), though this is regarded to be unlikely.

The importance of emissions-intensive export-related risk in producing an economic crisis will depend on the context (RF4). By itself, it is unlikely to cause a crisis before 2040. This simply reflects the fact that the major impact of the export reduction will be delayed to the 2030s. However, if the impact follows on from a period of financial system instability reminiscent of the GFC (where Australia avoids a crisis but its vulnerability increases well above the Baseline), the loss of fossil fuel export revenue could well be the catalyst for a crisis.

The probability of a penalty for excessive domestic carbon emissions provoking a crisis will again depend on what other events have occurred leading up to the 2030s, along with the timing of emission reduction initiatives. If RF4 and RF5 are combined, a crisis would be expected.

In the event of RF1 or RF2 taking place and a crisis is avoided, the increased fragility of the economy will mean that any following carbon-emission related shocks will increase the probability of a crisis to a near certainty.

Australia's carbon emission liabilities

On a per person basis, Australia is among the world's highest domestic greenhouse gas emitters. Added to this, greenhouse gas emissions attributed to Australia's exports are now 160 per cent of domestic emissions, and projected to increase to between 270 and 330 per cent in the next twenty years¹. Accepting that greenhouse gas emissions must be constrained to avoid runaway climate change, some penalty will materialise which realises this liability, causing heavy emitters to shift away from emissions-intensive practises to low and zero emission alternatives.

We cannot know the form of such a penalty, its magnitude or how it is administered at this time. This does not mean a carbon emission liability does not exist. There are a number of incidental and punitive outcomes which could eventuate, and it is worth considering a sample of:

- Nations which have already or are soon to implement a price on pollution could penalise trade partners without these measures, neutralising any introduced bilateral disadvantage
- A majority bloc in multilateral organisations central to the globalised economy (such as the WTO, the World Bank or the IMF), may introduce formal sanctions for uncooperative nations

1. According to BREE long term-energy projections in combination with the National Greenhouse Gas Inventory and the greenhouse gas accounting factors. The range reflects the difference between the 2012 and 2014 issue of the energy projections whereby exported emissions are approximately constant but the 2014 issue indicates higher future domestic emissions, reducing the export/domestic emissions ratio.

- Global funds for mitigation efforts could be levied upon excessive emitters
- Low carbon transitions in major economies will reduce demand for, and lower the value of, carbon intensive goods; which are important exports for many countries

Any and all of these outcomes are possible, each with the effect of escalating penalties as emission reduction targets grow tighter. However this penalty manifests in future, it corresponds to a current liability for emitters – a carbon emission liability which the Australian government is ignoring. As a consequence of the country's high per capita emissions, Australian citizens are exposed to one of the highest carbon emission liabilities of any person in the world today.

Of course this is only one way of looking at the threat of excessive greenhouse gas emissions. Essentially, the penalties discussed here are the social costs of being irresponsible global citizens. The physical effects on Australia and other regions will be more damaging, and have already been shown to be far costlier and challenging than mitigation efforts². At this time, when the Australian Government is intent on minimising domestic abatement of greenhouse gases, the public should be aware of the increasingly liability this presents.

In this report, *Carbon crisis: Systemic risk of carbon emission liabilities*, both the quantum and potential effect of this liability on the Australian economy is examined as it enters a challenging period. Indeed, as noted earlier, the carbon emission liability is not

2. IPCC Fifth Assessment Report, Working Group 2, *Impacts, Adaptation and Vulnerability, 2014*

the only threat to the stability of the Australian economy.

Domestic emissions liability

Australia is on track to deplete its fair share of the global emission budget in the early 2030s. Due to the slow progress in reducing annual emissions, the majority of the abatement task will still remain. At the same time, the cost associated with greenhouse gas pollution will escalate. This is a substantial liability for Australia. The liability for 2030 is expected to be approximately US\$50 billion; based on the current abatement trajectory and moderate carbon price projections.

Australia has developed an energy and emissions-intensive base. With access to abundant and historically low-cost fossil energy, it was logical in the past for Australia to produce the materials and equipment that the domestic industry could provide with a competitive edge.

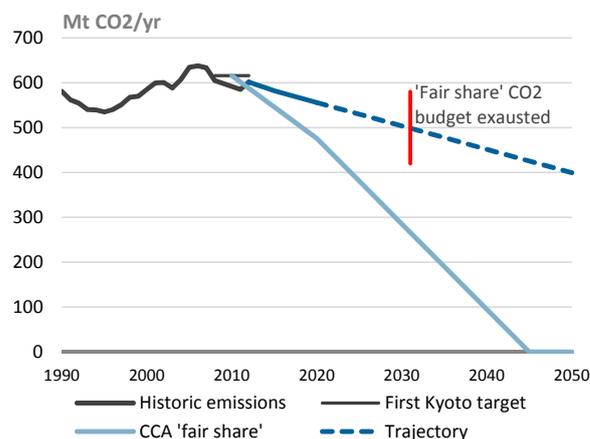
Abundant coal resources largely power Australia's electricity system, the third most emissions-intensive electricity supply in the world. Also making use of Australia's abundant fossil energy are industrial processes for materials manufacturing: industrial and agricultural chemicals, cement production, steel and aluminium manufacturing. Australia's urban development has been shaped by oil-based vehicle transportation, for which a domestic supply in the past has now given way to become a major import expense. Clearing of forests provided land for greenhouse gas-producing agricultural products. The recent growth in fossil energy exports is causing substantial fugitive emissions in the extraction process. Vast exports of fossil energy support Australia's foreign capital liability. The material outcomes from our past provided the lifestyles which Australians have enjoyed for many decades. This legacy is now known to be unsustainable. Reducing the corresponding liability will require time and effort, transitioning the economy to a clean and efficient base.

As time marches on and Australia under-performs on carbon abatement, the remaining carbon budget inexorably declines. Continued inaction by Australia will result in the nation consuming what the global community regard as our fair share of the remaining global carbon budget within as little as ten years³, depending on how the concept of a 'fair share' is regarded, and Australia's domestic efforts. The Climate Change Authority (CCA) recently evaluated

Australia's fair share to be 10.1 gigatonnes of CO₂-e to 2050, noting that this would be depleted in 17 years at current annual emission rates.

The emission reduction trajectory recommended by the CCA is shown in Figure 4. This shows the recommended target for 2020, a 19 per cent reduction on 2000 levels, and the resulting trend to avoid exceeding the fair share which the Authority has determined. Also shown in Figure 4 is the trajectory of Australia's current commitment of a five per cent reduction of 2000 emissions by 2020. Continuing this emission reduction trajectory would result in the 10.1 gigatonne budget being exhausted by 2032. The majority of the emission abatement task will still remain.

FIGURE 4 Projection of Australia's domestic greenhouse gas emissions. Climate Change Authority 'fair share' budget recommendation and current commitment trajectory.

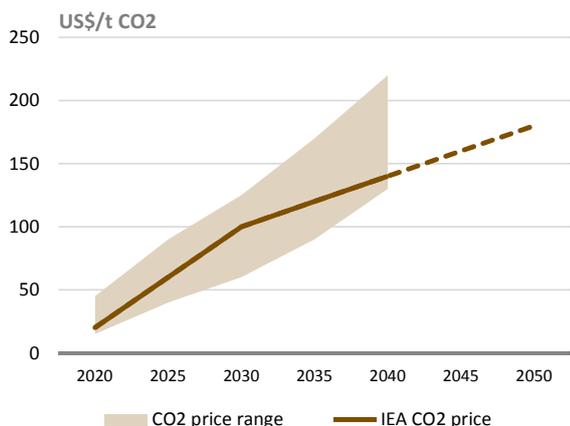


Subsequent emissions, in excess of Australia's fair share budget, can be considered the domestic emissions liability as this may attract some penalty in the future for insufficient action.

Currently there is no established cost penalty for nations exceeding their fair share of the global emissions budget. How long will this situation last? Would it be less disruptive to wait until a penalty of this nature is introduced before taking action? This study identifies that this market-driven, pricing signal approach is highly risky. It will take years before actions and investments convert to substantial emission reductions. By the time Australia consumes its fair share of the global emissions budget, pollution prices will have escalated. The carbon price trajectory of the International Energy Agency is shown in Figure 5 along with the price range assumed in the modelling for this report.

3. Based on equal per capita emissions

FIGURE 5 Probability of systemic crisis for each risk factor stress test.



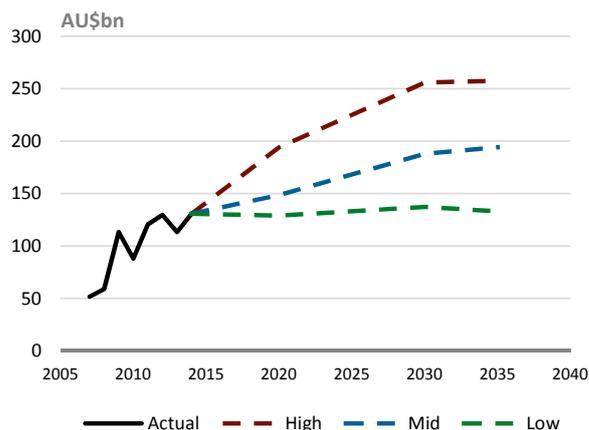
Export emissions liability

The liability associated with Australia's emissions-intensive exports has been explored in earlier work by Beyond Zero Emissions. The November 2014 report, *Fossil economy*, showed a reduction in demand for Australia's emissions-intensive exports as a result of changing global energy policies. This amounted to a decrease in gross revenue of up to AU\$118 billion per year with respect to government projections by 2030.

In the *Fossil economy* report, a comparison was made between the anticipated revenues projected by the Australian government with projections of the International Energy Agency (IEA). This comparison is shown in Figure 6. Government projections corresponded to the high revenue trajectory case. The IEA's New Policy Scenario corresponds to the mid trajectory case. The low trajectory case corresponds to the IEA's climate change mitigation 450ppm scenario.

Large write-downs of export revenue can be expected from a global transition to clean energy according to the International Energy Agency's climate change mitigation case. This is not only a plausible outcome, it was also shown to be consistent with the evolution of energy and environmental policy for Australia's major trade partners.

FIGURE 6 Comparison of total gross revenue for each trajectory case.



General economic risk factors

Circumstances in the global economy present a number of separate risks to the Australian economy. Three of these risk factors have been assessed in the accompanying systemic risk assessment report.

The first risk factor (RF1) assessed is world growth being lower than anticipated. The second risk factor (RF2) is financial market volatility resulting from the reversal of monetary policies introduced after the Global Financial Crisis (GFC). The third risk factor (RF3) is a geopolitical risk affecting Australia, which currently has a highly concentrated trade portfolio. These risk factors are generally regarded as outside the influence of Australia's domestic policies. As a result, policy in Australia must react and adapt to these situations as well as possible should they occur.

Assessment of these risks identified that a systemic crisis is not expected if the previously mentioned risk factors are short in duration. With lingering effects, these events can precipitate a crisis in the Australian economy. Should any of these events occur and Australia avert a systemic crisis, the economy's capacity for averting subsequent shocks will be weakened.

Low global growth (RF1)

The world economy is currently in a fragile state. The main reason for this is that due to the severity of the damage done during the GFC, trend productivity growth in the Eurozone and the United States is now significantly below its pre-2008 trends. As a result, the gap between pre-2008 trend

growth in GDP and the actual GDP trajectory of the major economies is widening with each passing year.

The duration of this low global growth case is a factor determining the probability of a crisis occurring. For this reason the probability was determined based on a recovery to trend growth in the next five to seven years (RF1), as well as sustained low growth (RF1a). If a recovery to trend GDP growth occurs in the short term then the probability of this leading to a systemic crisis in Australia is low, 11 per cent. If low growth is persistent then the probability of a crisis increases to 56 per cent; which would make a crisis the expectation.

Reversal of post GFC monetary policy (RF2)

The second event also reflects current weaknesses with the world economy. So-called 'quantitative easing' politics, aimed at injecting liquidity into the economy by central bank purchase of private sector securities, has been heavily relied upon in the United States and Japan over the past two to three years to stimulate their economies. The Eurozone is now adopting these policies. This policy is also called the 'exchange rate war' policy. One objective is to encourage capital outflows to lower the exchange rate, and encourage more trade-driven growth than would otherwise have been the case.

The effect of this has been to force large-scale capital inflows to major emerging economies which, as a result, have seen their debt to GDP ratios increase

significantly over the past four years. The risk is that the outflow of funds from these emerging economies when quantitative easing policies end, and interest rates in developed market economies rise, will trigger a crisis in one or more major emerging economies. That is, a second GFC will occur.

Once again this case has been tested for two periods of duration: a short-lived shock of up to two years (RF2), and a long-lived shock of five or more years (RF2a). If the shock is short lived, such as in Australia for the 2008 GFC, then the probability of a crisis occurring is negligible. If this event impacts on Australia for five years, then the probability of a crisis occurring becomes extremely likely - 93 per cent.

Geopolitical risk (RF3)

Currently the world faces a number of geo-political risks that were not as evident two or three years ago. They include:

- Russian policy objectives to increase its authority and control over countries that were previously part of the Soviet Union;
- increasing instability in the Middle East due to intensifying sectarian conflicts; and
- China's increased assertiveness in the China Seas.

Of the three geo-political risks, it is the China Seas instability that poses the greatest direct risk to Australia's economy – a consequence of China accounting for one-third of Australia's merchandise exports in 2014. Should this escalate to the point where sanctions are pursued, it would disrupt trade to and from China, imposing large-scale trade losses in Australia. It would take many years to restructure the economy to adapt to the changed economic reality (that is, resume satisfactory export growth levels).

The analysis indicates that the probability of a crisis stemming from geopolitical trade interruption is linked to the event probability. With a 30 per cent probability of the event occurring there is a 27 per cent probability of a crisis. It is considered unlikely that this event will occur.

Discussion

From this assessment it can be seen that Australia faces a moderate risk of a systemic crisis as a result of global economic factors. With the occurrence of any of these events, a well-managed response is most likely to avert a crisis. Even with a well-managed response, the occurrence of any event will reduce the capacity of the economy to manage subsequent negative shocks. Australia is not well placed to manage long-lived global economic woes.

Carbon emission liability risk factors

12

Beyond the general economic risks, the Australian economy has been stress tested for two potential scenarios related to global climate change mitigation. Both have been found to present a significant systemic risk to the national economy, especially in combination with general economic risks discussed in the previous section.

The first global climate change mitigation risk factor (RF4), is a decline in emissions-intensive exports as other nations transition to low emissions development. The second mitigation risk factor (RF5) is Australia exceeding what is considered to be its 'fair share' of global emissions and being subject to a penalty which is proportional to subsequent domestic emissions.

Emissions intensive exports (RF4)

BZE's recent report, *A fossil economy in a changing world*, explored in detail how Australia's emissions intensive exports would be affected by energy use according to the scenarios provided in the International Energy Agency's World Energy Outlook (WEO). The WEO's 450ppm scenario indicates global energy use consistent with the IPCC's recommended climate change mitigation pathway for limiting the temperature increase to 2 C. The Fossil economy report identified a write-down of Australian export revenue of up to AU\$118 billion by 2030 associated with the 450ppm scenario. This write-down will unbalance Australia's international account where foreign debt liabilities have grown substantially during the boom period.

The resulting increase in current account deficits introduces systemic risk to the economy by way of a balance of payments crisis.

When tested in isolation (RF4), this risk factor results in a 40 per cent probability of at least one crisis occurring in the assessment period (to 2040). This is a significant risk, however less than 50 per cent therefore not the expectation. As the revenue write downs are anticipated to be greatest in the decade following 2020, this risk factor was also assessed in sequence with the low global growth risk factor anticipated to occur prior to 2020 (RF4a). In this instance, the probability of at least one crisis increases to 56 per cent; that is to say, more likely than not.

Domestic emissions penalty (RF5)

The final risk factor assessed is Australia's domestic carbon emissions liability being realised as a penalty on international transactions. The mechanism for such a penalty is not regarded in this analysis. What has been modelled, is a foreign payment obligation in proportion to Australia's domestic emissions in excess of the nation's 'fair share'.

Three alternative scenarios were tested for this risk factor. The first case is one in which Australia does not make a full commitment to CO₂ reduction until it faces punitive measures (RF5). In this case, Australia is subject to an international penalty levied on domestic emissions at the corresponding cost for emissions at that time. Delayed effort has involves the compounding effect of a greater volume of emissions to be penalised in combination with a

rising cost for emissions. At the same time, the lag associated with transitioning the domestic economy to clean energy means it will take time before delayed investments reduce the domestic emissions liability. In this case the probability of a crisis is moderate at 38 per cent.

The second scenario assesses this case in sequence with a decline in emissions intensive exports which would be expected to precede punitive actions (RF5a). In this case, the probability of a crisis increases to 50 per cent.

The final scenario tested is one where Australia pro-actively reduces domestic emissions in advance of any punitive measures (RF6). This case accounts for the costs and effects of domestic emissions reduction as well as the change to external emission related liabilities. In this case the probability of a crisis is reduced to 16 per cent.

Discussion

What is evident here is that Australia's carbon emission liability poses a significant systemic risk to the national economy. What's more, domestic policy can strongly influence these risk factors and substantially reduce the probability of a systemic crisis.

Insights

It is evident that Australia faces a number of strategic risk factors over the next quarter century, a number of which could precipitate a major crisis.

Australia cannot directly control many of these systemic risk factors, such as world financial instability and geopolitical risk. All it can do is reduce the vulnerability of its economy by reducing the risks it can control, such as building up the capacity of low-emission industries focussed on exports and reducing the carbon intensity of the economy. Why is Australia reluctant to do this?

The deregulation of the financial system in the mid-1980s ushered in a market-driven policy philosophy. The basic philosophy is that market actors (that is, corporations, banks, households, foreign investors, etc.) are best equipped to know what change is required in the economy to maintain sustainable growth, and that the market is the only place in which such knowledge can be articulated. Though governments can influence a range of market outcomes (such as interest rates, exchange rates, prices, wage rates, investment effort) they should refrain from doing so. Public policy should concentrate on allowing market segments to operate effectively with minimal intervention in markets.

As a result, in Australia there is little recognised need to examine alternative futures and to investigate where planning (the public sector directly allocating or indirectly mobilising resources to achieve set desirable targets) could be of assistance in achieving superior outcomes. In the context of market-driven policy, this is considered unnecessary and counter-productive as, by definition, the market and market segments should engineer the necessary 'optimum' response.

Given this political philosophy, the prime response to climate change in general, and the coal industry in particular, is explainable. When and if an aggressive approach to climate change is demanded, the appropriate market price will be adopted to drive the necessary decarbonisation of the economy, or enable the import of permits from other jurisdictions with more efficient potential to reduce or offset CO₂ emissions. It is believed that, if circumstances reduce the value of coal exports from what is currently projected, the Australian exchange rate will fall along with real wages, which will encourage competitive expansion of alternative industries.

The conclusion from this study is clear. No matter how well the market signals may lead to the appropriate long-run outcomes (and this has been allowed for in this study), the facts of the matter are that the lags in adjustment to market signals, as well as resource constraints, decide how effectively the market responds over a given time frame. Whatever the benefits of maintaining business as usual until an adjustment is unavoidable, these positive benefits will be more than outweighed by the impact of the required market signal (exchange rates/carbon prices) in increasing the probability of systemic crises.

To reach desired objectives before a systemic crisis is triggered will require considered and effective forward planning.

