CGE modelling analysis of the 2026 Commonwealth Games

Final Report

Department of Jobs, Precincts & Regions

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KPMG.com.au

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Contents

1. Introduction

In this report we use KPMG-REG, a multi-region Computable General Equilibrium (CGE) model of the Australian economy to simulate the impacts on the Victorian economy from hosting the 2026 Commonwealth Games (the Games). The direct impacts of the Games on the Victorian economy have been estimated by EY, with EY providing estimates for best, mid and worst-case scenarios. The direct impact estimates have been conceptualised as shocks to the economy that have been processed in KPMG-REG to estimate the total impact of the Games on the Victorian economy, including the indirect (or flow-on) impacts.

Shocks instigated by the Games can be grouped into the following categories:

— **Temporary (or transitory) shocks** that have a one-off impact on the economy but that do not directly impact the economy in the longer term. Operational expenditures incurred by the government to host the Games and capex required to refurbish existing and/or build new venues and facilities are examples of this type of shock.
— **Permanent, or long-lasting, shocks** that continue to impact the economy long after the Games have concluded. These include legacy effects related to new or upgraded venues/facilities required to host the Games and branding or awareness effects that result in Victoria benefiting from higher visitor numbers and greater export opportunities.

Some shocks will have elements of both types of impact. For example, Games-induced visitation will have a temporary element relating to actual attendance or participation at the Games and a longer-lasting element where the Games showcases Victoria to a large interstate and international audience and influences their future visitation preferences.

The shocks (direct impacts) provided to KPMG by EY have a time profile. For all but two of the direct impacts the time profile does not extend beyond 2029-30.[1] Given the nature of the inputs and the inherent difficulty in separating out the temporary elements of a shock from the longer lasting elements, KPMG has not attempted to simulate the impacts of short-term impacts separately from long-term impacts. Instead, our computations will focus just on the period 2022-23 – 2029-30 and ignore any potential impacts beyond this horizon.

The scope of this assignment is limited to comparative static (or single period) analysis, where the typical practice is to define the length of the period in terms of flexibility in the labour and capital markets, rather than in terms of calendar time. The usual options for specifying the economic environment from a temporal perspective include:

a. **Short run 1**: sufficiently short so that the stock of productive capital cannot respond to the shock and sufficient slack in the labour market so that real wages are not impacted by the shock and employment is demand determined.
b. **Short run 2**: as above but there is no slack in the labour market (i.e., full employment) so any positive shock is absorbed by an increase in real wages.
c. **Long run**: sufficiently long after a shock has occurred that the economy has fully adjusted with all factors of production, including labour, fully employed and rates of return at their equilibrium levels.

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[1] The two impacts for which a longer profile is provided are: (i) *Lifecycle costs of new facilities at Kardinia Park* of $2 million per annum; and (ii) *Social Housing Benefits* of $22.75 million per year.

Depending upon the size and nature of the shock, the short run is likely to be a period less than 3 years while the long run might be reached 5 to 10 years after the shock. The economic environment over the focus period, 2022-23 – 2029-30, cannot be characterised as either a "short run" or a "long run". Our approach is to adopt an intermediate time frame that we label "medium run", where we allow a trade-off between capital growth and rates of return, and between employment and real wages.

In comparative static mode KPMG-REG is used to estimate how different the size and structure of the Victorian economy would be in a typical year in the period 2022-23 to 2029-30 if the Games are hosted. This involves simulating two scenarios:

— the **baseline scenario**, which is our best estimate of the average size and structure of the Victorian economy over the period 2022-23 to 2029-30 under the assumption that the Games are not hosted in Victoria; and
— the **Games scenario**, which is a counterfactual scenario designed to estimate the average size and structure of the Victorian economy over the period 2022-23 to 2029-30 under the assumption that the Games are hosted in Victoria.

The typical year approach means that we can use the average annual values of the direct impacts estimated by EY as shocks in the CGE modelling. In addition, the total impact of the Games on the economy over the period 2022-23 – 2029-30 can be approximated by scaling the impacts for the typical year by factor of 8, the number of years in the focus period.

2. Direct impacts

The shocks that are implemented in KPMG-REG to capture the direct economic impact of the Games on the Victorian economy are summarised in Table 2-1. These shocks are derived largely from estimates of the direct impacts of the Games provided by EY. The key exception relates to the social housing benefits. EY have estimated total social housing benefits to be $364 million in the mid case scenario. These benefits are estimated to be $22.75 million per annum for the period 2026-27 to 2041-42. For the focus period, 2022-23 – 2029-30, EY's estimates imply an average annual benefit of $11.4 million. EY's estimates appear to be based on the assumption that 325 additional dwellings will be added to the social housing stock because of the Games. No estimate of additional capex is included in the EY estimates.

We have taken a conservative approach and assumed that no new dwellings will be added to the social housing stock because of the Games, but that the construction of 325 such dwellings in time for the Games will represent a "bring-forward" of investment. Figure 2.1 shows the assumed cumulative increment to the public housing stock in the baseline and in the Games scenarios where the construction of 325 social housing dwellings is brought forward to 2025-26. Note that in both scenarios Victoria ends up with the same stock of publicly funded dwellings.

A notable feature of the direct impacts summarised in Table 2-1 is that the total injections of spending and productivity benefits into the Victorian economy are very similar across the best-case, mid-case and worst-case scenarios. This mostly reflects the fact that capex and expenditure by the government are higher in the worst-case scenario than in the other scenarios, which offsets the lower visitor expenditures and export sales. In the modelling reported below the imposition of a strict budget constraint ensures that higher government spending does not simply translate into higher levels of economic activity. The government must match the increased spending with higher tax revenues, which reduces the disposable incomes of taxpayers.

Our modelling, however, does not account for the negative economic impacts of higher capital costs in delivering venues and facilities for the Games. For example, if all the scenarios have similar projections for operating revenues that will be generated by a new venue over its life the economy will be better off if that revenue stream can be supported by an asset that costs $10 million to deliver rather than $12 million. Indeed, in a worst-case scenario the negative impact might be two-sided: the cost of constructing the asset might be higher and the revenue stream that it generates may be lower.

Table 2-1 Summary of direct impacts used as inputs in the CGE Modelling – average annual impacts over the period 2022-23 – 2029-30 measured in 2021-2022 dollars

|	Best	Mid	Worst
Incremental visitor spend			
Inter-regional Visitors	$51.7	$46.3	$40.9
International Visitors	$41.1	$36.8	$32.5
	$92.8	**$83.1**	**$73.5**
Incremental export sales			
Inter-regional Exports	$35.9	$33.3	$30.7
International Exports	$27.1	$25.2	$23.3
	$63.0	**$58.5**	**$54.0**
Other new spending in Victoria			
Net inter-regional exports	$11.20	$11.00	$10.90
Net international exports	$11.20	$11.00	$10.90
	$22.4	**$22.0**	**$21.8**
Government			
Operational spend	$222.5	$231.0	$239.5
Other	$9.4	$10.0	$10.6
	$231.9	**$241.0**	**$250.1**
Capex			
Venues/Facilities	$83.7	$95.2	$106.8
New Housing	$9.9	$9.9	$9.9
	$93.6	**$105.1**	**$116.7**
Productivity benefits			
Health Benefit	$70.1	$57.2	$44.3
Volunteering	$1.6	$1.6	$1.6
Social Housing Benefit	$6.0	$6.0	$6.0
	$77.6	**$64.7**	**$51.9**
Total injections	**$581**	**$574**	**$568**

Social housing impacts

Figure 2.1 shows the assumed cumulative increment to the public housing stock in the baseline and Games scenarios.

**Figure 2.1   Cumulative increment to the stock of public housing**
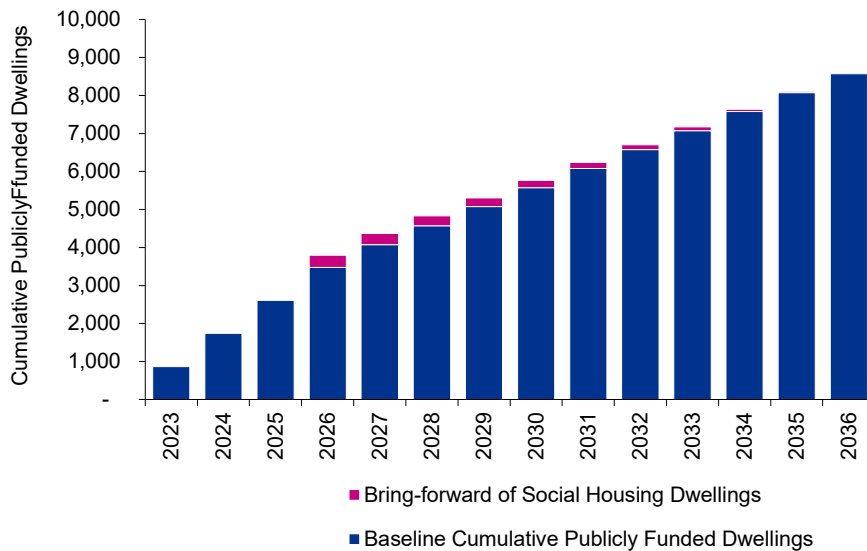
The benefits of pulling forward the provision of 325 dwellings for social housing is shown in Figure 2.2. These benefits are calculated on the same basis as the EY estimates: each dwelling has 2.8 bedrooms and each bedroom generates $25,000 of benefits each year. If we assume that the dwellings will be used to house the athletes for the period of the Games and that it will take between 18 and 24 months to ready the dwellings for occupation, then up to two years of benefits may be lost in the transition. In our simulations we have assumed that three years of benefits are captured in the focus period (i.e., those shown for 2028 – 2030 in Figure 2.2).

Figure 2.2   Incremental benefits from the pull-forward of social housing
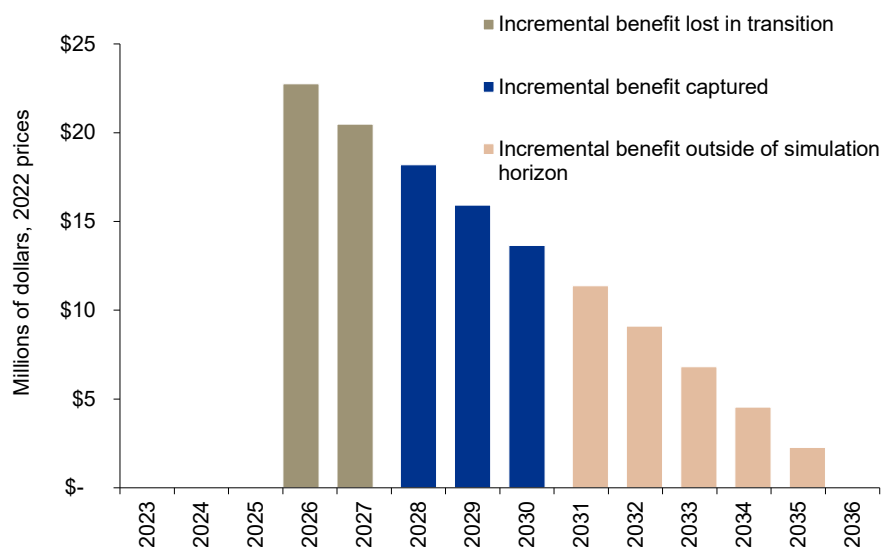
In our modelling we have also captured the incremental capex required to bring forward the construction of the 325 additional dwellings. This is shown in Figure 2.3 where the capex is loaded into 2026 and in subsequent years is less than would have occurred if the construction of the dwellings had not been pulled forward. We have assumed that the cost of constructing each dwelling is $406,504, consistent with the assumption in the Big House Build program

Figure 2.3   Incremental capex from the pull-forward of social housing
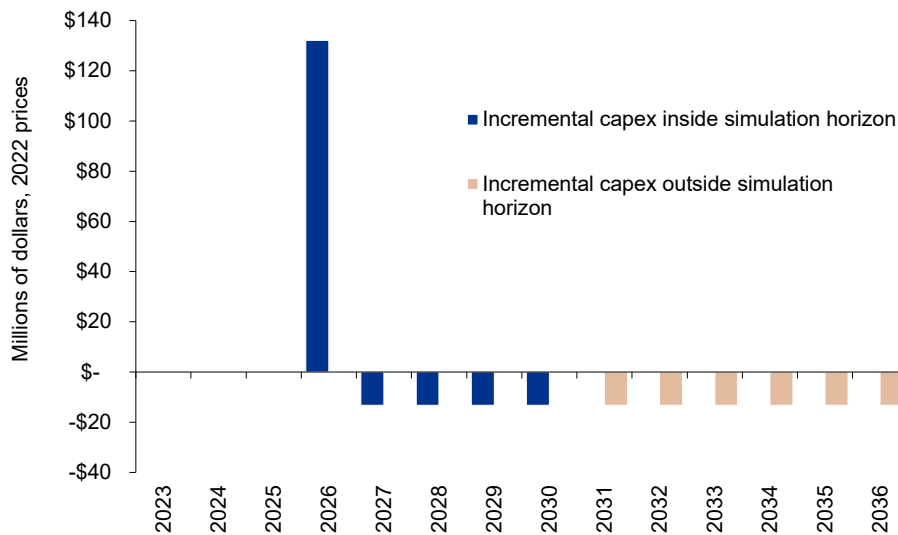
Imposition of the budget constraint

In simulating the scenarios with the government budget constraint in place we have assumed that the amount spent by the government is net of the operating revenues received from businesses and households domiciled in jurisdictions outside of Victoria. This includes revenues from broadcast rights, sponsorship, licensing and merchandising, and ticketing. We assume that 30% of revenues from licensing and merchandising and from ticketing are sourced from outside of Victoria. All revenues from broadcast rights and sponsorship are assumed to be sourced from businesses domiciled outside of Victoria and/or from Victorian businesses that re-direct comparable expenditures they would have made in other jurisdictions if Victoria did not host the Games.

3. Simulation results

In this section we report simulation results for the three Games scenarios (i.e., best-case, mid-case and worst-case) modelled under two different assumptions relating to the government budget constraint. In the first set of simulations no constraint is imposed on the government budget. In the second set of simulations we impose a strict constraint that does not allow the government budget to change in response to the Games shocks. An additional set of results designed to test the sensitivity of the health benefits assumptions is also reported. In these simulations the health benefits shocks are halved. All results are presented as average annual deviations from the baseline.

i. No government budget constraint

In the absence of a budget constraint the Games are estimated to increase real GSP by $262 million per year on average between 2022-23 and 2029-30 in the mid-case scenario. This average is about $16 million less in the worst-case scenario, with the best-case scenario generating an additional $16 million. On a cumulative basis over the 8 year timeframe, real GSP is estimated to increase by approximately $2.1 billion under the mid-case scenario.

Just over 1,400 additional FTE jobs are generated by the Games on average in the focus period and real household consumption increases by between $250 million and $256 million per annum on average. The differences across the scenarios are relatively small, reflecting the fact that in aggregate the injections into the economy are quite similar.

Table 3-1 Simulation results, deviations from the base line over the period 2022-23 – 2029-30 in headline Victorian macroeconomic variables – no government budget constraint

	Best	Mid	Worst	Best	Mid	Worst
	Average annual ($m, 2022)			*Cumulative ($m, 2022)*		
Gross State Product	$277	$262	$246	$2,220	$2,093	$1,966
Aggregate investment	$185	$193	$201	$1,480	$1,543	$1,606
Household consumption	$256	$253	$250	$2,048	$2,024	$2,000
Government consumption	$232	$241	$250	$1,855	$1,928	$2,001
Employment (# FTE)	1,430	1,425	1,420	NA	NA	NA
Real Wages (% deviation)	0.069%	0.068%	0.068%	NA	NA	NA

ii.   Government budget constraint imposed

While the imposition of a strict budget constraint pulls back the increase in real GSP generated by the Games, its impact is most evident in the results for real household consumption. This reflects the impact of the budget constraint on real disposable household income. The differences in the results across the three scenarios remain modest, although they are larger than was the case for the scenarios where the budget constraint was not imposed.

Table 3-2 Simulation results, deviations from the baseline over the period 2022-23 – 2029-30 in headline Victorian macroeconomic variables – strict government budget constraint

	Best	Mid	Worst	Best	Mid	Worst
	Average annual ($m, 2022)			*Cumulative ($m, 2022)*		
Gross State Product	$243	$223	$204	$1,942	$1,785	$1,628
Aggregate investment	$164	$170	$176	$1,312	$1,361	$1,409
Household consumption	$27	$6	-$15	$216	$49	-$119
Government consumption	$206	$216	$226	$1,645	$1,724	$1,804
Employment (# FTE)	1,303	1,279	1,254	NA	NA	NA
Real Wages (% deviation)	0.060%	0.058%	0.057%	NA	NA	NA

It is important to recognise that in a comparative static simulation it is difficult to impose a realistic budget constraint. In practice, the government may choose to meet its budget constraint by a combination of expenditure switching (e.g., re-prioritising the composition and timing of expenditures) and revenue raising. Moreover, the budget constraint may be met over a longer period than implied in our computations. A reasonable approach to interpreting the scenario results with and without the strict budget constraint is that the impact of the Games over the period 2022-23 to 2029-30 will best be characterised by some middle ground between the two sets of results.

iii.   Sensitivity of the results to the health benefit shocks

Table 3-3 and Table 3-4 report simulations results analogous to those in Table 3-1and Table 3-2 except that the health benefit shock has been halved. Focusing on the mid-case scenario, halving the size of the health benefit shock reduces GSP by about $40 million in the scenario where there is no budget constraint and by about $46 million in the scenario where a strict budget constraint is imposed.

Table 3-3 Simulation results, deviations from the base line over the period 2022-23 – 2029-30 in headline Victorian macroeconomic variables – no government budget constraint, direct health benefits halved

	Best	Mid	Worst	Best	Mid	Worst
	Average annual ($m, 2022)			*Cumulative ($m, 2022)*		
Gross State Product	$226	$219	$213	$1,806	$1,755	$1,704
Aggregate investment	$177	$186	$196	$1,415	$1,490	$1,565
Household consumption	$239	$239	$239	$1,909	$1,910	$1,912
Government consumption	$232	$241	$250	$1,855	$1,928	$2,001
Employment (# FTE)	1,361	1,368	1,376	NA	NA	NA
Real Wages (% deviation)	0.066%	0.066%	0.067%	NA	NA	NA

Table 3-4 Simulation results, deviations from the baseline over the period 2022-23 – 2029-30 in headline Victorian macroeconomic variables – strict government budget constraint, direct health benefits halved

	Best	Mid	Worst	Best	Mid	Worst
	Average annual ($m, 2022)			*Cumulative ($m, 2022)*		
Gross State Product	$186	$177	$167	$1,485	$1,412	$1,339
Aggregate investment	$154	$162	$170	$1,229	$1,293	$1,356
Household consumption	-$5	-$20	-$35	-$42	-$162	-$282
Government consumption	$206	$216	$226	$1,645	$1,724	$1,804
Employment (# FTE)	1,198	1,193	1,188	NA	NA	NA
Real Wages (% deviation)	0.055%	0.055%	0.054%	NA	NA	NA

4. Regional impacts

The Games will have a regional focus with all events proposed to be held in Geelong, Ballarat, Bendigo and Gippsland. In terms of athletes anticipated to compete in the Games, just over 40% are expected to do so at events held in Geelong, 27% at events held in Ballarat, 20% at events held in Bendigo and 12% at events held in Gippsland. This means that much of the capital expenditure needed to host the Games will be invested in the four regions. Similarly, visitation for the purpose of attending the Games will focus on the regional centres. This includes visitors from interstate and overseas as well as Victorian visitors from outside of the four regions. Operational expenditures incurred by the Victorian government to host the Games may also be focused on the four regions.

The CGE modelling done for this study does not break up the Victorian economy into its regional constituents. Thus, the results we report are estimates of the direct and indirect impacts of the Games on the Victorian economy as a whole. Given the nature of the Games we do believe there is a compelling way to disaggregate the CGE results outside of the model to provide guidance on the impacts at the regional level. To illustrate this point we could consider a naïve approach to disaggregating the Victorian estimate, which involves using shares of the total direct impacts assumed for each of the four regions. For example, the EY estimates suggest direct impacts are distributed across regions as follows:

— between 40% and 50% to Geelong;
— around 26% to Ballarat;
— around 17% to Bendigo;
— between 7% to 10% for Gippsland; and
— between 0% and 7% for other parts of Victoria.

If, however, we simply used these shares to disaggregate the uplift in Victorian GSP and jobs estimated in the previous section we would likely get a misleading picture of the regional impacts. For example, impacts on the Greater Melbourne economy would appear to be minor. While there may be scenarios where this is a reasonable estimate a more likely scenario is that Greater Melbourne and other Victorian regions that do not host Games events are likely to experience a complex range of impacts. These include:

— Supply chain impacts where shocks originating in the Games regions result in imports of goods and services from other regions to supplement/complement local capacity.
— Income impacts where increases in activity in the Games regions are partly accommodated by businesses and workers domiciled in other regions. For example, this may include businesses domiciled in Melbourne winning contracts to construct Games-related venues or facilities. Similarly, contractors and workers domiciled on the Surfcoast may be hired on a drive-in-drive-out basis to work on Game-related activities.
— Interstate and international visitors may base themselves in Melbourne and commute to events in the adjacent regions, which has implications for how their expenditure is allocated across the regions. Similarly, pre and post Games tourists are likely to include Melbourne and other non-Games regions in their itineraries.
— The regional focus of the Games will impact intra-state visitor flows with people domiciled in non-Games regions visiting those regions to attend the Games. These flows

boost activity in the Games regions by increasing exports of tourism services and potentially reduce activity in the non-Games regions that increase their imports of tourism services. How these impacts play out depends on a complex range of factors, including: what other expenditures the visitors displace to attend the Games; and how locals respond to the Games in terms of attendance and dealing with increased visitation.

— The potential health impacts of the Games are likely to be evenly disbursed across Victoria, reflecting the distribution of the population rather than the location of the Games events.

— The potential Games-induced uplift in exports is also likely to be relatively evenly disbursed across Victoria, reflecting the distribution of economic activity rather than the location of the Games events.

— The social housing impacts will spread beyond the Games regions if the construction is done by businesses and workers domiciled in non-Games regions and/or it requires imports of goods and services from non-Games regions. Moreover, the Games-induced benefits of social housing are assumed to result from pulling forward the construction of these dwellings. If the Games result in a redistribution of social housing across regions the impact will be different.

— Any population movements within Victoria induced by the Games will have complex impacts. Movements of population to the Games regions may boost those economies, including through better utilisation of capacity. Regions that lose population may benefit from reduced congestion and pressures on infrastructure but will lose from lower economic activity.

The issues described above have two implications. The first is that reliable estimates of the sub-state impacts of the Games requires analysis to be done with a CGE model that has greater region granularity than KPMG-REG. For example, KPMG-SD is designed to represent the economy at the finest level of regional disaggregation that is economically sensible (e.g., the SA4 or LGA level). Such a modelling framework allows the analyst to capture the regional dimensions of the direct impacts more accurately and to properly consider the issues discussed above. The second implication, which is related to the first, is that the inputs required to support such analysis are greater and more complex.

5. Key caveats

The key caveats associated with the CGE modelling presented in this report have, for the most part, been indicated in the discussion of key assumptions. This section provides a consolidated summary of these caveats.

Integrity of the direct impact estimates

The modelling of the direct impact of the Games is a work in progress and will evolve as further research is conducted into the cost and benefits of different options relating to the logistics of hosting the Games and into how the potential benefits of the Games in terms of induced visitation, induced trade and induced health benefits can be maximised. We have made some adjustments to the direct impacts of social housing estimated by EY but these need to be more carefully considered in the context of the government's social housing policies. We have also presented results where the health benefits estimated by EY, which are large and short-lived, are halved.

At this early stage of the analysis the composition and nature of the induced tourism and trade impacts have not been fleshed out. We have made assumptions about the industry/commodity composition of these impacts loosely based on other major event studies and we have made assumptions about how these impacts are allocated across inter-state and international sources.

As consideration of options progresses it will become easier to distinguish direct impacts that are temporary in nature from those that are longer lasting (legacy). This is important for estimating the full impact of the Games as temporary impacts are likely to be most valuable if the economy is operating at below full capacity while legacy impacts can provide benefits that should be measured long after the Games have concluded. In this context, the implications of the capex to refurbish and/or provide additional facilities and venues for the Games can be better developed. This includes considering the utilisation of these assets beyond the Games and the extent to which they represent a bring-forward of assets that would have been developed anyway versus the development of assets that would not be developed in the absence of the Games.

Comparative static analysis

The CGE analysis has been done in a comparative static framework. This simplifies the analysis and facilitates a rapid high-level assessment of the impact of the Games. However, a comparative static analysis is limiting because it cannot provide insights relating to the timing of particular impacts, such as the capex program, and the timing of benefits. Large injections of expenditure into the economy when it is near full capacity will have different impacts than if these same expenditures were made at a time when the economy is operating at below full capacity. This is particularly relevant when the expenditures are made in specific regions.

The absence of dynamics also makes it difficult to consider the full impact of the Games in a context where some impacts are temporary, and others are long lasting. For example, a dynamic analysis may allow for consideration of the impact of a capex shock, which is temporary, to develop a facility as well as the benefit stream accruing from facility operations which may last for many years.

Similarly, imposing a realistic budget constraint in a comparative static context is more difficult than in a dynamic context where the impacts can be smoothed over time, taking into account the impact of longer-term impacts on government revenues.

Aggregated regional analysis

It is proposed that the Games will have a regional focus. As discussed in the previous section the direct impacts of the Games will therefore be region-specific. The modelling for this study, however, has considered the impacts of the Games for Victoria as a whole. The case for doing more detailed regional modelling is covered in the previous section. It is important to recognise that a detailed regional modelling analysis may generate different results for Victoria as a whole even if the direct impacts measured on Victoria as whole do not change. This is because an expenditure shock of $10 million on the Victorian economy as a whole will have a different impact than a shock of $10 million that is concentrated on Ballarat. Drilling further down, an expenditure shock of $10 million on the Victorian *Sport and Recreation* industry will have a different impact on the Victorian economy than a shock of $10 million on the *Sport and Recreation* industry in Geelong.

6. Future considerations

In this section we provide some guidance on shaping future work aimed at better understanding the impact of hosting the Games and at developing frameworks to measure and maximise the benefits. This guidance draws on our experience at KPMG in analysing the impacts of major events on the economy and on the community.

Insights from KPMG's pre and post 2006 Commonwealth Games analysis

The analysis of the 2006 Games emphasised several key points:

— In the ex ante analysis it was important to carefully identify and quantify Games-induced impacts that were transparent and justifiable. It was understood that these ex ante projections would be held up as a yardstick for assessing the benefits of the Games after the fact.
— In preparing for the ex post analysis it was important to be able to draw on the ex ante analysis to frame the evaluation, including in the design of the survey used to capture the data required to measure the impacts that had been identified in the ex ante study.
— It is considered that a large part of the success of the analysis of the 2006 Games was that the ex ante analysis did not seek to overstate the benefits of hosting the Games and that the ex post analysis could draw on robust data to assess the metrics established in the ex ante analysis.

The importance of a benefits realisation framework

Identifying and estimating potential benefits from the hosting of major events is an important component of the decision-making process when considering such events. Once a decision is made to proceed with an event, however, it is even more critical to ensure that processes are put in place to determine whether identified benefits are achieved and whether they are in line with that predicted or expected. A recent report on potential economic, social and environmental impacts of a Brisbane 2032 Olympic and Paralympic Games identified that having "robust evaluation frameworks, measurable targets, transparent evaluation against these targets and clear lines of accountability for delivery against intended outcomes" was a critical success factor underpinning the hosting of a major event of this nature. [2] With this in mind, and should Victoria proceed with hosting the event, it is recommended that the Victorian Government immediately seek to develop and implement a benefits realisation framework and plan to ensure effective evaluation of outcomes, and to provide a coordinated and consistent approach to legacy planning in order to maximise benefits. This framework and plan should encompass at a minimum the benefits identified in the various ex ante economic analyses undertaken in relation to the event, and could also be extended to include measurement of other benefits and outcomes the Government is endeavouring to achieve through hosting the event.

As discussed in the previous section the specification and quantification of the direct impacts will continue to evolve as further research is completed. In conducting this additional research, it may be useful to be guided by a benefits realisation framework that

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[2] *Brisbane 2032 Olympic and Paralympic Games: Preliminary Economic, Social and Environmental Analysis Summary Report, DTIS & KPMG, 2021*

helps discipline the analysis and connect all the components. Such a framework may help deal with hard economic impacts alongside social and community impacts that are more difficult to quantify but potentially equally as important. The social housing benefits and health benefits that we dealt with in the economic modelling presented above fit into this category.

Importantly, it should be recognised that the direct impacts of the Games that are identified and measured before the fact will be used, implicitly or explicitly, to evaluate the success of the Games at some point in the future.

KPMG has promoted the idea that ex ante measures of impact expressly focus on potential benefits from hosting the Games. How many of those benefits are actually generated from hosting the event, however, depends on a range of factors, including how well the process of hosting the event is managed and what programs and policies are put in place to leverage the exposure that the Games provides. Thus, the focus of ex ante analysis is about "what's on the table" and the focus of ex post analysis is about "what was harvested".

More detailed modelling

We have already outlined the key dimensions in which the modelling could be enhanced to provide a deeper and more comprehensive assessment of the impacts. Specifically, consideration should be given to modelling the impacts at a finer level of regional disaggregation and to using comparative dynamics. The regional dimension is important because of the regional focus of the Games and dynamic analysis is important to understand the timing of the impacts and to allow for more realistic scenarios that better accommodate temporary and long-lasting shocks and government budget implications.

Appendix: Overview of KPMG-REG

KPMG-REG models the economy as a system of interrelated economic agents operating in competitive markets. Figure A1 is a stylised representation of the types of relationships that are captured in KPMG-REG.[3] Economic theory is used to specify the behaviour and market interactions of economic agents, including consumers, investors, producers and governments operating in domestic and foreign goods, capital and labour markets. Defining features of the theoretical structure of KPMG-REG include:

— optimising behaviour by households and businesses in the context of competitive markets with explicit resource constraints and budget constraints;
— the price mechanism operates to clear markets for goods and factors such as labour and capital (i.e. prices adjust so that supply equals demand); and
— at the margin, costs are equal to revenues in all economic activities.

Figure A4: Schematic overview of KPMG-REG
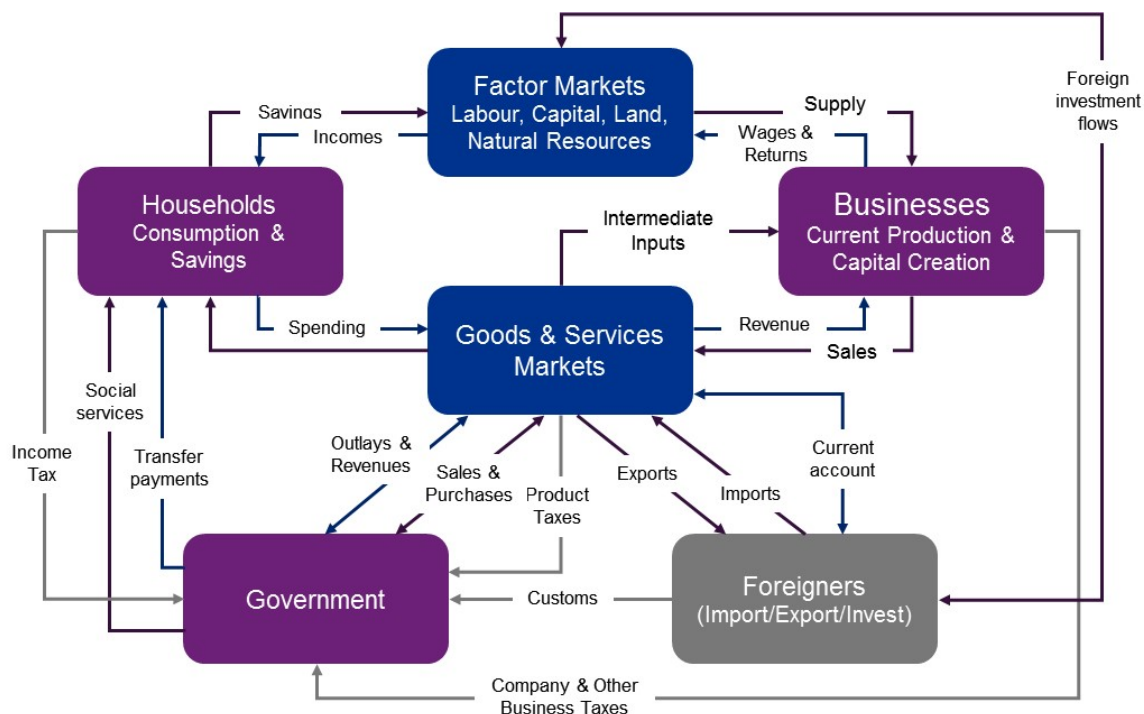
KPMG-REG uses Input-Output (IO) data to quantify the flows of goods and services between producers and various users (e.g., intermediate inputs to other producers, inputs to capital creators, households, governments and foreigners) and the flows associated with primary factor inputs (i.e., labour, capital, land and natural resources).

In KPMG-REG the IO database is combined with the model's theoretical structure to quantify sophisticated economic behavioural responses, including to:

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[3] These relationships apply at the regional level with an elaboration of the relationships with "Foreigners" to include inter-regional flows of goods and services, transfers and savings and people.

— price and wage adjustments driven by resource constraints;

— price and tax and/or government spending adjustments driven by budget constraints;

— allow for input substitution possibilities in production (e.g., allowing the combination of labour, capital, and other inputs required to produce a particular output to vary in response to relative price changes);

— capture a wide set of economic impacts driven by the responses of consumers, investors, foreigners and other agents to changes in prices, taxes, technical change and taste changes.

KPMG-REG's theoretical structure and database facilitates detailed modelling of State and Federal government fiscal accounts and balance sheets, including the accumulation of public assets and liabilities. Detailed government revenue flows are modelled, including a range of direct and indirect taxes, and income from government enterprises. Government spending includes public sector consumption, investment and the payment of various types of transfers (such as pensions and unemployment benefits).

Key modelling assumptions

For this study the industrial structure of the two regional economies in KPMG-REG, Victoria and Rest of Australia, is represented by 20 sectors, each producing one good or service. KPMG-REG contains many more variables than equations. The model can determine values for as many variables as it has equations. To run KPMG-REG it is necessary to select a sub-set of variables that will be determined by the model (endogenous variables) with the remainder determined outside the model (exogenous variables). Apart from the exogenous variables that will be shocked, the values of all remaining exogenous variables are assumed to remain unchanged from their baseline values.
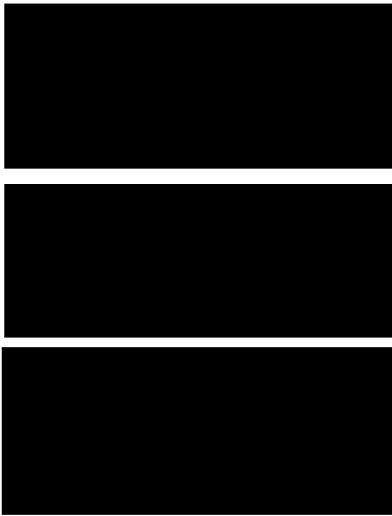
The choice of exogenous variables and the nature of the baseline determine the economic environment (or economic context) that is assumed appropriate for analysing the impact of the Games. The approach taken in this study is to analyse the impact of the Games in the context of a medium run economic environment, where we allow a trade-off between capital growth and rates of return, and between employment and real wages.

The key settings for the simulations where we do not impose a budget constraint include:

i.   tax rates and government spending are exogenous, with the latter shocked to reflect government expenditures required to host the Games;

ii.   government budget balances are free to vary;

iii.   investment in sector-specific capital stocks responds to rates of return, which are a function of the demand for fixed capital and costs of creating capital;

iv.   real wages are assumed to respond to changes in the unemployment rate;

v.   the number of working-age people is held fixed at the number in the baseline;

vi.   at the national level the supply of labour is inert, with limited scope to respond to real wages;

vii.   at the state level households (and labour) can move across regions in response to real wage differentials;

viii. the average propensity to consume out of household disposable income is held fixed at its baseline value; and

ix.   consumer preferences and technical change parameters are held fixed at their baseline values.

In the simulations where we impose a budget constraint a non-distortionary lump-sum tax is assumed to adjust to ensure that the budget balance remains unchanged from its baseline value.

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