Australian Economic Papers

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ORIGINAL ARTICLE OPEN ACCESS

The Australian Greens' Public Property Developer: An Input–Output Analysis

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Received: 28 April 2024 | **Revised:** 29 July 2024 | **Accepted:** 30 July 2024

Keywords: Australian greens | comparative economic systems | general aggregative models | general equilibrium and disequilibrium | housing affordability

ABSTRACT

The Australian Greens have recently proposed the establishment of a new federal government agency to build 360,000 extra homes over five years. These homes would be sold or rented at below-market rates. The appraisal of this plan has so far been confined to a fiscal balance perspective, where completed homes are sold, rental income is received, and government administration and borrowing costs are serviced. This ignores the flow-on effects on the broader economy from expanded residential building construction activity. This paper starts to fill this gap by using a simple Leontief input–output model to analyse a counterfactual in which the Greens' plan is partially implemented into the structure of the Australian economy in 2021–2022. In light of the $84.14 billion static change in the level of total national product that, other things equal, must have occurred to satisfy an augmented final use bill corresponding to the Greens' plan, the simulation finds that projected imposts on the federal budget are rendered relatively modest. Potential extensions and applications of the model for policymakers are considered.

JEL Classification: D5, E1, P5

1 | Introduction

Australia is in the grip of a housing shortage and affordability crisis.[1] The Australian Greens—the third largest national political party by vote—have recently proposed the establishment of a new federal government agency to build 360,000 extra homes over 5 years. These homes would be sold or rented at below-market rates. This works out to an average build rate of 72,000 homes per year.

The Parliamentary Budget Office (PBO) estimates this would cost the federal budget $12.5 billion in net terms over 5 years.[2] That is, after completed homes are sold and rental income is received, and government administration and borrowing costs for construction and land are serviced (PBO 2024, 7).

Many commentators have dismissed the Greens' plan as too expensive. However, the budget impost is just one consideration. The PBO costings ignore the flow-on effects on the broader economy as all these proposed new homes get built. This oversight is all too common in political discussions about housing policy, even though comparable public infrastructure projects are frequently evaluated based on their overall economic impacts.

In fairness, this is not within the strict remit of the PBO. A systematic consideration of this dimension of policy costings would significantly widen its scope and workload. Nonetheless, this means the PBO costings are, at most, an incomplete accounting exercise rather than a proper economic analysis.

This paper starts to fill this gap by analysing the flow-on effects of the Greens' plan using the standard techniques of input–output (IO) analysis and the latest IO data compiled by the Australian Bureau of Statistics (ABS). It is assumed throughout that the plan is workable in terms of the Australian Constitution and federal-state relations. The analysis should be taken as a simplified first cut that could subsequently be extended in a variety of directions. The focus is on production. No attempt is made to incorporate measures of welfare through utilities or externalities.

On the other hand, the analysis does offer some detailed insights into the impact of an alternative policy course on specifically relevant industries. Models with higher dimensionality can often obscure these mutual interdependencies.

This paper contributes a reference point for a more systematic discussion about the economic benefits of the Greens' plan. It moves us beyond the *ad hoc* forecasts concerning fiscal balance that have so far been the basis of most appraisals. The novelty of the analysis lies in its use of an economic model that, while being analytically and empirically well suited to housing construction, has generally been marginalised in favour of more elaborate techniques.[3]

The paper is structured as follows. Section 2 sets up the framework and approach to be used. Section 3 constructs the central counterfactual by simulating the output effect of an increase in final uses corresponding to the Greens' plan. Section 4 concludes with a summary of the main results, considers criticisms of the model, and discusses potential extensions and applications for policymakers.

2 | The Framework and Approach

2.1 | An Australian Leontief System

Suppose we ignore state and territory boundaries and divide the whole of Australia into n industries. These industries make final products used elsewhere in the economy, and for final use by households, government, investment, inventories,[4] and exports. To make its final product, each industry uses products made by other industries, as well as some made by its own industry. This is the general framework to be used, as famously pioneered by Leontief (1986).

The economic data to be organised and computed within this framework comes from the ABS input–output tables for financial year 2021–2022. These are the latest tables available. Given these consist of 115 industries,[5] only the key results from several large matrix transformations are presented in Table A1 of the appendix.

All data assumes the direct allocation of imports. This means imported products are isolated as a distinct category. The ABS further categorises these into products which are also produced domestically. These are referred to as competing imports and are included in all industry output totals.[6] The terms “output” and “product” are used interchangeably throughout this paper.

Finally, households are left outside the direct analysis.[7] A Type 1 Leontief model is initially used. In this context, the explicit inclusion of a household sector does not add much to the basic argument of the paper. Household incomes are implicitly captured in industry output totals. The employment dimension is also initially omitted to keep the argument on track. This does not mean induced impacts are unimportant. In Section 4.5, relevant employment flow-ons are partially derived and simulated using results from the basic model. This lays the groundwork for the development of more intricate extensions.

2.2 | Formal Setup Focused on the Residential Building Construction Industry

The system is more formally specified as follows.

(1) The national economy was composed of $n = 115$ industries in the reference year. Denote the initial output total of industry i as x_i, where $i \in \{1, 2, \ldots, 115\}$. Write the vector of initial output totals as $\boldsymbol{X} = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_{115} \end{bmatrix}$. The corresponding values in the relevant IO tables are categorised by the ABS as “Australian production” totals (ABS 2024a). These are presented in Table A1 of the appendix.

The heart of the Greens' housing plan is the residential building construction (RBC) industry. In Table A1 of the appendix, this is enumerated as industry no. 70. In the reference year, $x_{70} = \$109.7$ billion (Appendix, Table A1: Columns 1 and 2). Around 20% of this amount represented value-added components including salaries and wages, profit, and taxes (ABS 2024a).

(2) The 115 by 115 industry $\boldsymbol{A}$ matrix of direct requirement coefficients quantifies the product proportions each industry directly requires from other industries to make a unit of final product (ABS 2024b). In the Leontief system, it is assumed that these coefficients are fixed, and that all factors of production are used in fixed proportions.

Denote a_{ij} as a coefficient representing the amount of product from industry j directly required by industry i, where $i, j \in \{1, 2, \ldots, 115\}$. Here are some relevant examples. To make a dollar's worth of RBC industry product for final use in 2021–2022, the RBC industry directly purchased 27.8 cents worth of product from the construction services industry, 1.5 cents worth from the road transport industry, and 3.4 cents worth from itself (ABS 2024b).[8] In Table A1 of the appendix and the referenced ABS table, industry no. 70 and 73 correspond to the RBC industry and construction services industry respectively. This means that $a_{70,73} = 0.0278$.

(3) Subtracting $\boldsymbol{A}$ from the 115 by 115 identity matrix $\boldsymbol{I}$ gives the $\boldsymbol{I} - \boldsymbol{A}$ matrix. This represents the portion of each industry's product available for final uses.

(4) In making its 27.8 cents worth, the construction services industry purchased some product from the retail trade industry. In making its 1.5 cents worth, the road transport industry purchased some product from the petroleum industry, and so on. By “reversing” the isolation of direct effects in the previous matrix, the $(\boldsymbol{I} - \boldsymbol{A})^{-1}$ matrix of total requirement coefficients can account for the economy's indirect production ties (ABS 2024c). This matrix is sometimes referred to as the Leontief inverse.[9]

2.3 | The Flow-On Effect on Output

Summing together all coefficients in the RBC industry column of the Leontief inverse yields the basis of the industry's *flow-on effect* on output. This shows that, *ceteris paribus*, for every dollar's increase in the RBC industry final use bill for 2021–22, the total product of the national economy must have expanded by \$2.47 (ABS 2024c).

(5) The 115 by 115 matrix $\boldsymbol{Y}$ represents the exogenous final use values for each industry's product. The $(\boldsymbol{I}-\boldsymbol{A})^{-1}\boldsymbol{Y}$ matrix allows us to derive the *total final product* of each industry obtained through the Leontief inverse, or the direct and indirect transactions generated by each industry as it sells to final uses. Let y_i^* denote the total final product of industry i, where $y_i^* = \sum_{j=1}^{115}\left[(\boldsymbol{I}-\boldsymbol{A})^{-1}\boldsymbol{Y}\right]_{ji}$. Write the vector of total final products as $\overline{\boldsymbol{Y}} = \begin{bmatrix} y_1^* \\ y_2^* \\ \vdots \\ y_{115}^* \end{bmatrix}$. These computed values are conveniently presented alongside the $\boldsymbol{X}$ values in Table A1 of the appendix.

(6) We can now write the national economy's total output as a function of final uses, such that $\boldsymbol{X} = (\boldsymbol{I}-\boldsymbol{A})^{-1}\boldsymbol{Y}$.

Start on the right-hand side of this equation by multiplying the Leontief inverse (ABS 2024c) by matrix $\boldsymbol{Y}$ derived from the initial table of total industry flows which includes a statement of all final use components (ABS 2024a). The result of this matrix multiplication includes $y_{70}^* = \$200.54$ billion (Appendix, Table A1). In other words, this amount worth of total transactions was generated as the RBC industry sold to final uses in the reference year. How do we know this is true? Given the above identity, the following equality must hold in our system:

$$\sum_{i=1}^{115} x_i = \sum_{i=1}^{115} y_i^*$$

This means that the sum of our x_i values across all national industries (including the RBC industry's direct \$109.7 billion) and the sum of our y_i^* values (including the RBC industry's direct and indirect \$200.54 billion) must be equal. This is indeed the case (Appendix, Table A1: Columns 1 to 3).

3 | Counterfactual Analysis of the Greens' Plan

What would have happened if the Greens' plan was partially implemented in 2021–2022? This is recent enough to be relevant. We first need to specify an increase in the RBC industry final use bill that corresponds to this plan.

3.1 | The Greens' Augmented Final Use Bill

It is assumed, following the PBO costings, that the federal government can secure average market rates for construction (PBO 2024, 3). In April 2022, there were 14,908 total dwelling units approved, and the value of total residential buildings approved was \$7.06 billion (ABS 2022). This means the average cost of building a home in Australia was approximately \$473,000 in this period. This includes building site preparation costs but not the value of land.

The exclusion of land values from our direct analysis is consistent with the Leontief approach, which typically treats land as a fixed factor of production. In other words, land is not treated as a variable input that directly influences production costs or levels. This is not to say that land plays no role here. However, incorporating land values into the model would render it vastly more complicated by introducing uncertain location-specific and speculative dimensions. These additions may well come at the expense of insight. For this reason, land values are ignored.

In the PBO analysis, construction activity commences in the first year of the plan. The question becomes: what is the *horizon* over which the Greens' first-year construction target of 72,000 new homes would be fulfilled in the model? This heavily depends on the types of dwellings to be constructed. There are three broad types for our purposes: (a) houses, (b) townhouses, and (c) flats, units, and apartments (ABS 2019).

The latest ABS data on the national average period between the commencement and completion of construction projects for different types of new dwellings gives some historic sense of the timeframes that might be anticipated. Between 2013–2014 and 2018–2019, the national average completion time was 2.2 quarters or approximately 6 months and 2 weeks for houses; 3.06 quarters or 8 months and 6 weeks for townhouses; and 6.2 quarters or 18 months and 2 weeks for flats, units, and apartments (ABS 2019). This works out to an average national completion time of 3.82 quarters or approximately 11 months and 2 weeks across all three dwelling types over the specified period.

It is worth noting here that the PBO (2024, 3) asserts, in a single sentence, that the same ABS data carefully computed above indicates construction lags of 18, 24, and 36 months respectively for the same dwelling types. These seem way off base: they represent a threefold, threefold, and twofold differential respectively. Moreover, the stated numbers are not found in any of the original referenced ABS data. The basis of any extrapolation used to arrive at these values is also not detailed.

At any rate, the average national completion time could, in practice, turn out to be shorter or longer depending on the precise mix of dwellings planned. This understandably remains unspecified in the initial formulation of the Greens' proposal. As a first approximation for a preliminary simulation, it seems historically plausible to assume a first-year construction horizon of 12 months in the Australian context.

So, suppose we assume that all the expenditure from the average-priced construction of the Greens' 72,000 new homes (at \$473,000 per home) flowed into the RBC industry in our single reference year. The result is that the industry's final use transactions would have grown by \$34.056 billion. This is very close to the \$35.9 billion first-year outlay for construction and land as estimated by the PBO (2024, 8).

3.2 | Assumptions Underlying the Final Use Shock

It is assumed that the system responds to final use and output shocks in the usual Leontief way, as specified in Section 2.2. These simplifications are not unreasonable for our purposes because the production mix required to build housing in Australia has not basically changed much since 2021–2022. By ignoring the price adjustment mechanisms of great concern to general equilibrium modellers, we get a vastly more detailed picture of how the RBC industry's specific economic interdependencies respond to policy changes.

Equally, the fact that the IO approach is not directly concerned with the choices of optimising agents comes at the cost of certain insights. This is not a matter of one approach being better or worse than the other. They simply have different starting points and, in turn, cast brighter light on different aspects of economic processes. More specific objections are addressed in Section 4.

3.3 | The Extra Output Requirement

Precisely how much extra product would have been required to satisfy the Greens' augmented final use bill? This is derived by (a) multiplying each of the RBC industry's total requirement coefficients by the Greens' $34.056 billion injection, and (b) summing together each of these industry totals. Under the specifications of the system, the level of Australia's total national product would have—indeed, for the system to be *balanced* such that total uses equal total supplies, *must* have—grown by $84.14 billion in our single reference year (Appendix, Table A1: Column 4). This includes the direct injection, plus $50.08 billion worth of indirect flow-ons. The precise timing of this output expansion across the assumed 12-month horizon is left unspecified in the simple static model.

The PBO (2024, 7) estimates an $864 million net cost to the federal budget in the first year of the Greens' plan. This only includes public debt interest and the administrative costs of initially establishing and operating the proposed agency. At this juncture of the plan, the government would not yet have received income from property sales and rent. Public debt interest constitutes the largest projected cost component in each year of the plan.

Yet in light of the simulated $84.14 billion static change in the level of total output, even the PBO's projected $12.5 billion net cost to the federal budget over 5 years begins to seem fairly modest in terms of relative magnitudes.

4 | Concluding Remarks

4.1 | Summary of the Analysis

The aim of this paper was to begin analysing the flow-on effects on the broader economy from the Greens' plan to build 360,000 extra homes over 5 years through a new federal government agency. This was done by studying the RBC industry's flown-on effects on national output for a single period using the standard techniques of IO analysis. In Section 2.3, these flow-ons were derived from the latest Australian IO tables. This showed that, *ceteris paribus*, for every dollar's increase in the RBC industry final use bill, the total product of the national economy must have expanded by $2.47. At the level of total industry flows, it was shown that $200.54 billion worth of total transactions was generated as the RBC industry sold to final uses in the reference year. In Section 3, the RBC industry final use bill was plausibly augmented by $34.056 billion, corresponding to a single year of the Greens' plan. The $84.14 billion worth of additional output required to satisfy this new final use bill, which includes $50.08 billion worth of indirect flow-ons, renders the PBO's projected $12.5 billion 5 year net cost to the federal budget relatively modest.

This paper demonstrates that even a basic IO model can offer instructive insights on the interrelation patterns among relevant industries as they respond to national policy changes. The results should be of great interest to policymakers and citizens concerned about the economic implications of alternative housing policies in which the federal government takes on a more interventionist role. Indeed, federal government departments and agencies are ideally placed to utilise such models in the shaping and refinement of housing plans. These institutions are best placed to share and collect the necessary data. Some of these institutions, including the ABS, are already engaged in this.

4.2 | More Detailed Criticisms of the Model

A more specific criticism of the model is that its implicit assumption of fixed resource availability—regardless of changes in final use or output—is difficult to reconcile with the economic conditions of the reference year. This period was characterised by severe capacity constraints, including in the RBC industry. To a somewhat lesser extent, this continues to characterise the economy of 2024.

Under these conditions, it might be objected that the expanded RBC industry activity entailed in the presented formulation of the Greens' plan would have likely displaced resources and labour in other industries, and perhaps even within the RBC industry itself. Consequently, the net effect on output may well have turned out to be much closer to zero.

In addition, in an economy operating under inflationary pressure, the assumption of fixed production coefficients may be thought to make particularly little sense. Faced with higher input prices,[10] some profit-maximising firms would be incentivised to substitute certain RBC industry inputs for others, or even forgo increases in production altogether. And this behaviour will affect prices elsewhere in the economy.

The criticism just advanced amounts to deductive speculation in the absence of an alternative model. No model incorporating the mentioned mechanisms has, to date, been published as a challenge to the present analysis.

4.3 | Capacity Underutilisation

The force of the first criticism partly turns on the degree of the national economy's capacity and labour underutilisation for the reference year. This can begin to be informally gauged as follows.

(1) The capacity utilisation rate for Australian construction averaged 83.6% between November 2021 and November 2022 (Appendix, Table A2). While some of these rates were historically high, this still means an average of 16.4% of construction's overall productive potential remained underutilised over the period.

(2) An average of 10% of the national workforce was either under- or unemployed over the same period (Appendix, Table A2).[11] Some of this time partly coincided with the COVID-19 pandemic. However, between November 2014 and November 2019, the average seasonally adjusted labour force underutilisation rate was 14% (ABS 2023). These data are consistent with longer historical trends (Borland and Kennedy 1998). They are also consistent with our understanding of demand-constrained economies (Kornai 1980).

It is not suggested that the additional resources and person-hours required to fulfill the Greens' plan could have all been drawn from these underutilised reserves. However, the extent of resource constraints may have been less pronounced than the initial criticism suggests. More generally, there is no basis in mathematical economics for thinking that existing market institutions have moved the national economy to the production possibility frontier.

One way to fix ideas here would be to attempt a numerical estimation of the size of the difference between (a) the actual output level for our reference year and (b) the maximum potential output level without some defined notion of inflationary pressure.

This would in and of itself be an interesting avenue for further inquiry. It is a complex undertaking because these differences cannot be directly observed and depend greatly on the potential output benchmarks employed (Kuttner 1994; Laubach and Williams 2003).[12] There is no agreement on how best to proceed. The simulation in this paper could serve as one input into a broader systematic consideration of the opportunity costs of underutilised capacity. Alternatively, this data could be carefully extracted from a more elaborate general equilibrium model.

4.4 | General Equilibrium Extension

The deeper issue of what different models can or cannot reveal was canvassed in Section 3.2. No model can determine all economic variables. Some variables will inevitably be frozen to enable the measurement of others. The oversights of the general equilibrium approach in this regard need not be rehearsed here.[13]

Nonetheless, a complementary avenue for further research would be the construction of a computable general equilibrium (CGE) model of the Greens' plan using the results generated in this paper as a benchmark for comparison. This would enable the speculative intuitions advanced in Section 4.2 to be rigorously tested.

In addition to the standard inclusions of a consumer demand and (non-Leontief) production function, the model would presumably include estimated elasticities of supply and demand with respect to prices, and elasticities of substitutions between alternative inputs.[14] It would then be possible, analysing available IO data in some future period, to find the parameter values necessary to reconstruct an equilibrium snapshot of the 2021–2022 Australian economy. That is, as it would have looked in the presence of the Greens' augmented final use bill.

It would be interesting to compare the results of the two models, and to examine which dimensions account for any significant discrepancies. A team of researchers, or a capable PhD candidate, would be best placed to undertake this project. Moreover, the modeller's choice of functional and behavioural forms, the robustness of econometric inferences or studies used as the basis for elasticity estimation,[15] and the model's closure assumptions, could and likely would all be subject to well-founded conceptual and empirical criticisms.

4.5 | Some Extensions and Applications for Policymakers

Given the problem with which we began, the framework developed in this paper naturally lends itself to configuration for practical policymaking. In this perspective, the economic analyst has a goal: to reallocate resources to satisfy exogenous social objectives, while keeping supplies and final uses in line. An RBC industry plan, which balances in this sense, of course, may not necessarily be welfare optimal.

For example, from the viewpoint of a planner interested in providing more affordable housing, the prospect of labour being displaced in other industries to satisfy this objective may in some sense be welcomed. This development can be coherently handled within the Leontief framework.

A full elaboration of a mechanism is beyond the present scope and is being given fuller treatment in a separate paper. However, consider the following brief sketch of an approach.

(1) During our reference year, there were 131,900 annual full-time and 21,700 annual part-time workers employed in the RBC industry, equating to 142,700 annual full-time equivalent (FTE) workers (ABS 2024d).[16] Suppose we use this FTE measure as a basis for calculating the direct employment coefficient for the RBC industry in the reference year. Seasonal variations in construction activity could subsequently factor into a more refined approach. The result of this simple calculation is that 1.3 FTE labour units were directly required to make an additional million dollars' worth of RBC industry product.

(2) Calculate these data for all industries in the form of an employment coefficient matrix. It is also possible to further partition FTE employment data into the *type* of workers employed. For instance, differential skill levels could be introduced through a "skilled" and "unskilled" labour categorisation. Given the state of communications technology and the interconnected nature of many public databases, modern government departments and agencies are far from blind to this kind of information.

(3) Incorporating this information into our IO system, the federal government could start to test and adjust to the employment flown-ons of its housing construction targets across all industries on an ongoing basis.

Here is a very basic first simulation to fix ideas. Suppose we crudely assume that a typical FTE worker in the RBC industry works 1700 h per year. This assumes a 34-h workweek for 50 weeks of the year, which seems reasonably plausible for many industries including construction. Given (a) the direct employment coefficient calculated above, and (b) the required $84.14 billion increase in RBC industry product as calculated in Section 3.3, we can compute the direct number of RBC industry workers required to fulfill the first year of the Greens' plan. This is carried out in the following two steps:

$$\text{(i) Additional FTE labour units} = \frac{1.3 \times 84.14 \times 10^9}{10^6} = 109.38 \times 10^3 \text{FTE labour units.}$$

$$\text{(ii) Number of FTE workers} = \frac{109.38 \times 10^3 \text{FTE labour units}}{1700 \text{ h}} \approx 64{,}341 \text{ FTE workers.}$$

As well as considering direct employment effects, first- and subsequent-round employment effects (including induced effects) could also be calculated and carefully taken into consideration. The New South Wales Treasury (2022) recently developed such a Leontief-based framework to estimate the employment effects of COVID-19 related policy changes.

(4) Using now well-established methodology including industry surveys, administrative data computations, stakeholder consultations and interviews, on-site inspections of facilities, and statistical inferences and modelling, coefficients in the overall system could be routinely updated to reflect any major changes in the production mix.

(5) Another advantage of IO systems is their adaptability for sensitivity analysis.[17] This paper was strictly focused on the output effect of a policy proposal with a *given fiscal envelope*. A broader space of fiscal policy alternatives was not considered. Appropriately constructed IO models can simulate variations in federal tax rates and spending levels across different budget categories. For example, and consistent with a broader Greens approach, policymakers could pose the question: what would happen if (a) federal spending on the defence industry (where $x_{102} = \$45.35$ billion and $y^*_{102} = \$83.2$ billion) and the public order and safety industry ($x_{103} = \$38$ billion and $y^*_{103} = \$47.3$ billion) was reduced by some feasible percentage, and (b) federal spending on the RBC industry was correspondingly increased?

An IO model could generate estimated impacts on output, employment, and household incomes under such alternative scenarios. This approach should be of particular interest to institutions such as the PBO, because the analysis can also inform potential federal budget balancing strategies through different fund redistributions. In the broader economy, capacity constraints in plan-relevant industries, if binding, might also guide federal fiscal and monetary policy interventions to maintain inflation within specified bounds.

(6) In a computationally tractable and politically practical setup, this planning process could conceivably be undertaken by iteratively comparing pairs of IO tables over a horizon that fits within the timing of federal election terms.

The role and scope of the federal government's economic data collection regime would require some, perhaps significant, expansion under this programme. Australian IO tables have tended to take a couple of years to compile. Small changes in the values of some economically influential coefficients can result in large changes in the elements of the Leontief inverse (Gurgul and Lach 2015). The more regularly such sensitive coefficients are updated, the more accurate the planning simulations are likely to be.[18]

4.6 | Towards a Dynamic Model

(1) A related line of complementary research would be to extend the static model into a dynamic one. The main difference between static and dynamic Leontief models is that, in the latter, the investment component of final uses is rendered endogenous through the introduction of a separate capital coefficients matrix. More specifically, investment can change in proportion to the rate of output expansion in other industries (Leontief 1953, 22). The gross fixed capital formation categories in the final use structure of the Australian IO tables already provide much of the relevant information necessary to construct such matrices.

(2) As discussed in Section 3.1, RBC industry activity is characterised by time lags between construction and occupancy. Time lags extending beyond a single period can be mathematically incorporated into dynamic Leontief models (Johnson 1985; Wagner 1954).

It is not suggested that these dynamic extensions of the model could or should be immediately introduced into practical planning settings. The discrete-time framework, with its reliance on regularly updated coefficients, remains historically proven and robust. As an experimental first step, however, it would be interesting to study how well observed output levels for the RBC industry and other parts of the economy compare against the predictions generated by alternatively formulated dynamic Leontief models.

(3) In the longer run, the productive capacity of the economy may need to expand if it is to accommodate a more structural role for the Greens' public property developer. This is itself a planning problem that has been extensively covered in modern growth theory. As shown by Kurz and Salvadori (2000), certain formulations of the dynamic Leontief model are consistent with classes of growth models in which steady-state rates of growth are determined endogenously.

Acknowledgements

The author is grateful for helpful suggestions from two anonymous reviewers. The usual disclaimer applies. Open access publishing facilitated by University of Sydney, as part of the Wiley - University of Sydney agreement via the Council of Australian University Librarians.

Conflicts of Interest

The author is a member of the Australian Greens. The paper was researched and written in a private capacity, without any financial support or direction, whether formal or informal, from the Australian Greens or any associated organisation.

Data Availability Statement

The data that supports the findings of this study are available in the supporting information of this article.

Endnotes

[1] At the time of commencing this paper, the author resided in a city where the residential rental property vacancy rate was 0.4%.

[2] This cost is in terms of the underlying cash balance. All prices hereafter in AUD.

[3] The Leontief IO model is, mathematically, one very simple general equilibrium model, with very special properties. During World War II, the United States government used basic IO models to identify production bottlenecks and more efficiently prioritise armament-producing industries.

[4] Or, more precisely in the case of the Australian IO tables, *changes* in inventories.

[5] "Imputed rent for owner-occupiers" and "actual rent for housing" are two included categories which stretch the notion of an industry.

[6] Imported malt whisky which is used domestically to make Australian Scotch whisky would count as a competing import for the wine, spirits and tobacco industry.

[7] See Leontief (1941, 41) for a conceptualisation of households in this framework.

[8] The ABS expresses these coefficients in terms of dollar amounts of input directly needed to produce $100 of output.

[9] The ABS does not derive this through a manual inversion of the $\boldsymbol{I} - \boldsymbol{A}$ matrix. This would be extremely impractical given the large number of industries. The inversion was probably undertaken using a combination of more sophisticated numerical and approximation methods.

[10] See the annual percentage change in the producer price index for construction since 2021 (ABS 2024e).

[11] The problem of where to precisely locate the unemployment rate continues to be debated among economists. At one historically anomalous point in 2022, the national unemployment rate reached a level where the number of unfilled vacancies and the number of unemployed workers were approximately equal. One speculative interpretation is that unemployment is largely frictional under such conditions. Yet many workers switch jobs without becoming unemployed. See Scharfenaker and Foley (2023) for an interesting statistical equilibrium approach to modelling frictional unemployment.

[12] Such estimates can also be subject to considerable revisions in light of new data (Orphanides and van Norden 2002).

[13] See Dawkins, Srinivasan, and Whalley (2001), McKitrick (1998), and Taylor and von Arnim (2007) for some specific problems with CGE models.

[14] The factor substitution elasticity is 0 in our framework. A polar extreme would be the Cobb–Douglas production function—a special case of the constant elasticity of substitution production function commonly used in CGE models (Arrow et al. 1961), which has a factor substitution elasticity of 1. A standard form of this function produces output using perfectly substitutable aggregate capital and labour inputs. This gets at the previous point about loss of industry-specific detail.

[15] As one reviewer rightly pointed out, elasticities are not static over time. For example, resource constraints will be less binding during construction downturns.

[16] This is defined as full-time plus 50% of part-time employment.

[17] Thanks to an anonymous reviewer for emphasising this dimension of IO systems.

[18] Curiously, the ABS has purposely discontinued the publication of IO multipliers, citing previously inappropriate use by parties attempting to justify industry assistance bids (ABS 2024f). The Bureau has presumably never been asked to systematically produce these data for the purposes of national economic planning. The Bureau's statement on this decision ends with the confused argument that, since the IO approach makes assumptions that are questionable or wrong, CGE models are better.

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Appendix A

TABLE A1 | $\boldsymbol{X}$, $\overline{\boldsymbol{Y}}$, and augmented RBC industry final use bill output addition values.

Industry	X vector values (Direct Australian production totals)	$\overline{Y}$ vector values (Total requirements multiplied by final uses)	Output additions resulting from augmented RBC industry final use bill
1. Sheep, grains, beef and dairy cattle	64,913.00	48,660.41	103.03
2. Poultry and other livestock	10,010.00	4519.24	20.78
3. Other agriculture	35,329.00	25,791.22	161.08
4. Aquaculture	3050.00	1471.65	8.51
5. Forestry and logging	4169.00	816.00	318.41
6. Fishing, hunting and trapping	2900.00	2828.70	8.62
7. Agriculture, forestry and fishing support services	12,533.00	6519.78	82.84
8. Coal mining	119,109.00	152,138.16	151.71
9. Oil and gas extraction	105,646.00	125,653.91	263.04
10. Iron ore mining	135,849.00	165,340.88	173.21
11. Non-ferrous metal ore mining	62,497.00	46,339.92	377.83
12. Non-metallic mineral mining	11,166.00	7473.20	391.23
13. Exploration and mining support services	22,026.00	10,317.65	113.20
14. Meat and meat product manufacturing	38,887.00	60,492.79	69.36
15. Processed seafood manufacturing	1493.00	2323.56	4.17
16. Dairy product manufacturing	15,580.00	24,897.57	21.45
17. Fruit and vegetable product manufacturing	5745.00	10,755.37	4.61
18. Oils and fats manufacturing	2515.00	3165.92	5.66
19. Grain mill and cereal product manufacturing	6655.00	11,100.94	9.25
20. Bakery product manufacturing	9184.00	14,563.47	12.23
21. Sugar and confectionery manufacturing	10,748.00	12,644.86	26.35
22. Other food product manufacturing	14,510.00	19,027.02	29.56
23. Soft drinks, cordials and syrup manufacturing	6345.00	13,293.65	7.53
24. Beer manufacturing	4444.00	7456.89	4.42
25. Wine, spirits and tobacco	6962.00	13,492.44	11.57
26. Textile manufacturing	413.00	464.06	5.10
27. Tanned leather, dressed fur and leather product manufacturing	728.00	1373.11	2.89
28. Textile product manufacturing	3489.00	3700.49	129.15
29. Knitted product manufacturing	37.00	50.87	0.32
30. Clothing manufacturing	1174.00	1262.32	10.13
31. Footwear manufacturing	408.00	472.35	2.75
32. Sawmill product manufacturing	5616.00	2614.80	466.29

(Continues)

TABLE A1 | (Continued)

Industry	X vector values (Direct Australian production totals)	$\overline{Y}$ vector values (Total requirements multiplied by final uses)	Output additions resulting from augmented RBC industry final use bill
33. Other wood product manufacturing	11,301.00	2063.08	1804.92
34. Pulp, paper and paperboard manufacturing	2913.00	1624.33	56.47
35. Paper stationery and other converted paper product manufacturing	6966.00	5756.43	113.60
36. Printing (including the reproduction of recorded media)	5404.00	1422.54	83.91
37. Petroleum and coal product manufacturing	17,691.00	11,697.38	213.60
38. Human pharmaceutical and medicinal product manufacturing	9335.00	14,502.12	25.03
39. Veterinary pharmaceutical and medicinal product manufacturing	1028.00	874.67	2.26
40. Basic chemical manufacturing	21,290.00	19,627.37	234.76
41. Cleaning compounds and toiletry preparation manufacturing	4708.00	5970.11	18.97
42. Polymer product manufacturing	14,924.00	8210.99	519.12
43. Natural rubber product manufacturing	1051.00	607.41	12.39
44. Glass and glass product manufacturing	4397.00	1295.71	284.46
45. Ceramic product manufacturing	1674.00	715.36	109.35
46. Cement, lime and ready-mixed concrete manufacturing	10,268.00	349.46	887.51
47. Plaster and concrete product manufacturing	4088.00	468.62	285.57
48. Other non-metallic mineral product manufacturing	2257.00	357.33	170.17
49. Iron and steel manufacturing	16,580.00	4976.18	936.76
50. Basic non-ferrous metal manufacturing	54,501.00	131,838.30	124.16
51. Forged iron and steel product manufacturing	1114.00	529.08	24.40
52. Structural metal product manufacturing	22,701.00	4653.78	1884.34
53. Metal containers and other sheet metal product manufacturing	5383.00	3988.92	185.34
54. Other fabricated metal product manufacturing	10,379.00	5771.26	414.17
55. Motor vehicles and parts; other transport equipment manufacturing	13,279.00	17,908.69	52.09
56. Ships and boat manufacturing	7156.00	8840.83	21.82
57. Railway rolling stock manufacturing	4468.00	3045.07	25.11
58. Aircraft manufacturing	5084.00	4372.54	28.48
59. Professional, scientific, computer and electronic equipment manufacturing	13,038.00	11,293.51	73.06
60. Electrical equipment manufacturing	5808.00	4431.11	119.62

(Continues)

TABLE A1 | (Continued)

Industry	X vector values (Direct Australian production totals)	$\overline{Y}$ vector values (Total requirements multiplied by final uses)	Output additions resulting from augmented RBC industry final use bill
61. Domestic appliance manufacturing	1606.00	1538.54	61.18
62. Specialised and other machinery and equipment manufacturing	17,465.00	16,341.96	187.14
63. Furniture manufacturing	6095.00	6633.90	306.32
64. Other manufactured products	3172.00	3072.70	47.49
65. Electricity generation	21,171.00	18,317.82	140.44
66. Electricity transmission, distribution, on selling and electricity market operation	56,591.00	33,087.10	345.02
67. Gas supply	5541.00	2781.24	46.56
68. Water supply, sewerage and drainage services	27,399.00	26,954.14	408.85
69. Waste collection, treatment and disposal services	21,769.00	3224.14	404.95
70. Residential building construction	109,694.00	200,541.57	35769.40
71. Non-residential building construction	67,379.00	129,510.49	628.33
72. Heavy and civil engineering construction	84,733.00	155,079.97	249.85
73. Construction services	280,083.00	162,558.79	14204.88
74. Wholesale trade	159,109.00	146,554.66	2215.90
75. Retail trade	163,571.00	226,443.73	878.34
76. Accommodation	16,943.00	22,415.54	120.36
77. Food and beverage services	77,902.00	121,646.01	267.70
78. Road transport	72,400.00	43,828.80	1429.85
79. Rail transport	16,948.00	19,976.19	84.21
80. Water, pipeline and other transport	10,768.00	7282.00	109.02
81. Air and space transport	16,575.00	17,493.97	102.88
82. Postal and courier pick-up and delivery service	21,788.00	9260.55	306.14
83. Transport support services and storage	85,206.00	57,643.37	1011.12
84. Publishing (except internet and music publishing)	23,725.00	21,507.02	140.81
85. Motion picture and sound recording	8666.00	9459.34	27.50
86. Broadcasting (except internet)	10,388.00	8161.48	66.64
87. Internet service providers, internet publishing and broadcasting, websearch portals and data processing	20,454.00	8186.77	259.20
88. Telecommunication services	58,002.00	41,917.94	615.33
89. Library and other information services	1965.00	2644.21	0.14
90. Finance	139,145.00	48,386.74	1265.92
91. Insurance and superannuation funds	62,208.00	110,353.75	126.59
92. Auxiliary finance and insurance services	70,775.00	10,394.82	1095.65

(Continues)

TABLE A1 | (Continued)

Industry	X vector values (Direct Australian production totals)	$\overline{Y}$ vector values (Total requirements multiplied by final uses)	Output additions resulting from augmented RBC industry final use bill
93. Rental and hiring services (except real estate)	26,843.00	3767.64	578.27
94. Imputed rent for owner-occupiers	182,116.00	233,060.08	0.00
95. Actual rent for housing	57,623.00	82,876.64	0.00
96. Non-residential property operators and real estate services	101,626.00	35,827.32	1294.89
97. Professional, scientific and technical services	240,146.00	63,242.66	4006.23
98. Computer systems design and related services	73,247.00	44,954.72	413.58
99. Employment, travel agency and other administrative services	94,548.00	17,404.54	1171.24
100. Building cleaning, pest control and other support services	26,061.00	3233.11	406.92
101. Public administration and regulatory services	131,565.00	197,513.27	509.65
102. Defence	45,351.00	83,205.22	2.83
103. Public order and safety	38,021.00	47,312.77	165.30
104. Primary and secondary education services (including pre-schools and special schools)	81,500.00	113,108.79	1.19
105. Technical, vocational and tertiary education services (including undergraduate and postgraduate)	57,511.00	82,632.26	43.50
106. Arts, sports, adult and other education services (including community education)	11,460.00	16,335.58	7.13
107. Health care services	145,227.00	212,749.27	18.42
108. Residential care and social assistance services	111,409.00	155,533.34	0.88
109. Heritage, creative and performing arts	9093.00	10,469.19	23.27
110. Sports and recreation	21,032.00	26,251.46	93.40
111. Gambling	11,857.00	21,465.69	15.38
112. Automotive repair and maintenance	23,302.00	18,682.42	270.16
113. Other repair and maintenance	20,520.00	1238.33	427.03
114. Personal services	15,639.00	24,965.87	17.86
115. Other services	13,057.00	13,661.27	45.63
Total	4,280,906.00	4,280,906.02	84,144.17

Note: Columns 1 to 3 from left to right. Comparison of X values and $\overline{Y}$ values. Industries are enumerated in ascending order from 1 to 115. All totals are expressed in millions of dollars. The RBC industry is no. 70. Final uses include the final consumption expenditures of households and general government; gross fixed capital formation for the private sector, public corporations, and general government; changes in inventories; and exports of goods and services. The two grand totals are off by two hundredths of a dollar due to rounding. In the context of trillion-dollar magnitudes, this is more than good enough. Slight discrepancies are common in large national accounting exercises. Column 4: Output additions resulting from a $34.056 billion increase in the RBC industry final use bill ($m). All RBC industry total requirement coefficients (ABS 2024c) have been multiplied by this amount.

TABLE A2 | Australian construction capacity utilisation rate (CEIC 2024) and labour force underutilisation rate (ABS 2023) for the period November 2021–November 2022.

Months	Capacity utilisation rate (construction)	Labour force underutilisation rate (seasonally adjusted)
November 2021	85.7	12.1
December 2021	—	10.7
January 2022	82.3	10.8
February 2022	85.6	10.5
March 2022	83.6	10.2
April 2022	85.8	10.1
May 2022	85.6	9.7
June 2022	82.4	9.7
July 2022	80.6	9.5
August 2022	82.6	9.5
September 2022	83.2	9.6
October 2022	82.8	9.4
November 2022	82.9	9.3
Average	83.6	10.0