

Possibilities of Growth, Decent Jobs and Poverty Reduction without Industrialisation: Application of Discrete-Time Markov Process

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Abstract

The paper aimed to examine the possibilities of growth, decent jobs, and poverty reduction without industrialisation. The study uses secondary data from 23 countries sampled randomly from developing and developed countries. The discrete-times Markov process was used. The study found that a country such as Mongolia has higher industrial growth but less state transition probability. The study found that the G7 and G20 countries such as Canada, Germany, the USA, Australia, India and Mexico have less industrial growth, resulting in the unpredictability of the growth, decent job creation and poverty eradication. The study concludes that the growth of industrialisation does not grant for growth, decent job creation and poverty eradication, but the industrial structure, policies and location with be determined by such effects. Therefore, the paper recommends using the discrete-Time Markov process to predict the economic growth in developed and developing countries.

Keywords: growth, decent jobs, poverty reduction, discrete-time Markov process, Tanzania.

1. Introduction

Industrialisation and structural transformation are integral to the African Union's Agenda 2063. The literature suggests that industrialisation drives the sustained growth in jobs and productivity that marks most developed economies' social and economic take-off (Kaleb et al. 2021). However, it is evidenced that the prospects of manufacturing in Sub-Saharan Africa are limited due to the emerging trends in technology and international trade (Kaleb et al. 2021). Moreover, several studies suggest strong claims that the region's economies have experienced "premature deindustrialisation," which reduces the viability of policies and strategies to promote manufacturing as a driver of sustainable growth (Kaleb et al. 2021). Industrialisation features prominently in several African and other developing countries' development strategies, and some are currently implementing policies to promote the manufacturing sector's capacity (industrialisation) to engage in value-addition processes and create jobs (Kaleb et al. 2021). The prospects for industrialisation are bound to differ across countries, depending on resource endowments and initial policy configurations. Thus, an assessment of the region should account for the heterogeneity across the continent. Such prospects must also be assessed in specific countries in the context of new and emerging digital technologies, the evolution of regional and global value chains, and the implications of these developments for regional trade agreements and the broader international trading system.

Rapid economic growth is often essential for reducing absolute poverty (Kniivilä, n.d; Obioma, Uchenna and Kalu, 2015). Industrial growth has had an important role in

countries' economic growth (Kniivilä, n.d). Several studies explained the role of industrial growth, the contribution of a range of policies to growth performance, and the impact of growth on poverty and income inequality (Kniivilä, n.d; Obioma, Uchenna and Kalu, 2015). The industrial affects growth and poverty in the long run, such as the structure, location of industries, policies and others (Kniivilä, n.d). Although, industrialisation may increase the income inequality between rural and urban (Kniivilä, n.d; Obioma, Uchenna and Kalu 2015). The industries in the agriculture sector tend to create more jobs, increasing growth and reducing income poverty. Job creation, particularly in agricultural industries, signifies economic growth (Hussein et al., 2023). The current study shows a direct positive effect between job creation and economic growth through the absorption of unemployment (Hussein et al., 2023; Kaleb et al., 2021). Kaleb et al.2021 confirmed industrialisation offers a viable path to structural transformation and job creation. To the extent that there is renewed interest in industrialisation across the continent, and certain countries have successfully created manufacturing jobs, the central question is the industrialisation grant for economic growth, decent job creation and poverty reduction. Manjula(2022) concluded that Industrialization has been the basis for the economic development of any serious-minded nation; this is why it is obvious that no advanced nations reached the developed stage without industrialisation. The industrialisation has been seen as a veritable channel of attaining the lofty desirable conception and goals of improved quality of life and the populace (Manjula, 2022). This is because; industrial development involves extensive technology-based development of the productive system of the economy. This conclusion leads to the question that economic growth, decent job creation and poverty are impossible without industrialisation. Therefore, this study aimed to study the possibilities of economic growth, decent job and poverty eradication by considering developing and developed countries.

In most cases, the economic determinants (factors) usually influence the decisional outcome in the economic decision process. The outcome is mostly uncertain as rarely are assigned to their possibilities outcome (prior probabilities). This became the entire plan uncertainty. The study on growth, decent jobs, and poverty reduction is mostly done by establishing short-term or long- term relationships without industrial conditioning. Moreover, the findings are still uncertain as they are weighted on the "determinant intensively" rather than on the possibility of the outcomes. This study is uniquely working on that methodological flaw by introducing the possibility– decisional outcome plan. The study aimed to examine the possibility of growth, decent jobs, and poverty reduction with industrial conditioning. Specifically, the study determined the probability (possibility), mean hitting times and mean return times of event or state variable behaviour (growth, decent jobs, and poverty reduction) on two event-process behaviour (conditions) in the Markov process. Condition one assumes all the states are communicated; growth, decent jobs, and poverty reduction are transient states. This means once a country or event leaves a state i to state j at time t , it will never return to state i again. In this situation, the state poverty reduction is an absorption state. Therefore, the absorption probability will be determined that once a

country eradicates poverty, the probability of return to decent jobs and growth is less than one. Moreover, we determined the number of expected years to enter the state of poverty reduction (mean hitting times). Condition two assumes all the states are communicated;

the process is irreducible, that the event process (Markov Process) can start from growth, move to poverty reduction and then returns to growth. Condition two examined the possibility of events (state) to reverse. That is, growth causes poverty reduction, poverty reduction causes future growth, and the process continues forever. We examined condition two by the state transition probabilities. We determined the expected years that required the state or event to return to its previous state (Mean return times).

2. Literature Review

Conceptually, in condition one, a country change state to state j , and stays in state j forever; that is, it never returns to state i . Therefore, if the event or country stayed forever at a certain state, say j , that state is called the absorbing state, and the probability of entering that state is called the absorption probability. Consider a finite Markov process, with state space, $S = \{\text{growth, decent job, poverty reduction}\}$. Suppose that all states are either absorbing or transient. Let j be an absorbing state. Define t_j for all i . That is, t_j and a_{ji} if j is any other absorbing state. To find unknown values of t_j we use the equation

Condition one can be illustrated by using a state-transition diagram (Figure 1). In this model, the self-transition is allowed,

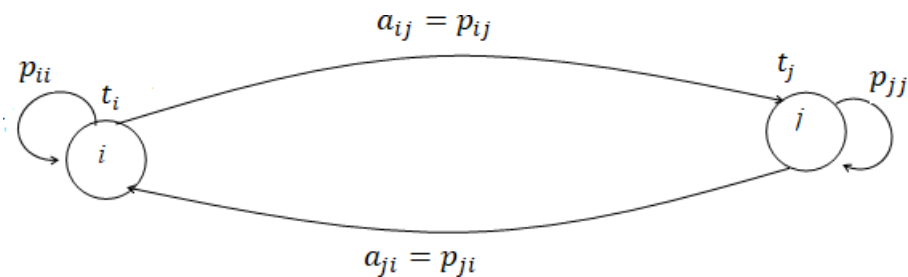
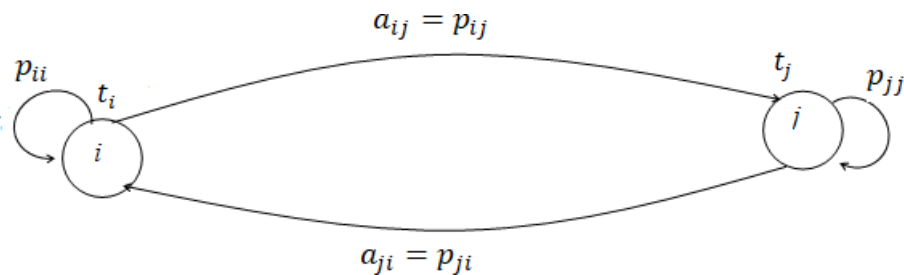


Figure 1: The state-transition diagram for condition one Markov process model.

Figure 1 shows how the country in state i can be self-transient with a probability of p_{ii} , and the probability of remaining at state one of p_{ii} . The figure for the probability of the country remaining at state two is p_{jj} and the probability of the country returning to the state one, is a_{ji} . The process shows that once the event or a country enters the state j , the country can return to state i . The transition probabilities can be summarised or presented by using the transition probabilities matrix P .

Mean hitting times and mean return times. The mean hitting time is the expected time until the process hits/reaches the set of states the first time. Also, it is obtained by using the law of total probability with recursion. Let t_i be the first time the process visits a state in S , for all i , defined that is, t_i for all i . To find the unknown values of t_i , we use



From Figure 1, we calculate the mean hitting times, t , by using the formula,

On the other hand, the Mean return times, t_i , is the expected time (number of steps) needed until the process returns to state i . Consider a finite irreducible Markov process, with state space $S = \{0, 1, 2, 3, \dots, r\}$. let i be a state. Moreover, let t_j be the mean return time to state j , then,

Therefore, mean return times, t_i , can be simplified by the formula.

3. Research Method

The methodology of the study is described as follows; the population of the study was developed and developing countries. The random selection of 23 countries is entered into the sample space if the researcher has all the required information (sorting techniques). The G7 and G20 countries were involved in the sample size by using the sorting sampling producer. The data source included the trading economics report in 2023 and world development indicators. The state variables are growth, measured by GDP per cent (annualised); industrialisation, measured by industrial production growth in per cent; decent jobs, measured by the employment rate in percentage; and poverty reduction, which is measured by poverty rate in percentage. Moreover, industrialisation is the mediating factor used as a conditioning factor in probability estimation. The dependence conditional probability was to calculate the *initial probability* (for Markov process modelling). The discrete-time Markov Process model established each state or event's probability (transition and absorption).

We collected data about the industrial production, employment rate, GDP per capita and poverty rate for 2021 to 2023 from 23 randomly sampled countries. Some countries are member of G7 and G20 economic forum, representing the countries with advanced and advancing economic structures. The rate of employment (decent job), GDP per capita and poverty rate were divided by industrial production growth rate to measure or establish the "*relative unit effect*" of the industrial growth" in GDP per capita, employment and poverty rates. This is done to disclose or detect the effectiveness of industrial production in growth, job creation and poverty eradication.

4. Findings and Discussions

The proportions represent the industrial growth rate's relative unit impact or effect (Table 1).

Table 1. The annualised growth rate and proportions of growth, decent job and the poverty

rate

Country	Annualised Growth percentage								Proportions by industrial growth					
	Averaged rate from 2021 to 2023								Growth		Job		Poverty	
	I(S2)	I(S1)	J(S2)	J(S1)	G(S2)	G(S1)	P(S2)	P(S1)	G1/I1	G2/I2	J1/I1	J2/I2	P1/I1	P2/I2
Albania	0.50	6.80	66.50	65.40	9.53	2.52	4.57	6.07	0.37	19.05	9.62	133.00	0.89	9.13
Australia	1.90	1.00	64.40	64.30	2.11	0.67	0.50	0.50	0.67	1.11	64.30	33.89	0.50	0.26
Canada	1.86	1.80	62.40	62.40	3.97	0.43	0.25	0.25	0.24	2.13	34.67	33.55	0.14	0.13
Costa Rica	4.80	5.20	50.75	52.75	6.94	1.54	2.22	1.06	0.30	1.45	10.14	10.57	0.20	0.46
Czech	2.20	2.00	75.80	75.80	5.49	2.63	0.01	0.01	1.31	2.49	37.90	34.45	0.00	0.00
Denmark	9.40	19.70	68.70	68.40	4.40	1.13	0.25	0.17	0.06	0.47	3.47	7.31	0.01	0.03
Georgia	1.70	17.60	44.20	45.20	10.87	5.16	4.23	3.78	0.29	6.39	2.57	26.00	0.21	2.49
Germany	1.80	0.70	77.30	77.30	2.58	0.83	0.00	0.23	1.18	1.44	110.43	42.94	0.33	0.00
India	1.10	5.60	44.70	44.50	7.82	2.68	10.00	11.08	0.48	7.11	7.95	40.64	1.98	9.09
Israel	6.90	4.80	61.40	61.20	6.89	2.19	0.24	0.46	0.46	1.00	12.75	8.90	0.10	0.03
Macedonia	1.30	1.00	47.20	47.34	4.34	3.89	3.40	4.56	3.89	3.34	47.34	36.31	4.56	2.61
Malta	12.50	18.50	78.50	77.50	9.62	1.83	0.31	0.10	0.10	0.77	4.19	6.28	0.01	0.02
Mauritius	11.70	7.10	93.20	92.50	3.68	2.86	0.21	0.56	0.40	0.31	13.03	7.97	0.08	0.02
Mexico	1.60	3.30	97.61	97.28	4.14	1.23	3.10	2.63	0.37	2.59	29.48	61.01	0.80	1.94
Mongolia	55.50	63.60	54.90	56.00	0.01	3.37	0.50	0.47	0.05	0.00	0.88	0.99	0.01	0.01
Morocco	0.80	3.10	39.10	39.00	6.79	1.80	1.44	4.24	0.58	8.49	12.58	48.88	1.37	1.80
Philippines	4.90	9.00	95.30	95.20	4.14	4.38	2.74	6.14	0.49	0.84	10.58	19.45	0.68	0.56
Rwanda	6.70	5.60	44.40	46.40	8.29	6.88	56.52	57.90	1.23	1.24	8.29	6.63	10.34	8.44
Serbia	0.90	1.90	50.10	50.80	8.57	4.89	2.33	0.29	2.58	9.52	26.74	55.67	0.15	2.59
Spain	4.50	0.10	50.78	50.99	5.41	1.26	0.79	0.84	12.55	1.20	509.90	11.28	8.39	0.18
Switzerland	6.10	6.00	79.90	79.30	3.44	0.42	0.03	0.03	0.07	0.56	13.22	13.10	0.01	0.01
Uruguay	4.10	1.00	57.30	57.50	4.45	0.31	0.18	0.99	0.31	1.09	57.50	13.98	0.99	0.04
USA	0.20	0.10	60.40	60.40	5.82	1.83	1.00	1.00	18.30	29.10	604.00	302.00	10.00	5.00

Source: Trading economics (2023) and world development indicator (2023).

Table 1 shows data for this study. The 23 countries sampled involve the countries of G7 members, such as Germany, the USA, and Canada, and the exclusive members of G20 countries, such as Australia, India and Mexico, and Denmark. On the other hand, the study involved data from developing countries such as Rwanda, Morocco, and Mauritius. The table depicts that Mongolia has the highest industrial growth recorded in March 2023, which is 55.50 percent, and the USA has the lowest industrial growth of about 0.20 per cent as recorded in January 2023. Moreover, Mexico has a maximum employment rate of 97.61 per cent, as recorded in March 2023, and Morocco had at least an employment rate of 39.10 per cent in December 2022. Georgia has the maximum GDP per capita growth rate of 10.87 in 2021, and Mongolia has the least GDP per capita growth rate of 0.01 in 2021. The country with the maximum poverty rate is Rwanda, which had 56.52 in 2021 and the least poverty in Germany at 0.00 per cent.

State transition probabilities. The state transition probability is the probability of a state variable or a system moving from state to state. From Table1, we compute the state transition probabilities by using the general formula, that is, for the initial state transition probability for the Markov process,

Table 2. State transition state probability for growth, decent job and the poverty rate

Country	P(G/I1)	P(G/I2)	P(J/I1)	P(J/I2)	P(P/I1)	P(P/I2)	P(I1)	P(I2)
Albania	0.019	0.981	0.0674	0.9326	0.0891	0.9109	0.0632	0.9368
Australia	0.375	0.625	0.6548	0.3452	0.6557	0.3443	0.6499	0.3501
Canada	0.100	0.900	0.5082	0.4918	0.5092	0.4908	0.4945	0.5055
Costa Rica	0.17	0.830	0.4900	0.5100	0.3060	0.6940	0.4600	0.5400
Czech	0.345	0.655	0.5238	0.4762	0.5182	0.4818	0.5149	0.4851
Denmark	0.109	0.891	0.3221	0.6779	0.2444	0.7556	0.3120	0.6880
Georgia	0.044	0.956	0.0899	0.9101	0.0794	0.9206	0.0810	0.9190
Germany	0.452	0.548	0.7200	0.2800	1.0000	0.0000	0.7161	0.2839
India	0.063	0.937	0.1636	0.8364	0.1787	0.8213	0.1547	0.8453
Israel	0.313	0.687	0.5890	0.4110	0.7357	0.2643	0.5725	0.4275
Macedonia	0.538	0.462	0.5659	0.4341	0.6353	0.3647	0.5690	0.4310
Malta	0.114	0.886	0.4001	0.5999	0.1858	0.8142	0.3777	0.6223
Mauritius	0.562	0.438	0.6206	0.3794	0.8133	0.1867	0.6195	0.3805
Mexico	0.126	0.874	0.3258	0.6742	0.2914	0.7086	0.3187	0.6813

Mongolia	1.000	0.000	0.4711	0.5289	0.4375	0.5625	0.4853	0.5147
Morocco	0.064	0.936	0.2047	0.7953	0.4314	0.5686	0.1972	0.8028
Philippines	0.366	0.634	0.3523	0.6477	0.5495	0.6943	0.3603	0.6397
Rwanda	0.498	0.502	0.5556	0.4444	0.5507	0.4493	0.5491	0.4509
Serbia	0.213	0.787	0.3245	0.6755	0.0559	0.9441	0.3030	0.6970
Spain	0.913	0.09	0.9780	0.022	0.979	0.021	0.977	0.0230
Switzerland	0.111	0.889	0.5022	0.4978	0.5272	0.4728	0.4931	0.5069
Uruguay	0.222	0.778	0.8045	0.1955	0.9566	0.0434	0.7956	0.2044
USA	0.386	0.614	0.6667	0.3333	0.6668	0.3332	0.6529	0.3471

Table 2 shows the state transition probabilities of the growth, decent job and poverty rate in 23 countries. The tables depict that the highest state transition probability of growth is about 1.00 in Mongolia in state one. On the other hand, the highest state transition probability in growth in state two is 0.9809, found in Albania. The least state transition probabilities in states one and two are 0.01911 and 0, found in Albania and Mongolia, respectively. The tables also show that the countries with the highest state transition probabilities in a decent job in state one are Spain, with a value of 0.978 and Albania, in state two, with a value of 0.9326. The least values of state transition probabilities are found in Albania in state one, which is 0.067 and in Spain, which is 0.0217 in state two. The maximum state transition probability in poverty rate is 1.000, found in Germany in state one, and is 0.9440 in Serbia in state two. The least values of state transition probabilities in poverty rate are 0.0560 in state one and 0 in state two found in Serbia and Germany, respectively. Furthermore, in the table, we found that the state transition of the industrial production growth is about 0.9767 in state one and 0.9368 in state two in Spain and Albania, respectively.

On the other hand, the least state transition probability in industrial production growth is 0.063 in state one and 0.023 in state two found in Albania and Spain, respectively. The Markov process involves the two states, and the maximum state transition probabilities are equal to one. Therefore, the countries experiencing the highest state transition probabilities in state one will also experience the least state transition probabilities in state two, and vice versa.

STATE TRANSITION PROBABILITY MODELS. The state transition probability model is the probability predictive model that models the probability or likelihood of the state variable in the Markov process to move or shift from one state to another. These models involve the probability parameters such as the state transition probability, the mean hitting times and mean return times. This study prefers to establish the state transition probability model in 9 countries with given criteria, such as Mongolia and Malta, with the highest industrial growth in the sample. Two countries from the G7 are Germany and Canada, three countries with G20 membership are Australia, India and Mexico, and two

countries with the least industrial growth are USA and Albania.

MONGOLIA PROBABILITIES PREDICTIVE MODEL. Mongolia is one of the countries with the second industrial growth in 2023, after Trinidad and Tobago in March 2023. The predictive state variables of the model are growth, decent job and poverty rate. The state transition matrix and Markov process of Mongolia (Figure 2).

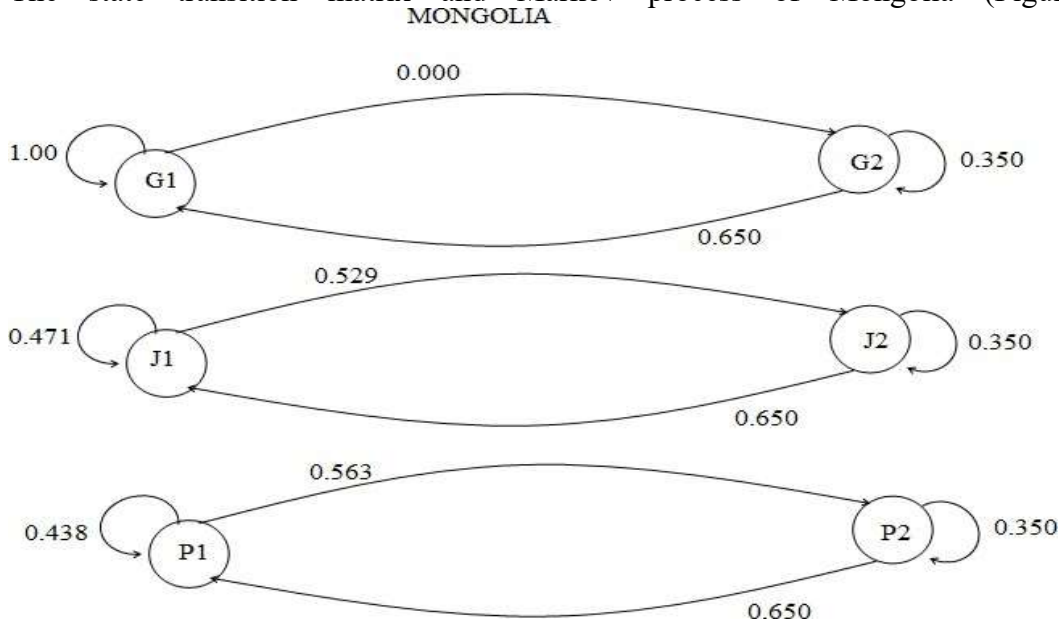


Figure 2: The periodic state transition Markov Process in Mongolia

Figure 2 shows the periodic state transition Markov process for Mongolia country in two states. The state variables are growth, decent job and poverty rate, and the conditioning variable is industrial production growth. Mongolia was selected because it had the highest industrial production growth rate of about 55.54 per cent on March 2023 in the sample. The country shows that in the growth state variable, the probability of a country entering into state two is zero, and the probability for a country to remain in state one is 1 in the growth state variable. Moreover, the probability of a country's growth to return to state one is 0.650, greater than that of a country's growth to enter state two. This means that the country in growth will never enter state two since the probability of a country remaining in state one is 1 or 100 per cent. On the other hand, the probability of a country creating a decent job in state one is 0.471, and the probability of the country entering into state two is 0.529. Since the probability of entering state two is less than the probability of the country returning to state one, that is, 0.650, the country is expected to return to state one in future. Hence, decent job creation is not sustainable. Moreover, the probability of a country with a poverty rate at state one is 0.438, and the probability of entering state two is 0.563; since this value is less than the probability of returning to state one, which is 0.650, the country will enter the state two, but in future, it will return to state one. *Mean hitting times and mean return times.* We compute the mean hitting time and return times in respective countries by using the state transition probabilities of Mongolia in growth, decent job and poverty rate. **Interpretation:** The mean hitting times and mean return times are the same, indicating that the time required for the country to move from state one to state two is 1.54 years. On the other hand, the country will return

to its growth position decent jobs and poverty rate.

The G20 countries are among the countries that involve the G7 countries. The only distinction is that the G20 countries include both countries, that their economic structure is advanced and that their economic structure is advancing significantly. Therefore, the G20 countries also involve the G7 countries. In this study, we involved only the countries that are members of G20 but of G7. The study randomly selected only three countries, Australia, India and Mexico, to examine how their industrial growth predicts growth, decent job and poverty rate. The Markov process is used.

THE AUSTRALIA PROBABILITIES PREDICTIVE MODEL. Australia is among the countries which are classified as a member of G20 countries. Consider the state transition matrix and Markov Process model for Australia (Figure 8).

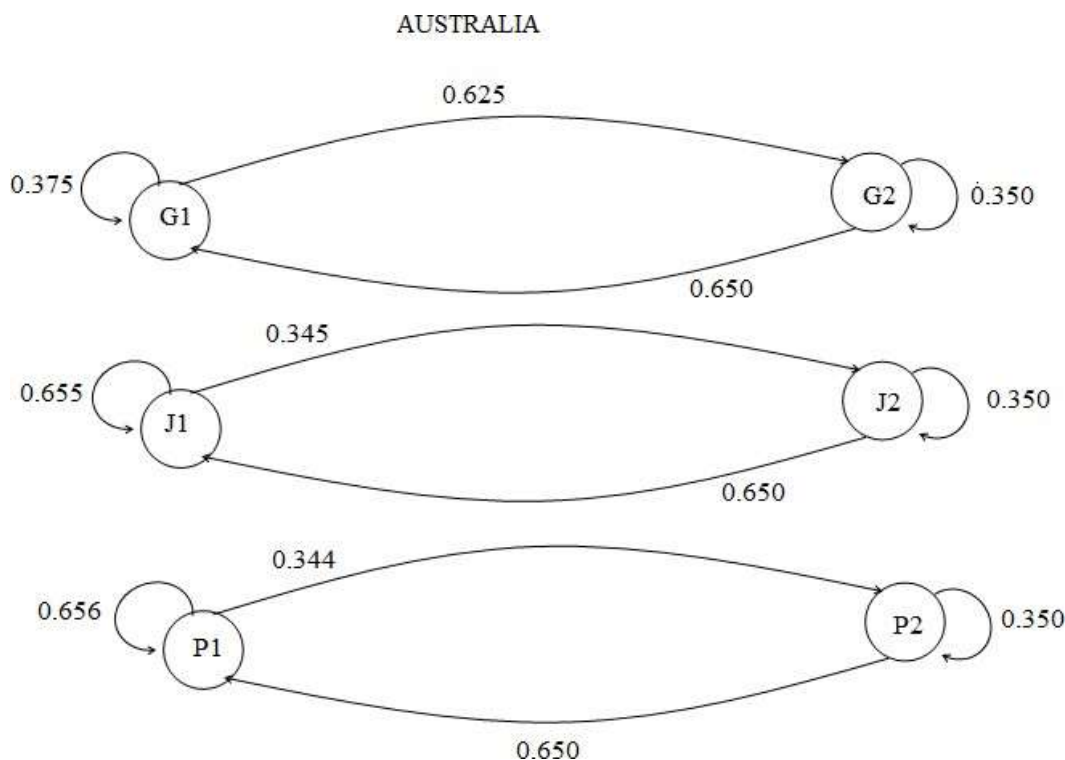


Figure 8: The periodic state transition Markov Process in Australia

Figure 8 shows the periodic state transition Markov process model for Australia in two states. The state variables are growth, decent job and poverty rate, and the industrial production growth is the state conditioning variable. Australia is a country that is classified as a member of G20 countries; it has industrial production growth of 1.90 percent in 2023. The country shows that the probability of a country entering into state two in growth is 0.625, to remain in state one is 0.375. Moreover, the probability of a country in growth to return to state one is 0.650 to remain at state two is 0.350. That is, the country in growth will enter into state two and easily return to state one, because the probability of returning and remaining at state one is greater than the probabilities of entering and remaining at state two. On the other hand, the probability of a country in decent job to remain in state one is 0.655, and to enter into state two is 0.345, and the probability to remain in state two is 0.350. The probability of a county returning to state

one in decent job is 0.650, greater than the probability of entering into state two. Therefore, the country will hardly enter into state two. On the other hand, the probability of a country remaining in the poverty rate at state one is 0.656, and to enter in the state is 0.344. The probability of a country remaining in poverty rate at state two is 0.350 and the probability to return in state one is 0.650, greater than the probability of a country remaining at state two. Therefore, the country will hardly enter in state two.

Mean hitting time and mean return times. We compute Australia's mean hitting time and return times by using state transition probabilities of Australia in growth, decent job and poverty rate. Interpretation: The mean hitting times and mean return times are the same, and this indicates that the time required for the country to move from state one to state two is 1.54 years. On the other hand, the country will return to its state of growth, a decent jobs, and the poverty rate is 1.54 years.

We repeated the same process and the interpretation for Malta: The mean hitting times and mean return times are the same. This indicates that the time required for the country to move from state one to state two is 2.64 years. On the other hand, the country will return to its state of growth, a decent jobs, and a poverty rate is 2.64 years. For USA: The mean hitting times and mean return times are the same, indicating that the time required for the country to move from state one to state two is 1.53 years. On the other hand, the country will return to its state of growth, a decent jobs, and the poverty rate is 1.53 years.

For Albania: The mean hitting times and mean return times are the same, indicating that the time required for the country to move from state one to state two is 15.87 years. On the other hand, the country will return to its state of growth, a decent job, and the poverty rate is 15.87 years. For Canada: The mean hitting times and mean return times are the same, indicating that the time required for the country to move from state one to state two is 2.02 years. On the other hand, the country will return to its state of growth, a decent jobs, and the poverty rate is 2.02 years. For Germany: The mean hitting times and mean return times are the same. This indicates that the time required for the country to move from state one to state two is 1.40 years. On the other hand, the country will return to its state of growth, a decent jobs, and a poverty rate is 1.40 years. For Australia: The mean hitting times and mean return times are the same, and this indicates that the time required for the country to move from state one to state two is 1.54 years. On the other hand, the country will return to its state of growth, a decent jobs, and the poverty rate is 1.54 years. For India: The mean hitting times and mean return times are the same. This indicates that the time required for the country to move from state one to state two is 6.45 years. On the other hand, the country will return to its state of growth, decent job, and the poverty rate are 6.45 years. For Mexico: The mean hitting times and mean return times are the same. This indicates that the time required for the country to move from state one to state two is 3.13 years. On the other hand, the country will return to its state of growth, decent job, and the poverty rate is 3.13 years.

5. Conclusion

The paper aimed to address the issues of growth, decent jobs and poverty eradication without industrialisation. The paper used the Markov process model to predict the state probabilities of the countries in two years (two states). The study classified the data into the countries with the highest industrial growth in the sample, Mongolia and Malta, and

the countries with the least industrial growth, USA and Albania. Furthermore, the study considers the G7 countries, which are Germany, Canada and the USA, and the G20 countries, which are Australia, India and Mexico and other, which are not in developing countries, such as Rwanda and Morocco and others. The aim is to capture the broad aspect of how industrial growth affects growth, decent job and poverty rate. The study concludes that the growth of industrialisation does not grant for growth, decent job creation and poverty eradication, but the industrial structure, policies and location will be determined by such effects. Therefore, the paper recommends using the discrete-Time Makov process to predict economic growth in developed and developing countries.

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