A Portfolio Approach to Economic Development: Evidence from a Regional Economy

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-Extended Abstract-

This paper investigates the economy-wide risk-return patterns of a transitional regional economy against the backdrop of systemic shocks. It presents a diversification framework that utilises the modern portfolio theory in connection with the theory of economic development. Taking the COVID-19 shock using the case study of the Gold Coast, Australia, we investigate the shock to local sectors, for example, tourism and agriculture, from the perspective of a regional economy. We explore how these shocks cause significant economic upheaval and propose how this may be mitigated over the long run by using an economic development portfolio framework. We extend this framework to the major industries impacted by structural changes on their path toward economic recovery. We suggest that this framework can assist policymakers (economic and social planners) in deciding upon the best combination of diversified initiatives and programs in sector development to ensure a more stable path of future long-term growth.

Many scholars have highlighted that volatility in GDP growth significantly affects the growth rate in itself.[1] Ramey and Ramey (1995) demonstrate that large volatilities in growth lower the average economic long-run growth rate. Similarly, Pritchett (2000) investigated variation in growth paths and their relationship with the average long-run economic growth rate for developing and developed economies. Prichett shows that growth volatility from developing countries has six times more adverse effects on average economic growth relative to developed countries. More recently Raju and Acharya (2020) found from a large sample of 67 countries that output volatility has a significant negative impact on economic growth.

To overcome and respond to these uncertain and unstable paths of growth, scholars have proposed industrial diversification to avoid the disbenefits of large economic fluctuations. Acemoglu (1997) shows this in an overlapping generation model with competitive markets

[1] For example, Ramey and Ramey (1995) and Pritchett (2000) are prominent among others.

and non-altruistic households, assuming that different projects are not perfectly correlated hence diversification helps reach desired goals. Further, it is emphasised that economies that are unable to diversify face greater uncertainties in achieving stable long-term growth rates. In other words, diversification opportunities help achieve higher productivity and economic growth. In particular, the developing and regional economies which have increasing returns to capital, with a lack of diversification opportunities, may have a long-lasting adverse impact on output growth.

Mobarak (2005), following Ramey and Ramey (1995) and Acemoglu (1997) investigated connections between volatility and average growth from 80 countries using a simultaneous equations model. In a volatility and growth nexus, Mobarak has also controlled for many other macroeconomic variables including income distribution, GDP per capita, democracy, diversification, trade, and inflation. The above study confirms that volatility has a significant adverse effect on economic growth. Further, Mobarak finds that diversification and increasing GDP per capita, help reduce volatility in economic growth.

After the Global Financial Crisis and more recently the COVID-19 health and economic shock, there is a debate as to whether policymakers should follow a one-size-fits-all approach. The majority of scholars align with Kuznets's philosophy that each problem needs a different solution and diversification in industrial policy remains critical in circumventing any adversity in the process of sustainable growth.

We explore this problem in the context of a restructuring economy and propose a framework to minimise volatility while achieving greater long-term growth. Our paper aims to discuss the sectoral relevance of the Gold Coast economy, the sixth-largest city and largest regional economy of Australia from 1990 to 2021. We explore local government initiative options that encourage greater economic diversification. We attempt this through the portfolio model of economic development which highlights the relevance and impact of diversification in transitional regional economies[2]. We closely follow the approach and theoretical discussion proposed by Vu, Jalbert, and Hammes (2010), Hansen and Singleton, K. J. (1983) and

[2] We define transitional regional economies as those that have traditionally focussed on a few large sectors but are moving towards a more mature economic base with a number of productive and contemporary sectors contributing to GRP (Gross Regional Product).

Sukharev, (2020). We also benefit from a range of other studies on this subject matter including de Andrés, de la Fuente, and Velasco (2021).

Model and methodology

Our economic model is centred on the concept of diversification and has great relevance to a typical policymaker.[3] Based on Cass (1965) and Mankiw (1982) models, the social planner maximises:

$$Max: W_0 = W_0 \int_{t=0}^{\infty} e^{-\rho t} U_t[K_t(C_t)]dt \quad (1)$$

$$subject\ to:\ S_t = Aw_t - K_t - \delta K_t + rS_t \quad (2)$$

$$and\ K_t \equiv -\delta K_t + C_t$$

W_0 is the society's lifetime welfare at the initial period, U_t is the immediate utility with usual properties of being negative and positive. K_t and C_t are stock of durable goods and flow of the durable expenditures respectively. S_t is the social asset, Aw_t aggregate wage income, r the interest rate, ρ and δ are the social time preference and depreciation rate. If the depreciation rate is 1 then we return to the case of non-durables and services as described in Hall (1978). The first-order condition for the social welfare maximation:

$$W_0 \frac{C_t}{C_t} = \frac{1}{\theta}\left[\frac{\gamma}{2} + r - \rho\right], where\ \theta = -U''C/U' \quad (3)$$

θ is the consumption elasticity of marginal utility and 1/θ = ф is the consumption elasticity of intertemporal substitution.

In contrast with Lucas (1978) and Romer (2011), the model below involves nondurable and durable goods assuming that a fraction of output is readily consumed, and the remaining is saved for future investment and capital formation—for future consumption.
therefore,
$C_t = aY_t$, where 'a' is marginal propensity to consume. Then the expected consumption expression from the above can be written as:
$W_0 (Y_t/Y_t) = [1/2]\theta (\sigma)$ where σ is the variance of the output.
Further differentiating both sides w.r.t. σ yields:

[3] We disclosed to have formed our empirical analysis using the model of Vu, Jalbert, and Hammes (2010).

$$\frac{dW_0\left[{}^{Y_t}/_{Y_t}\right]}{d\sigma} = \frac{1}{2\theta} > 0, as\ U' > 0\ and\ U'' < 0 \quad (4)$$

This means that there is a positive association between the output growth rate and variance. This implies that the policymaker faces the trade-off between low unemployment or volatility. In other words, a society that sacrifices high output growth in the present, can enjoy a more stable pattern of growth in the future. As mentioned above by Ramey and Ramey (1995) and Mobarak (2005) that growth volatility has a negative effect on the average rate of growth in the long run. Consistent with our interpretation, this means unemployment can be reduced by foregoing a higher rate of growth in the present time. This indicates that a social planner who aims at achieving steady growth in future should attempt to reduce uncertainty by targeting a smoother growth trajectory.
In the light of the above analysis, we derive two corollaries below:

Corollary 1: In a regional economy, a policymaker who wishes to maximise social welfare may be facing a trade-off between growth and volatility. Therefore, the policymaker/planner should be focusing on smoothing growth by decreasing the output growth volatility.
In the context of transitional economies, Acemoglu (1997) demonstrates that diversification can sufficiently increase the average growth rate. Smoothing growth can be achieved by diversifying into a multi-sector economy, focusing on overall output growth rather than one special sector. Our model is a combination of development theory and portfolio theory, therefore we consider all major sectors as investments within the portfolio and output growth is the total rate of return of the portfolio.
Corollary 1 in the above, allows us to state:

Corollary 2: In a regional economy, a policymaker or a planner who aims to diversify using a portfolio approach to development should attempt to minimise the variance of the overall portfolio return.

A stable portfolio return will guarantee stable employment and will effectively reduce the need for fiscal interventions during recessions and booms. Further our stable portfolio returns support diversification which is often embarked on by local, state or federal governments in

their industrial policies. Specifically, a transitional economy at the local government level, seeking sustainable growth could benefit from this approach. In the empirical section, we demonstrate the usefulness of this approach instead of testing a specific hypothesis.

Computations

The diversification analysis offers an optimal combination of the risk-minimising portfolio at each possible level of highest return. In finance, this is aligned with the theoretical framework of the Capital Asset Pricing Model (CAPM). In this process, weights are computed for portfolios whereas the negative weights are not considered. It is reasonable to consider that a government may eliminate a sector.

The rate of return (R_i)is as follow:

$$R_i = ln\left[\frac{R_t}{R_{t-1}}\right] \tag{5}$$

R_t and R_{t-1} are the current and previous year levels of the return. The resulting returns are then weighted by the proportion each sector has in the overall economy. This can be shown as:

$$R_{P,j} = \sum_{j=1}^{n} w_i * R_i \tag{6}$$

Further, the historical average and standard deviation of returns on the portfolio can be calculated as:

$$E(R_p) = \sum_{t=1}^{T} R_{P,j} \tag{7}$$

$$S_p = \sqrt{\frac{\left(R_{p,j} - E(R_p)\right)^2}{T-1}} \tag{8}$$

The objective is to minimise the standard deviation for return by altering the different shares of sectors in the economy. Hence when the economy is fully invested, denoting * as the desired return on the economy, the objective function and corresponding constraints can be written as:

$$Minimise: S_p = \sqrt{\frac{\left(R_{p,j} - E(R_p)\right)^2}{T-1}} \tag{9}$$

$$subject\ to: E(R_p) = \omega\ ;\ w_i \geq 0 \cap i\ and\ \sum_{i=1}^{n} w_{i=1} \quad (10)$$

The weighted standard deviation is computed as

$$WStd = \sum_{i=1}^{n} w_i * S_i \quad (11)$$

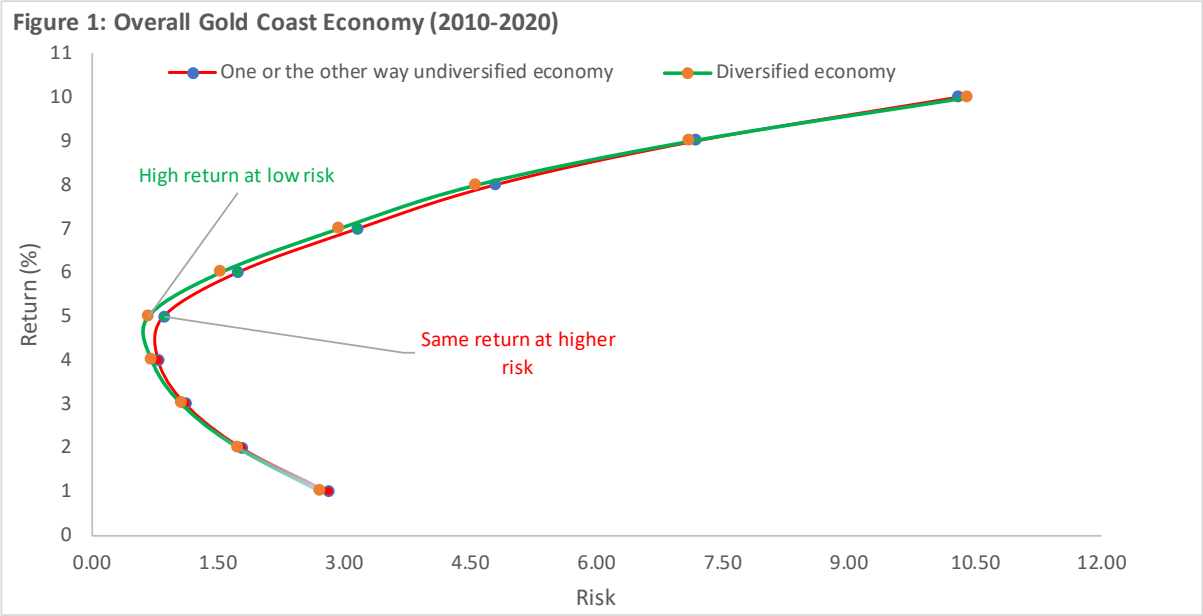
The weighted standard deviation is computed for comparison purposes differentiating between diversification and no diversification. Finally, the risk elimination because of diversification can be computed as:

$$Risk\ elimination = 1 - \left(\frac{S_p}{WStd}\right) \quad (12)$$

Data, preliminary results, and discussion

Using data from 2010 to 2020 obtained from ABS supplied by economy.id, we consider the annual growth rate of real gross value added for all 19 sectors in the analysis. Appendix Table 1 shows a continuous compound annual growth rate with an average growth rate, standard deviation, and a proportionate contribution of each sector to the overall economy. Data shows an average growth rate of 3.0 percent during 2010-20 across all 19 sectors. It is observed that 8 sectors have shown significantly higher growth than the sectoral average growth, 5 sectors have been at par with the average and the remaining 6 sectors have performed below average. The descriptive summary suggests that retail trade has shown the minimum standard deviation with an almost 3.0 percent average growth which is at par across the sectoral average growth over the period of 2010-20.

Figure 1, in the following page and Appendix Table 2 shows results when considering the overall economy and allows for a comparison between a diversified and relatively undiversified economy. The undiversified economy is the average outcome of eliminating one sector at a time and repeating for each of the 19 sectors. An individual sector analysis has also been conducted and becomes a part of the explanation of the results.



The overall findings suggest, for the minimum variance minimum, 89 percent of the total risk was eliminated as a result of diversification effects. This minimum risk portfolio produced a return of 4.3 percent with a standard deviation of 0.57 percent.

Further findings suggest that a fully diversified economy achieves almost 5 percent growth of gross value added at the minimum risk level. It is relevant to note that the Gold Coast's economy, on average, has observed 3.3 percent growth for the last decade, which is below the potential growth rate that could have been achieved as suggested in our model.

Regarding risk mitigation, findings suggest that the fully diversified economy, in relative terms, mitigates the risk in a range of 2.6 percent to 5.2 percent, from a smaller to significantly higher mean growth rate respectively. Results may be biased towards some of the sectors which predominantly lead the overall economy. To address this, we have estimated risk and return for each of the sectors individually.

These results demonstrate how this portfolio approach to economic development bridges the modern portfolio theory and modern economic development theory. This provides further support for the diversification approach to sector development, sometimes implemented by governments as industrial policy. At the atomic level, benefits of diversification depend on the returns of a new product in association with the products already being produced. The benefit is greater when the returns from a new product are inversely correlated with returns of the products already being produced in the economy. In finance, the benefit of diversification is that, by adding subsequent investments to a portfolio, overall portfolio risk can be

minimised to the systemic level of risk, or the lowest risk portfolio possible, while maintaining a stable return. A portfolio approach to economic development is based on this similar concept of diversification and its benefits when compared with sectoral or industrial concentration. Consequently, variance in the overall output level would be expected to be reduced significantly. Overall, the normative policy position assumed is that a slightly lower but steady state of growth as a result of diversification is preferred to a higher but volatile growth rate.

As highlighted by others, we observe trade-offs between volatility and growth. It is plausible that smoothing out may slightly lower output and slightly increase unemployment in the short run. However, the net return from lowering the variability of output aims to achieve a positive and stable return in the long run. This creates a more sustainable economy, reflected in both stable and continuous employment and output growth. This is supported by the literature, with Ramey and Ramey (1995) and Mobarak (2005) confirming that volatile growth results in lower long-run average rates of economic growth. Therefore, reducing volatility helps achieve higher growth rates in the long run.

There are several other benefits of reducing volatility in economic growth. Lower volatility of output growth benefits the return on investment to governments spending on social policies and programs, relative to those implemented in a more volatile output path. This becomes obvious from the cost an economy may face during high economic fluctuations in recessions and expansions. In fact, once social policies and programs are expanded it becomes difficult to reduce them in size when demand for such services falls abruptly during recessions. This leads to government intervention and financial assistance packages (public expenditure) for those most impacted by the volatility in the economy. Thus, stabilising output fluctuation would help reduce non-developmental expenditure. In addition to the above dis-benefits, individuals must bear higher costs of job searching and relocation costs. Output smoothing would reduce these costs. Output smoothing also allows tax smoothing which significantly reduces deadweight losses as compared with variabilities which substantially increase the deadweight losses. Thus, this benefits the overall economy through risk reduction, cost savings, and tax smoothing. Diversification in our portfolio approach to economic development provides a systematic framework in which policymakers can target sectors through economic development which benefit the overall economy and provide a more sustainable path of growth.

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Appendix:

Table 1: Summary statistics of sectoral return (2010-2020)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average return	Std. Dev.	2020 Wt.
Agriculture, Forestry and Fishing	-16.6	10.5	75.7	1.8	10.2	16.5	-0.6	-6.9	2.3	-21.2	-23.9	4.3	25.9	0.3
Mining	4.5	-18.1	15	59.4	12.2	8.1	29.7	-1.1	11.2	13.9	0.7	12.3	19.6	2.2
Manufacturing	-1.1	0.4	7.4	4.4	-6.1	3.4	6.2	0.7	8.3	4.3	0.6	2.6	4.2	8.8
Electricity, Gas, Water and Waste Services	10.6	12.6	-4.7	-5.8	-1	2.4	-1.3	-0.9	28	0.1	-11.1	2.6	10.8	2
Construction	-4.1	-9.4	-0.9	-2.5	19.2	2.2	7.9	8.4	4.9	-11.2	-11.8	0.2	9.5	10.8
Wholesale Trade	-3.1	-1.8	9.2	6.9	-1.4	-0.4	-1.4	4.5	-1.1	1.9	-4.3	0.8	4.3	4.4
Retail Trade	2.8	3.6	6	3.1	1.7	4.1	2	1.3	3.8	5.3	-1.8	2.9	2.1	7.3
Accommodation and Food Services	0.1	-0.6	7.4	2.9	-0.2	3.3	4.1	-3.1	7.9	9.8	-12	1.8	6.1	5.4
Transport, Postal and Warehousing	2.3	-1.6	8.6	6.5	2.6	0.6	5.7	9.5	13.8	13.7	-10.2	4.7	7	4.8
Information Media and Telecommunications	3.9	6.9	2	4.3	2.7	12.5	20.8	6.7	-7.8	-6.9	16.5	5.6	8.7	2.3
Financial and Insurance Services	-5.6	-3.1	16.7	3.8	-4.6	3.3	11.5	8.6	-3.7	3.7	7.6	3.5	7.3	8
Rental, Hiring and Real Estate Services	-11.1	-5.6	11.8	9.3	10.5	-0.8	5.8	-1.3	3	-2.7	-5.3	1.2	7.4	5.6
Professional, Scientific and Technical Services	10.6	3.8	9.2	4.8	2.8	8.3	3.8	9.3	-0.8	-3.4	2.3	4.6	4.4	6.4
Administrative and Support Services	-2.8	5.7	0.5	1	8.7	5.7	6.1	12.2	19.7	-7.8	-12.6	3.3	9.1	5
Public Administration and Safety	-5.1	16.5	0	-2.6	2.4	-1.9	9.3	1.9	2.4	5.5	11.2	3.6	6.5	4.1
Education and Training	3	1	4.3	1.6	17.9	5	6	-0.8	1.8	3.8	1.2	4.1	5	6.4
Health Care and Social Assistance	6.7	1.7	7.2	5.4	1.5	12.8	7.2	5.9	5	15.8	10.9	7.3	4.4	11.8
Arts and Recreation Services	-4.5	-0.3	5.3	-2.5	-1.1	0.3	2.3	-0.8	5.6	6.1	-10	0	4.8	1.9
Other Services	0	-6.3	9.7	-0.2	5.4	1.1	2.3	0.7	7.4	1.7	-9.7	1.1	5.5	2.4
Tourism	0.9	0.8	6.8	3	1	2.7	3.4	1.5	7.4	8.7	-7.8	2.6	4.4	19.5

Notes: Sectoral returns are continuously compounded percentage changes in the level of economic activity in the sector. The average return is simply the arithmetic mean during the period, Std. Dev is the sample standard deviation and Wt. is the proportion of the sector in the economy in the last year of the sample period. The tourism sector is a composite of four sectors including Retail Trade, Accommodation and Food Services, Transport, Postal and Warehousing and Arts and Recreation Services.

Table 2: Diversified and undiversified economy

Panel A: Unrestricted model with all industries/sectors			**Output growth (return)**									
	Industries	**MVP**	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**
Weights	Agriculture, Forestry and Fishing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00
	Mining	0.03	0.00	0.00	0.00	0.01	0.04	0.07	0.09	0.15	0.34	0.54
	Manufacturing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Electricity, Gas, Water and Waste Services	0.08	0.02	0.11	0.13	0.10	0.08	0.05	0.03	0.00	0.00	0.00
	Construction	0.00	0.10	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Wholesale Trade	0.06	0.40	0.46	0.40	0.20	0.02	0.00	0.00	0.00	0.00	0.00
	Retail Trade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Accommodation and Food Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Transport, Postal and Warehousing	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
	Information Media and Telecommunications	0.00	0.02	0.10	0.11	0.02	0.00	0.00	0.06	0.01	0.00	0.00
	Financial and Insurance Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Rental, Hiring and Real Estate Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Professional, Scientific and Technical Services	0.23	0.00	0.00	0.01	0.18	0.28	0.21	0.02	0.00	0.00	0.00
	Administrative and Support Services	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.08	0.00	0.00	0.00
	Public Administration and Safety	0.17	0.14	0.13	0.11	0.17	0.20	0.14	0.02	0.00	0.00	0.00
	Education and Training	0.12	0.00	0.08	0.16	0.16	0.14	0.04	0.00	0.00	0.00	0.00
	Health Care and Social Assistance	0.20	0.00	0.00	0.09	0.17	0.22	0.44	0.68	0.83	0.66	0.46
	Arts and Recreation Services	0.00	0.33	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Standard deviation	**Std.**	**0.58**	**2.71**	**1.73**	**1.06**	**0.71**	**0.68**	**1.53**	**2.94**	**4.57**	**7.10**	**10.40**
	Wt.	**5.37**	**5.48**	**5.98**	**5.99**	**5.73**	**6.11**	**6.33**	**6.91**	**6.94**	**9.58**	**12.61**
	Risk reduction	**0.89**	**0.51**	**0.71**	**0.82**	**0.88**	**0.89**	**0.76**	**0.58**	**0.34**	**0.26**	**0.18**

Notes: Panel A shows the optimal weighting when all sectors are included. MVP--is the minimum variance portfolio. Std. is the standard deviation on the portfolio. Wt. is the theoretical standard deviation that would occur if each of the sectors were perfectly correlated. The expected return on the minimum variance portfolio in Panel A is 4.0. Risk reduction is the proportion of risk that was eliminated due to portfolio effects.

Table 2: Diversified and undiversified economy

Panel B: Unrestricted model overall average (excluding all sectors one by one at a time)			Output growth (return)									
	Industries	**MVP**	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**
Weights	Agriculture, Forestry and Fishing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00
	Mining	0.02	0.00	0.00	0.00	0.02	0.04	0.07	0.10	0.16	0.33	0.52
	Manufacturing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Electricity, Gas, Water and Waste Services	0.08	0.02	0.09	0.11	0.08	0.08	0.05	0.03	0.00	0.00	0.00
	Construction	0.01	0.10	0.04	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
	Wholesale Trade	0.13	0.40	0.42	0.33	0.16	0.02	0.00	0.00	0.00	0.00	0.00
	Retail Trade	0.05	0.00	0.05	0.10	0.06	0.00	0.00	0.00	0.00	0.00	0.00
	Accommodation and Food Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Transport, Postal and Warehousing	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
	Information Media and Telecommunications	0.01	0.03	0.09	0.09	0.02	0.01	0.01	0.06	0.02	0.02	0.02
	Financial and Insurance Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Rental, Hiring and Real Estate Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Professional, Scientific and Technical Services	0.20	0.00	0.01	0.03	0.18	0.26	0.20	0.03	0.01	0.00	0.00
	Administrative and Support Services	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.08	0.00	0.00	0.00
	Public Administration and Safety	0.17	0.12	0.13	0.12	0.16	0.19	0.13	0.03	0.00	0.00	0.00
	Education and Training	0.14	0.00	0.07	0.13	0.14	0.13	0.05	0.00	0.00	0.00	0.00
	Health Care and Social Assistance	0.19	0.00	0.00	0.08	0.16	0.23	0.43	0.66	0.80	0.65	0.47
	Arts and Recreation Services	0.00	0.34	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Standard deviation	**Std.**	**0.76**	**2.81**	**1.78**	**1.11**	**0.79**	**0.86**	**1.73**	**3.16**	**4.80**	**7.19**	**10.31**
	Wt.	**5.64**	**5.49**	**5.77**	**5.60**	**5.64**	**6.13**	**6.45**	**6.99**	**7.11**	**9.59**	**12.37**
	Risk reduction	**0.87**	**0.49**	**0.69**	**0.80**	**0.86**	**0.86**	**0.73**	**0.55**	**0.33**	**0.25**	**0.17**

Notes: Panel B shows weights when one or the other sector is eliminated as a candidate sector. MVP--is the minimum variance portfolio. Std. is the standard deviation on the portfolio. Wt. is the theoretical standard deviation that would occur if each of the sectors were perfectly correlated. The expected return on the minimum variance portfolio in Panel B is 4.3 Risk reduction is the proportion of risk that was eliminated due to portfolio effects.

Key Words

Portfolio investment theory, economic development, diversification, risk-return trajectory

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