EXPORT DRIVEN REGIONAL DEVELOPMENT: A COMPARISON OF POLICIES BASED ON TIBERI-VIPRAIO-HODGKINSON INNOVATION STRATEGIES AND NETWORKED INFORMATION FLOWS[1]

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ABSTRACT: Sixteen supply-side and seven demand-side export promoting policies were simulated and examined for export and associated employment impacts. Policy design considered the spatial distributions of export promoting and constraining variables defined within the Tiberi-Vipraio Hodgkinson (TVH) regional innovation context typology (2000), and examined movements in their value-added industry support export enhancing information multipliers. These were derived using innovation indicator matrices (IIMs) within an extended input-output framework as designed by the author. The information sector was derived using a modified decomposition and aggregation (Jussawalla *et al*., 1988) whilst IIMs build upon DeBresson's (1999) innovative interactive matrices to show innovation strategy information spillover contributions rather than innovation inputs and outputs as an intermediate transactions quadrant subset. Policy simulations showed that information sharing consistent with the innovative milieu theory best stimulated exports and associated employment. That is, assistance to promote related scientific research delivered the best export, associated employment outcomes and related flow-on effects.

Keywords: Export promotion; innovation indicator matrices; information spillovers; small firms; Tiberi-Vipraio and Hodgkinson (TVH) variables.

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1. INTRODUCTION

The literature identifies many innovation strategies and information sources as influencing export product and production process developments and sales. In more recent times the Australian studies have included those of Tiberi-Vipraio and Hodgkinson (2001), Hodgkinson (2004, 2008) and McPhee (2010). Specifically, these studies have examined the performances and innovation behaviours of 146 surveyed regional New South Wales exporting firms and the variables of analysis were referred to as the Tiberi-Vipraio and Hodgkinson (TVH) strategy variables. Innovation indicator matrices (IIMs) within an input-output framework containing an information sector were since used to determine the spatial distributions and dependencies of these TVH variables and their information induced product and process multiplier values (McPhee, 2010).

Analysis of variance (ANOVA) and Chi-Squared Dependency tests were used to determine TVH strategy distributions and dependencies and the ANOVA tests found significant variations in innovation strategy use across the network, region and sector levels. These were strongest at the sector than the regional level, with the competitive advantage and specific product or production process development strategies being the exception suggesting a sourcing of innovation information from a larger geography than the firm's region of location (McPhee, 2010). In summary, networked information sharing was found crucial to export product and process development with main influences being: networking with agencies and partners; using internet and e-mail facilities; sourcing information from attending capital city conferences; and travelling to or visiting service providers, clients, agents and partners. These findings emphasise the need for policies based on sector interconnectivities.

This paper describes and compares several policies that are based on these TVH spatial qualities. The policies are designed to promote the generation, and sharing of information for export development and are simulated for 2000/01, 2006/07, and over the whole period, using the GRIMP input-output software. Their impact upon export and associated employment multipliers are then compared to determine the most supportive.

2. BACKGROUND

The debate continues regarding the importance of sector connectivity in policy design. For example, a UK Department of Trade and Industry study (2001) identified that sector connectivity could be utilised to improve the export performance and associated employment levels of already clustered firms in the services, manufacturing, media and computer related biotechnology industries. It also identified same industry non-manufacturing, national and international innovation and learning networks which were as important, if not more important, than locally based networks (Bathelt, 2005; Swann *et al*., 1998) suggesting that local networks as supply chains may not be as important as national and international links for such industries. These results suggest that these firms seek non-local lower cost better quality factors across space rather than source locally. This strategy was also observed in studies of the German and Italian industrial districts by Paniccia (2002) and Staber (2001) and Birkinshaw and Hood (1998) who suggested that this behaviour is often demonstrated by transnational corporations that choose locations where available assets, organisational and institutional structures provide the required innovation information.

Within Australia, national clusters have comprised nation-wide networks of regionally based firms within the fishing, wine, tourism, film and education industries occasionally collaborate and innovate collectively as well as independently through a range of alliances, federations, commissions and associations (Roberts and Enright, 2004). In contrast, regional clusters have an acknowledged national or international competitive advantage and these are localized, very small and have a strong export focus. Examples of this latter group have included: the high speed catamaran industry in Cairns, Hobart and Fremantle, and the equine clusters around Scone in New South Wales (Roberts and Enright, 2004). Roberts and Enright (2004) also suggest that many Australian regional firms are members of business networks rather than clusters and that the cluster related policy initiatives have meet with considerable difficulties.

Contrary to expectations, Marceau (1999 cited in National Economics, 2000) first found evidence of cluster shrinkage associated with increased globalisation and structural change from 1975 to 1989 using national input-output tables. This was substantiated by the State of the Regions Report (National Economics, 2000; Table 1) which showed declining domestic

supply chains and information networks compared to other OECD nations. Brown and Duguid (2000) identified that three main problems for Australian clusters were: insufficient critical mass, lack of focus and distinctiveness and various political and administrative difficulties.

Roberts and Enright (2004) have since claimed that many Australian cluster initiatives have failed because of a lack of experience, resources and training, and the failure of regional development agencies to facilitate the development programs. These failures were in clusters that were developed in some of the national industry restructuring programs (termed natural or deductive clusters) as well as some of the Federal, State and Local Government initiatives. Those that evolved from the national industry restructuring programs were intended to be driven by market forces to enable location specific competitive advantages to develop via industry agglomerations in a manner described by Weber (1929) and it is now considered that many of these initiatives failed to recognize the functional links between the regional, state and national firms. Those Federal Government initiatives that experienced difficulties were identified in:

- the Australian Manufacturing Report (Pappas Carter Evans & Koop and Telesis, 1990) which proposed that core and other regional industries work together to strengthen regional networks and encourage innovation and technology transfer;

- the McKinsey report titled *Lead Local, Compete Global* (McKinsey and Company, 1994) which suggested that governments adopt clustering as an approach to industry and regional economic development through soft infrastructure, leadership and entrepreneurship (Roberts *et al*., 1996);

- the 'Working Nation' (Keating, 1994) report which encouraged Federal and State governments to use cluster policies to stimulate regional industry; and

- the Regional Summit and Regional Solutions program (Department of Transport and Regional Development, 2000) which underwent several administrative changes to the Federal Department of Transport and Regional Services then the Regional Assistance

Program within the Department of Workplace Relations and Small Business.

Roberts *et al*., (1996) and Roberts and Enright (2004) have suggested that these initiative also failed because of an inherent lack of support for metropolitan regions where some of the major structural adjustment problems and greatest potential to develop industry clusters were located. Consequently, the preferred Federal initiative has become the industry-university Cooperative Research Councils (CRCs) partnership program (Roberts and Enright, 2004).

The Queensland Government initiated innovation centres within the information, food, biotechnology, and new materials technology-based industries with limited success (Markusen and Hall, 1985, cited in Roberts and Enright, 2004) and one spin-off was the Queensland Cape York International Spaceport (1988) which failed to raise sufficient development funds. In Queensland the State Government developed several joint industry task forces for example: the Tourism and Trade Coast Development taskforce was established to facilitate the development of logistics, chemicals and processing industries in the Brisbane Gateway Ports area and the Cairns region of Far North Queensland. In addition, the fair go for local industry campaign (Queensland Department of State Development, 2000) encouraged major project investors to use local supply chains as a means of promoting clustering.

A Japanese consortium also proposed the Multi-function Polis (MFP) in partnership with the Queensland Government in 1986 and this was based upon the Japanese Technopoles where the purpose was to facilitate international technological and cultural exchange driven by networked and clustered industries (Castells and Hall, 1994, cited in Roberts and Enright, 2004). Whilst the Japanese participants took a real estate view of the project, the Australian partners viewed it as a new urban development, lifestyle and working environment concept. In reality the project encompassed several themes including biotechnology, IT and CAD/CAM based industry production. The project collapsed when the Queensland Government refused to purchase the Northern Gold Coast site so it was moved to Adelaide. Since then, the project has subsequently attracted very little international interest and the corporation was wound up in 1998 with very little to show for the efforts.

In South Australia, the Departments of Industry and Trade, Transport and Urban Planning and the Arts investigated and mapped clusters using Geographical Information Systems (GIS) and investigations of the defence, spatial, water and multi-media industries led to the formation of several clusters. The South Australian Regional Development Taskforce Report (Bastion, 1999) has supported cluster located in the Upper Spencer Gulf region for the environment, conventions and food industries.

In New South Wales, Sydney has been promoted as a global financial centre where firms in the finance sector are well connected to information technology, biotechnology and producer service industries (Brotchie *et al*., 1995). In addition, the Sydney central business district, northern suburbs and Ryde corridor contains information services and technology industry clusters. Furthermore, the Sydney airport corridor contains clusters in transportation, logistics; whilst the Sydney mid-west contains biomedical clusters and the west and south-west component manufacturing clusters (Roberts and Murray, 2002; cited in Roberts and Enright, 2004). O'Neill and McGuirk (2002) argue that all of these clusters are driven by international factors as Sydney becomes more integrated into the global market, and the State Development Strategy is driven by the assumption that attracting international corporations to Sydney should have beneficial multiplier effects. They argue that this strategy has worked well with over forty percent of Australia's largest national and international corporations based in Sydney but it has done little to support new industry developments within the regions (Roberts and Murray, 2002; O'Neill and McGuirk, 2002).

The Victorian Government cluster initiatives of the mid 1980s were designed to develop specialized high technology industrial districts in Werribee and East Melbourne regions (Blakely *et al*., 1987). Roberts and Enright (2004) argue that their success was limited because they were driven by political rather than market considerations. Following the election of the liberal government in the 1990s interest in these projects waned and in 2000, the Department of State and Regional Development audited the automotive, environmental management, renewable energy, metal fabrication, precise engineering, professional and technical servicing, textile clothing, footwear, leather, transport and logistics industries, to identify their needs and Roberts and Enright (2004) suggest that the development initiatives have since followed a non-cluster approach.

3. METHOD AND SIMULATIONS

In a review of government regional development policies concern is expressed regarding regional disparities and growing skill shortages when regions have a narrow base for their economies (Collits, 2008). A main question arising in the policy debate is whether assistance should go to all regions equally, to growing regions, to declining regions, or to regions that suffer sudden economic shocks? A further question follows as to whether assistance should be given to firms, regional bodies or to a combination of both or infrastructure projects. A study by Epps (1999) of New South Wales assistance programs found little relationship between the types of firms assisted by the State Government and the objectives of the Regional Development Board which emphasizes the need to determine the precise policy objectives before implementing a policy program. Collits (2008) also suggested that Australian governments have often introduced new programs without first identifying the desired objectives and again it raises the issue of what kinds of regions should be helped. The policies simulated in this paper help address these issues as there are eight simulation scenario categories that generate information sharing to facilitate export-induced economic growth whilst minimizing disparities across geographical space.

Such simulations were based on earlier identified TVH spatial strategy distributions. Specifically, that information sharing stemming from the use of networks was found to be an important driver of export performance. Using suitably constructed input output tables, a random value of $22.6M AUD with no particular significance, is first allocated at the beginning of 2000/01 and a value of $33.96M AUD is then allocated at the beginning of 2006/07 and this assistance was assumed to run over the whole time period till the end of 2006/07. The 2000/01 input-output tables include the sales and export data from the survey firms whilst the 2006/07 tables are an update of the 2000/01 tables using ABS data. The tables for each time period were decomposed to illustrate an innovative milieu and no information sector; and no innovative milieu but having the information sector split into its primary and secondary components (see Jussawalla *et al*., 1988). The later year's allocation is based on a 50.27 percentage increase in total economic output of over the time period as measured from the respective input-output tables. All scenarios were simulated by adjusting upwards those cell values where the *targeted sector-flows* intersected with *gross fixed capital formation in the private*

sector, as well as for *public enterprises* and *general government*. This assumes capital building through information sharing, goodwill, and reputation and that general government bodies, public enterprises and private firms were cooperating to implement the policies and achieve the desired outcomes.

There are specific reasons why 2000/01 and 2006/07 were used. First, the final year of the TVH survey data was 2000/01. Second, 2000/07 was considered a medium-term projection from 2000/01 and used the most recent data available at the time. Third, projecting the input-output tables and simulating the policies too far into the future would overlook structural changes that cannot be anticipated at the projection time. However the exercise successfully demonstrated that these policies can be simulated and analysed using the input-output methodology.

Whole system impacts were examined using total demand and supply multipliers for output, income, employment, value added, exports, imports and final consumption and additional supply multipliers such as: government expenditure; gross fixed capital formation for the private sector, public trading enterprises and general government. Net exports multiplier change values were calculated as the export change values less import multiplier change values. The two most successful simulations are identified and discussed in section 5.

Table 1 illustrates the policy simulations that are performed and shows how they cause TVH strategies to be chosen as regional context and global markets interact to cause all multiplier changes (it also lists the on-disk appendices where the relevant input-output tables and proportioning exercises are stored). Specifically, the TVH variables do not have multiplier values in their own right, but derive these through their interaction with the intermediate sector and global interface. This table also indicates the questions from the Survey of New South Wales regional exporters that are used to gather these data and their choices within each strategy category. The simulated demand and supply flows are based on the TVH strategy usages, in which the policy scenarios allocate a final demand or final supply increase to a targeted sector as follows (see Table 2 in McPhee, 2011, pp. 7-8):

- *The equity scenarios* are intended to promote economic growth and resultant exports with minimum growth divergence across the sector-flows. They take into account the concerns expressed in the Collits'

review (2008) that one region's gain may be another region's loss and spread the induced growth benefits in a manner so that no region is overwhelmingly disadvantaged. As such the strongest performing sectors receive the smallest assistance and vice-versa. This scenario contains the policy simulations D1, D2, and S1. Allocations are made to the three weakest non-zero balance regional sector-flows chosen from the three weakest regions respectively in reverse proportion to the demand-induced relative sector-flow output so that the weakest flows receive the most assistance to minimize growth divergence. D2 allocations are made similarly to D1 but to the five regional sector flows that have a zero balance and final demand increases are made in reverse proportion to their respective demand induced regional output balances so that the weakest region receives the most assistance and vice-versa. This stimulates the non-performing export sectors within the lowest performing regions. For the S2 simulation (sector specific) the allocation is made to the five weakest non-zero balance supplying regional sector-flows respectively in direct proportion to the supply-induced relative output multiplier values.

- *The sector-specific scenarios* are designed to take advantage of the targeted sectors well established input supply networks. Assistance is allocated proportionally to the relative values of total output, export sales, total output or export multiplier for the targeted sector as these values provide some indication of the strength of the connectivity with the input suppliers. Earlier analysis (McPhee, 2010) indicated that firms in these targeted sectors were drawing on inputs networks that spanned a geographical area much larger than the defined regions. Targeting these sectors would then increase final supplies to specific regional sector-flows; this scenario contains simulations S2 to S10 inclusive.

- *The innovative milieu scenarios* are chosen to stimulate the scientific research component of the state economy. Subsidising such research encourages more of this activity and benefits are considered to flow into the product and process developments of exporting industries. Theoretical discussion suggested that information stemming from the milieu will benefit a network of SMEs, MNCs, customers, suppliers,

competitors, universities and research bodies (Maillat *et al*., 1994, Maillat, 1998; Capello, 1999b) whilst Nelson and Winter (1982) and Dosi *et al*. (1988) emphasised its role in reducing decision making uncertainty and associated costs in times of innovation. These researchers have also emphasised the long-term benefits in that the milieu collectively directs research and scientific information to benefit future exporting industries as well as controlling it at a specific point in time. In summary, the simulations in these scenarios are based upon the assumption that increasing scientific research will have beneficial flow-on effects for the linked sector-flows and they contain the simulations D3 and S11.

- *The information split scenario* stimulates both the primary and secondary information components. It is believed that increasing the primary and secondary information contributions to the state economy will have beneficial flow-on effects to strongly linked sectors. Earlier analysis (McPhee, 2010) showed that declines in both the primary and secondary information components were associated with declines in export sales and associated employment. Stimulating the secondary component is actually subsidizing the internal communication costs of firms within the connected sectors and this assists in the delivery of the primary information component stimulation. The increases in final demand and final supply are made in direct proportion to the respective primary and secondary information state balances. This is equivalent to increasing the secondary and primary information coefficient of the linked sectors in proportion to the strength of their linkages and these scenarios contains the simulations D4 and S12.

- *The information combined scenarios* contain simulated increases in final demand and final supply which are allocated to the complete information sector. It is believed that increases in total information will flow on to sector-flows that use this information and this is equivalent to increasing the total information coefficient of the linked sectors in proportion to the strength of their linkage. These scenarios contain simulations D5 and S13.

Table 1. Policy Simulation Summary.

Simulation		On-Disk Appendices			Regional Context, Global Interaction and Survey Details		
Scenario	**Identi-fication Demand / Supply**	**2000/01 Input-Output Tables**	**2006/07 Input-Output Tables**		**TVH Strategy (and number of choices),**	**Survey Question**	**Innovation Indicator Matrix**
Equity	D1	9.13(RO1), 6F	9.14(RO7), 9.1		Corporate primary strategy (3)	2.1	1
Equity	S1	9.13(RO1), 6F	9.14(RO7), 9.1		Competitive advantage (7)	2.2	1
Equity	D2	9.13(RO1), 6F	9.14(RO7), 9.1		Production strategy (4)	2.3	1
Sector Specific	S2	9.13(RO1), 6F	9.14(RO7), 9.17		Perceived leadership position (4)	1.5	1
Sector Specific	S3	9.13(RO1), 6F	9.14(RO7), 9.18	=> => =>	R&D (innovation) (4)	25	1
Sector Specific	S4	9.13(RO1), 6F	9.14(RO7), 9.19		Primary exporting reason (12)	3.4	2
Sector Specific	S5	9.13(RO1), 6F	9.14(RO7), 9.20		Exporting strategies (7)	3.6	2
Sector Specific	S6	9.13(RO1), 6F	9.14(RO7), 9.21		Perceived export expansion difficulties (15)	3.5	2
Sector Specific	S7	9.13(RO1), 6F	9.14(RO7), 9.22		Domestic sales	5.7	2
Sector Specific	S8	9.13(RO1), 6F	9.14(RO7), 9.23	=> => =>	Sourcing of inputs (35)	4.4	3
Sector Specific	S9	9.13(RO1), 6F	9.14(RO7), 9.24		Cost of information about new technologies (6)	2.6	3
Sector Specific	S10	9.13(RO1), 6F	9.14(RO7), 9.25		Cost of information about market developments. (12)	4.9	3
Innovative Milieu	D3	9.11(MO1), 6J	9.12(MO7), 9.3		Primary inputs		3
Innovative Milieu	S11	9.11(MO1), 6J	9.12(MO7), 9.3		Australian Government attitude (4)	5.1	4
Information Split	D4	9.15(SO1), 6J	9.16(SO7), 9.4	=> => =>	New South Wales Government attitude (4)	5.2	4
Information Split	S12	6J	9.4 Trans.		Local Government attitude (4)	5.3	4
Information Combined	D5	9.9(I01), 6H transposed	9.10(IO7), 9.5		Overseas market information (4)	5.4	4
Information Combined	S13	9.9(IO1) Trans. 6H transposed	9.10(IO7), 9.5		Exporting process advice (8)	5.5	4
Region. Inform. Combined	D6	6H	9.6		Non-information exports		4
Region. Inform. Combined	S14	6H	9.6 Trans, 9.26		Domestic sales		4
Sector Inform. Combined	D7	6H	9.7		Corporate primary strategy (3)	2.1	1
Sector Inform. Combined	S15	6H, 6H transposed	9.27 Trans. 9.27		Competitive advantage (7)	2.2	1
Small Business	D8	6H	9.8,		Production strategy (4)	2.3	1
Small Business	S16	6H, 6H transposed	9.8 Trans, 9.28		Perceived leadership position (4) (Q 1.5)	1.5	1
					R&D (innovation) (4)	25	1
					Domestic sales	5.7	2
					Imports		
					Exports		

Notes: 1. First line on-disk appendices refer to the proportioning and re-allocation files; 2. Second line on-disk appendices refer to the input-output tables the allocations are based on and thereby applied to; 3. RO1, MO1, SO1 and IO1 denote regional sector-flow, innovative milieu, information split, and information combined

for 2000/01 respectively; and 4. RO7, MO7, SO7 and IO7 denote regional sector-flow, innovative milieu, information split, and information combined for 2006/07 respectively.

- *The regional information combined scenarios* stimulate the sector-flow of each region that has the weakest information component as measured by their information components to enhance export performance. The choice is made using the lowest value information coefficients so that more than one sector-flow can be chosen for each region. The simulated increases in final demand and final supply are made in direct proportion to the demand or supply induced relative export values. This is based upon the belief that increases in final demand and final supply for the information deficient regional sector-flows will cause an increase in the information content and provide beneficial flow-on effects to other strongly linked flows within the region. These scenarios contain simulations D6 and S14.

- *The sector information combined scenario* stimulates the eleven most information deficient regional sector-flows regardless of their region. For these scenarios, the increases in final demand and supply are allocated in direct proportion to their demand and supply induced relative output values. These allocations are based on the belief that increasing demand and supply for these sector-flows will draw information into these flows or will increase its supply respectively. Some information deficient sector-flows will be stimulated to source their information from other linked flows within the system, and this will spread through the flow-on effects. These scenarios contain the simulations D7 and S15.

- *The small business scenarios* are those in which the small business components of each regional sector–flow experiences increases in either final demand for simulation D8, or increases in final supply for simulation S16. These simulations should increase the small business information component and be beneficial for their export related product or process developments. McPhee (2010) identifies significant and wide SME dispersion throughout all sectors and some innovative milieu connections. Schumpeter (cited in Marshall, 1987;

> Davelaar, 1989) also considered that SME entrepreneurs would import exogenously produced inventions before and during the peaks and troughs of economic change for reuse as commercial innovations. Furthermore, a study by Williams (2005) reports that SMEs with marketing and exporting budgets are more likely to use all of the marketing information sources and that this would improve their export performances.

Two similar but slightly different analytical methods were used to identify which simulation policies should be chosen as a basis for maximizing export sales without losing any industry-support induced contributions. These were referred to as the *combined multiplier-shift rank* and the *average rank* methods of analysis. The similarities of these methods were in identifying the simulations that first, deliver the highest overall exports increase; and second, deliver the highest industry-support induced contributions in recognition of factor-supply importance for the production process and product development. The differences in these methods were that with the *combined multiplier shift rank* method the final choices were based upon the multiplier change that occurred over the whole study period plus the rankings for the 2006/07 year whilst the *average rank* method choice was based solely on the whole of study period average ranks. The *combined multiplier-shift rank* approach consists of:

- First, choosing the policy simulation that delivers the largest net-exports increase over the study period, and illustrating its export and import component changes, as induced by the consumption and industry-support activities;

- Second, choosing the policy simulation that delivers the largest industry-support induced changes for both export increases and import decreases; and

- Third, recommending from a combination of the identified stage one and stage two simulations.

Alternatively, the *average rank* method consists of:

- First, calculating average ranks for the whole study period of the total, consumption, and industry-support policy simulation contributions;

- Second, choosing the policy simulations that deliver the highest export performance overall alongside the highest industry-support induced contributions; and

- Third, recommending from a combination of the identified stage one and stage two simulations.

4. METHOD CONTRIBUTION

The simulations identify ways to stimulate information generation and exchange in a manner that maximises export induced economic growth and associated employment using multipliers whilst minimising spatial or regional divergence. Such multipliers contain an information spillover that came into existence as the chosen innovation strategy, regional context and global markets interacted. The policy simulation effects were measured by analysing the resultant multiplier direction and magnitudes whilst the design, implementation and analysis of earlier policies did not consider these approaches. For example, cluster analysis by Knoke and Burke (1980) used hierarchical log-linear models, logistic regressions, Pearson chi-squared and likelihood ratios to show that stage of cluster development and sector were significantly associated with employment growth, and that international significance was associated with sector growth. The *combined multiplier-shift rank* and *average rank* analysis methods as described earlier were unique in their methods.

5. RESULTS AND DISCUSSION

Simulations D3 and S11 emerged as the leading export and associated employment stimulating policies over the whole time period when examined from an industry-support rather than consumption induced effect. This ensures that the development and stimulation of export products or production processes is driven by innovation and technology changes rather than wage earners spending their incomes. Detailed simulation results for

each year can be seen in Table 3 of McPhee (2011, pp. 12-14). This table clearly shows that:

- For the total impact changes, S9 followed by S14 are the leaders for 2000/01; and S10 followed by S5 are the leaders for 2006/07;
- For the consumption-induced impact changes, D3 followed by S11 are the leaders for both 2000/01and 2006/07;
- For the industry-support induced impact changes, S12 followed by D4 are the leaders for 2000-01 while D3 and S11 are the leaders for 2006/07;
- Simulations D3, S11, S12 and D4 all demonstrated gradual increases in their net-export multipliers from 2000/01 to 2006/07;
- These gradual increases in net-export multipliers were caused by gradual increases in export multipliers associated with gradual decreases in import multipliers;
- This is evident with increasing consumption-induced export to import ratios of 0.0746 and 0.4674 for both D3 and S11 for 2000/01 for 2006/07 respectively, followed by industry-support induced export to import ratios of 0.8179 and 1.72 for S12 and D4 in 2000/01 and 1.72 for D3 and S11 by the end of 2006/07 (not shown due to space considerations); and
- Simulations D3 and S11 are also associated with positive employment increases of 534.57 and 498.02 equivalent full-time persons respectively.

Similarly the *combined multiplier-shift rank* approach analysis was used to examine changes in the multipliers from 2000/01 to 2006/07. Detailed results can be found in Table 4 of McPhee (2011, pp. 15-17), listing the changes in the total impact, consumption-induced impact and the industry-support impact, in decreasing order of the net-exports multiplier changes. This shows S10 and S5, both of the sector-specific simulation group as having the largest

beneficial net-export changes for the total impacts for both 2000/01 and 2006/07. It also shows D3 and S11of the innovative milieu scenario to be the consumption and industry-support induced simulation leaders for both 2000/01 and 2006/07. Simulations D3 and S11, for example, are shown as having the highest net-export consumption-induced changes of -$81.11M AUD and -$21.99M AUD for 2000/01 and 2006/07 respectively. These simulations are also shown as having the highest net-export industry-support induced changes of -$2.02M AUD and $9.72M AUD for 2000/01 and 2006/07 respectively and were associated with increases in the corresponding export to import ratios over the study period. For example, the consumption-induced export to import ratio for D3 and S11 increased from 0.0746 to 0.4674 whilst the industry-support induced export to import ratio increased from 0.8228 to peak at 1.7259. These ratio increases were caused by export increases that were associated with import decreases or were far greater than any import increase. For example, consumption-induced net-exports have increased from -$81.19M to -$21.99M as consumption-induced exports increased from $6.54M to $19.30M while consumption-induced imports decreased from $87.65M to $41.29M. Over the same time period, industry-support induced net exports increased from -$2.02M to $9.72M. This was caused by industry-support induced exports increasing from $9.38M to $23.11M while industry-support induced imports increased very slightly from $11.4M to $13.39M.

These changes indicate D3 and S11 to be the overall industry-support induced simulation leaders suggesting that government subsidies and tax deduction for scientific research leading to the improvement of export products or processes is the most successful of the simulated policies. For stimulating innovations in new products or production processes then, simulation D3 and S11 have advantages over simulation S10 which was the total impact leader for 2006/07 and were mainly consumption induced. Alternatively, a combination of both policies would stimulate net-exports through developments of new products and production processes plus consumption.

Table 2 presents a summary of the S10 and D3 simulation changes and indicates the overall leading net-export supply and demand induced performer as S10 (sector specific) and D3 (innovative milieu) at $75.87M and $82.33M as improvement to net-exports respectively. It also shows that simulation D3 delivers the highest ranking industry-support induced and

consumption induced contributions, with both being allocated a ranking of one (1) for 2006/07 although S10 ranks above D3 at (1) for the overall 2006/07 contributions. The analysis using the *combined multiplier-shift rank* method therefore suggests that a compromise combination of simulations S10 and D3 may be employed to maximize net-export performance.

Table 2. Relative Multiplier Movements for Policy Simulations S10 and D3. Sources: McPhee (2010 and 2011).

Policy Simu-lation	Simulation Scenario	Net-export Change	Export Change	Import Change	Rank in 2006/07	Component
S10	Sector specific	75.87	39.06	-36.81	1	Total
S10	Sector specific	46.50	10.48	-36.02	18	Consumption induced
S10	Sector specific	3.37	0.03	-3.34	11	Industry-Support Induced
D3	Innovative milieu	82.33	47.89	-34.44	11	Total
D3	Innovative milieu	59.12	12.76	-46.36	1	Consumption induced
D3	Innovative milieu	11.74	13.73	1.99	1	Industry-Support Induced

In contrast, Table 3 illustrates the *average rank* method. In this table, each component of each year's simulation is ranked from one to twenty-four with a score of one being for the highest achieving component. Component averages are listed in the three far-right columns and the policy that achieves the highest average rank for overall contributions is chosen. This method nominates simulations S9, S14 and D6 with average overall rankings of 4.5, 4.9 and 4 respectively. However, these are mainly consumption-induced rather than industry-support induced.

Data in the far-right column indicates that simulations D3, S11 and D5 deliver the most industry support to net-exports at rankings of 2, 3 and 4 respectively. Simulation D3 provides consumption-induced leadership for both 2000/01 and 2006/07 and industry-support for 2006/07 whilst S11 is the consumption-induced effects leader for both 2000/01 and 2006/07 and ranks second in industry-support effects for 2006/07. This is consistent with the combined multiplier-shift rank method findings and so once again D3 and S11 are the leaders with the industry-support induced effects ranking an average of 2 and 3 respectively.

Over the time span from 2000/01 to 2006/07 the economic system changes structure due to changes in consumer demand and factor input contributions.

The analysis can be extended to take into account the dynamic interaction between these structural changes and running the policies from 2000/01 to 2006/07 (see Table 7 of McPhee, 2011, pp. 21-25). This means that policies that are the leaders in 2000/01 may not be the leaders by the end of 2006/07 because of this structural change. The analysis shows that the overall leading simulation became S10 (previously S9 and both of the sector specific group) with the Shoalhaven region increasing its overall dominance with its other machinery and equipment sector remaining the main net-exports contributor despite its export multiplier falling slightly and representing mainly initial impacts with no industry support. By 2007, the performance of the Shoalhaven's other machinery and equipment sector was matched by the following sector-flows: forestry and fishing, fabricated metal products, and the Wingecarribee's education sector.

Table 3. Policy Simulation Export Ranking by Export Multiplier Contribution. Source: McPhee (2011).

Policy Simu-lation	Policy Scenario	Total 2000/01	Cons. Induced 2000/01	Industry Support 2000/01	Total 2006/07	Cons. Induced 2006/07	Industry Support 2006/07	Total Average	Cons. Induced Average	Industry Support Average
S9	Sector Specific	1	6	9	8	7	6	4.5	6.5	7.5
S14	Reg. Inform. Comb.	2	12	17	7	9	15	4.9	10.5	16
D6	Reg. Inform. Comb.	3	10	8	5	8	9	4	9	8.5
D8	Small Business	4	14	18	9	12	18	6.5	13	18
S1	Equity	5	18	20	16	11	16	10.5	14.5	18
D1	Equity	6	13	19	15	10	8	10.5	11.5	13.5
S6	Sector Specific	7	11	10	13	15	10	10	13	10
D7	Sector. Inform. Comb.	8	16	21	17	22	17	12.5	19	19
S15	Sector. Inform. Comb.	9	17	22	18	23	21	13.5	20	21.5
D5	Inform. Combined	10	21	5	20	3	3	15	12	4
S13	Inform. Combined	11	22	6	21	4	4	16	13	5
S5	Sector Specific	12	15	12	2	16	12	7	15.5	12
S10	Sector Specific	13	3	13	1	18	11	7	10.5	12
S8	Sector Specific	14	4	14	3	17	13	8.5	10.5	13.5
D2	Equity	15	7	7	19	24	7	17	15.5	7
S2	Sector Specific	16	8	11	14	5	5	15	6.5	8
S7	Sector Specific	17	9	15	22	6	20	19.5	7.5	17.5
D4	Information Split	18	23	2	23	19	24	20.5	21	13
S12	Information Split	19	24	1	24	20	23	21.5	22	12
S3	Sector Specific	20	5	16	4	21	22	12	13	19
S16	Small Business	21	19	23	10	13	19	15.5	16	21
S4	Sector Specific	22	20	24	6	14	14	14	17	19
D3	Innovative Milieu	23	1	3	11	1	1	17	1	2
S11	Innovative Milieu	24	2	4	12	2	2	18	2	3

The overall leading consumption simulation remained D3 due to the continued dominance of the personal and other services sector and increased contributions from the other listed sectors. These export increases were accompanied by far larger decreases in imports of ownership of dwellings, education, health and community services, and electricity gas and water. However, the overall leading industry support simulation also became D3 (previously S12) due to increased importance of the Far North Coast region over the Wingecarribee region, whilst the secondary information and miscellaneous manufacturing sectors remained dominant even though decreases in contributions that were far greater than the property and business services and retail trade import decreases were experienced. Overall then, D3 remained the dominant strategy over the study period and this is consistent with the earlier analysis. Indeed, in choosing between D3 and its supply-side counterpart S11, D3 always delivers the larger employment increases.

The extended analysis also provides details of simulation export multiplier changes for the regions and their sectors. It shows that increases for D3 are greater than all other policies within the simulation groups at 0.9 to 1.0 for basic metals and metal products within the Hunter region, 0.81 to 0.99 for meat and dairy products within the Western region, and 0.43 to 0.95 for meat and dairy products within the Northern region; and it also delivers the smallest offsetting multiplier decreases for the overall impact. In terms of the consumption-induced effects D3 (innovative milieu) delivers multiplier increases that are mid-way in the range of consumption-induced multiplier increases. Its offsetting consumption-induced multiplier decreases are also in the mid-range of all consumption-induced multiplier decreases. However, an examination of its industry-support effects show that it delivers the largest multiplier increases and these were 0.26 to the Wingecarribee region's transport equipment and miscellaneous manufacturing sectors and the Far North Coast region's petroleum and coal products sector and these were 0.26, 0.26 and 0.25 respectively. It also delivered multiplier increases in the offsetting multiplier changes and was the only policy to achieve this. All other policies recorded decreases or no change in their industry-support effects.

In summary, tax cuts and subsidies supporting scientific research (policy simulation D3) was the most successful policy in increasing the export related multiplier and this is consistent using both the static analysis as well as the more dynamic analysis that takes account of structural change

occurring over the study period. This finding supports the innovative milieu approach to regional development as discussed further in the conclusion.

6. CONCLUSION AND RECOMMENDATION

This paper presents a comparative analysis of simulating seven increases in final demand and sixteen increases in final supply. These were designed to increase the sourcing, generation, transfer and sharing of information to benefit export product or production process development and increase associated employment; thereby facilitating export induced economic growth within the region whilst minimising regional divergence. The specific contributions of the method were that: policy design was based on identified and tested TVH strategy usage spatial distributions and these variations were stronger at the sector level rather than regional level with the exception of competitive advantage and innovation strategies. Hence policies must be based on sourcing from across a larger geography and not limited to the region.

The demand-side followed by the supply-side innovative milieu simulation identified as D3 and S11 respectively were identified as best for export and associated employment stimulation. Both generated the highest industry-support spillover and associated employment contributions with D3 slightly ahead of S11 with the employment creation. The D3 demand-side policies would comprise tax-cuts and subsidies to encourage the use of new research and technologies by developing exporters whilst the S11 supply-side policies would comprise providing tax cuts and subsidies for those performing such scientific research. This is consistent with the innovative milieu theory in that milieu network participation provided information spillovers through cooperative learning and product or production process design and developments (Maillat *et al*., 1994, Maillat, 1998; Capello, 1999a) and views expressed by Nelson and Winter (1982) and Dosi *et al*. (1988) who have argued that the milieu network serves to reduce decision making uncertainty during innovation developments. Theoretically the innovative milieu approach considers not just the control over given technologies or stocks of complementary assets at a point in time, but considers long-term control over the development of these technologies. Fundamentally the milieu network

has a collective intention to focus these scientific developments towards specific applications that usually benefit exporting industries.

Consistent and supporting evidence for this is found in the analysis of this paper. It shows D3 delivering the largest growth in exports associated with the largest import declines, accompanied by evidence of beneficial networks and linkages via very supportive export multiplier changes for the regional sector-flows. For example, D3 delivered the largest increases for regional sector-flows compared to other policies, delivered the smallest offsetting multiplier decreases for the overall impact, and also delivered multiplier increases in the offsetting multiplier changes and was the only policy simulation to achieve this; as all the other policies recorded decreases or no change in their industry-support effects.

It should also be noted that two complementary but slightly different methods of analysis were used to choose the best policies. The *combined multiplier shift rank* method examines multiplier changes over the whole study period, while the *average rank* method uses a system of determining an average rank after each component change has been ranked. Both methods account for any market induced structural change that takes place while the assistance is provided over the six year period thereby adding some dynamics to the system.

In concluding this paper the demand-side followed by the supply-side innovative milieu stimulations are the recommended policy. Their results are consistent the theoretical expectations and make sense in light of the findings reported by Hodgkinson (2004, 2008) and McPhee (2010).

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