City Economic Convergence in KwaZulu-Natal – Integration or Isolation?

Key Words*:* Economic Integration, Economic Isolation, Economic Convergence, City Economic Growth, Regional Input-Output Table, Gravity Model, Panel Data Model

JEL Classification number: D57, R11, R12

ABSTRACT

Economic activity in the province of KwaZulu-Natal is predominantly concentrated in the five main cities. These cities contribute about 70 percent of the provincial gross domestic product. These cities are however economically diverse and spatially fairly dispersed and it could be argued that such urban diversity and dispersal results in spatial isolation. On the other hand it seems plausible that there does in fact exist some level of economic integration between the cities. And if this is the case, the neoclassical Solow growth model suggests that the cities should experience some level of convergence. The purpose of this paper is to test the above hypothesis and will include an analysis of the degree of economic integration and convergence between the cities by developing and using a regional input-output table, a gravity model and testing for β and σ convergence.

1. INTRODUCTION

Turok (2010) argues that cities have been both sources of wealth creation and sites of power for the expropriation and accumulation of wealth. Dense concentrations of population and trade have spurred human progress through creative problem-solving, entrepreneurial discovery and improvements in the division of labour – finding new ways of doing things and new things to do. Coetzee (2012) argues that the one striking issue of economic geography or the rediscovery of space in the national economy is the concentration of economic activity in cities. This fundamentally suggests that the city is an integral and significant subject in the national economic space. Cities have also become natural units of analysis as they have common non economic characteristics and are where economic activity and decision making occurs. Cities do matter and are becoming increasingly more important as economic and population concentration in the cities increase.

But cities differ significantly from one another. No two cities are identical even when they are in close proximity, i.e., cities differ, for example, in their economic structure, economic growth rates, per capital income, unemployment. The neoclassical Solow growth model argues that regional or city incomes differ because of differing capital-labour ratios. In this model, regions with higher initial capital-labour ratios are richer because workers in those regions are more productive. Economic integration in factors significantly increase the pace of income convergence in the growth model because labour and capital mobility speed up the rate at which capital-labour ratios converge. The neoclassical Heckscher-Ohlin trade model argues that incomes of regions vary because of differing factor endowments and factor prices. Economic integration and trade in goods lead to income convergence through factor price equalization. However, the convergence in factor returns does not lead to full convergence in aggregate incomes. Because regions differ in factor endowments, regions will specialize in different industries (Kim, 1998).

Economic integration also provides two sources of income divergence. The models of growth based on increasing returns in physical or human capital externalities, advanced by Paul Romer and Robert Lucas respectively, predict the possibility of income divergence. In these models, regions with higher levels of physical or human capital can become even more wealthy as increasing returns reinforce their initial advantages. The models of trade based on increasing returns advanced by Paul Krugman also predict the possibility of income divergence through the divergence in industrial structures. If high-tech, high-wage industries are subject to external economies, then the opening up of trade will cause the concentration of all the high-tech, high-wage industries in a few regions. This in turn causes regional incomes to diverge as the remaining regions are left with only the low-tech, low wage industries (Kim 1998).

Economic Integration therefore can support either convergence or divergence. Redding and Venables (2002) argue that economic integration is a function of distance. Spatial isolation in general is viewed as being negative for progress and development since it deprives the isolated city from competition, innovation and scarce resources. Redding and Venables (2002) state that empirical work confirms the predictions of theory, that distance from markets and sources of supply can have a significant negative impact on per capita income. Economic isolation therefore will institutionalize and increase the existing disparities between the cities.

The economic integration between two or more cities is a measure of the degree of the flow of goods and service between the two or more cities, or the degree of preference between the two or more cities. It is a term used to describe how different aspects between city economies are integrated and is a process whereby cities cooperate and integrate with one another to reduce or eliminate barriers to the flow of products. As economic integration increases, the barriers of trade between markets diminish. This, according to theory, should to lead to lower prices for distributors and consumers, support innovation, create economies of scale, etc. (see for example Bagella et al (2000), Kritzinger van Niekerk (2008), European Commission (2011), McKinsey Quarterly (2011) and the African Development Bank (2011)).

The paper is structured as follows. In the next section the theory of economic convergence will be discussed. Section 3 will present an economic analysis of the five cities. The level of the potential and actual economic integration between the five cities will be the focus of section 4, whilst the level of economic convergence between the five cities will be the focus of section 5. Finally, the conclusions will be presented.

2. THE THEORY OF ECONOMIC CONVERGENCE

The most concise concept of economic integration can be found in the pure models of trade theory (particularly NEG models, e.g. Fujita et al., 1999; Baldwin et al., 2003) that define economic integration to be the inverse of transportation costs. In these models, integration is assumed to reach from autarky (no integration at all) to unrestricted freedom of trade (complete integration). Moreover, integration usually refers to the freedom of exchanging goods and services only (Krieger-Boden and Soltwedel, 2010).

Economic integration among countries is linked to economic convergence. The theory of economic integration studies the creation of a common market as a process that goes together with economic growth. The deepening of this process tends to be deepened, via monetary and political integration, coupled with growth is related directly to the idea of convergence among countries and regions. Full economic convergence is said to be the last resulting phase of economic integration (Sotelsek, 2001).

The economic convergence term is used when two or more economies tend to reach a similar level of development and wealth. It is a topic that has been studied broadly by economists. On the one hand, the study of economic convergence is used in the debate between the different theories of economic growth. The debate is usually between the neo-classical, endogenous and distribution dynamics models.

In general, convergence in the context of economic growth is said to occur in a cross – section of economies, if there is a negative relationship between the growth rate of income and the initial level of income (Barro, 1991; Sala-i-Martin, 1994 and 1996a and 1996b; Barro and Sala-i-Martin, 1995). In other words, convergence takes places, in a cross-section of economies, if poor economies tend to grow faster than wealthy ones, implying that the poorer the economy the more quickly it will tend to grow over a long time horizon, and vice versa. Similarly, Baumol, et al (1994) defines convergence as a tantamount diminishing in the degree of economic inequality among countries.

The literature of growth defines the condition where the poorer countries' growth rates increase faster than the rich ones as convergence of growth. The idea of convergence is sometimes referred to as the catch–up effect. There are three types of convergence, namely the σ-convergence, absolute (unconditional) β-convergence and conditional β-convergence. Σ-convergence occurs if the dispersion of income per capita across countries declines overtime. On the other hand, β–convergence occurs if the countries are converging to their own steady state of growth rate in long run (Song et al, 2012).

Workie (2004) states that the convergence debate is also vital as it is concerned with the gaps in living standards between countries, i.e, whether these gaps are narrowing or rather widening across countries and over time (Pritchett, 1996). Sala-i-Martin (1996), and Barro and Sal-i-Martin (1995), using β-convergence and σ-convergence concepts, elaborate the convergence debate more broadly. Sala-i-Martin (1996, p. 1025) points out that the lack of convergence means that the degree of cross-country income inequality not only fails to disappear, but rather tends to increase over time (σ-divergence); and that economies (nations) which are predicted to be richer a few decades from now are the same countries (nations) that are rich today (β- divergence).

Cashin and Sahay (1996) states that assuming that all regions possess similar technology and similar preferences, and that there are no institutional barriers to the flow of both capital and labor across state borders, the Solow-Swan neoclassical growth model would predict that states would have similar levels of real per capita income in the long run. Across regions of a given country that share such a common long-run level of real per capita income, convergence of per capita incomes is driven by diminishing returns to capital. That is, each addition to the capital stock generates large increases in output when the regional stock of capital is small. If the only difference between regional economies lies in the level of their initial stock of capital, the neoclassical growth model predicts that poor regions will grow faster than rich ones—regions with lower starting values of the capital-labor ratio will have higher per capita income growth rates. Other channels through which convergence can occur are interregional capital mobility; the diffusion of technology from leader to follower economies; the redistribution of incomes from relatively rich regions to relatively poor regions of a federal country by its central government; and flows of labour from poor to rich regions.

Barro and Sala-i-Martin's studies are the most cited contemporary studies on economic convergence. They find evidence supporting conditional convergence where regions are converging towards their national steady state at an annual rate of about 2 percent. While the papers of Baumol (1986), Dowrick and Nguyen (1989), Barro (1991) and Barro and Sala-i-Martin (1991, 1992) are part of the large body of empirical work that tests for convergence, these studies mainly address the issue of convergence among large numbers of countries or regions. Papers that move away from this conditional, cross-section convergence approach however, show more mixed results. For example, Quah (1996) suggests that the data can show persistence and immobility across countries, evidence of convergence clubs and some evidence showing the poor getting poorer and the rich richer with the middle class vanishing. At the regional level, Chatterji and Dewhurst (1996), in their study of convergence clubs, find that convergence is associated with recession while divergent economic performance is found in boom periods (Lall and Yilmaz, 2000).

The starting point for the convergence debate is the Solow growth model. The model can be taken by assuming a Cobb-Douglas type of production function:

$$Y_t = K^{\alpha}_t (A_t L_t)^{1-\alpha}$$

where: *Y* = Output; *K* = Capital, *L* = Labour, *A* = Total Factor Productivity. The steady state level of per capita income *y** is given by:

$$y^* = A_0 e^{gt} [s/(n + g + \delta)]^{\alpha/1-\alpha}$$

where s is the investment rate, while g and n are assumed to be the exponential growth rates of At and Lt, respectively. The formula clearly indicates that a country's steady state income level depends on A_0, s, g, n, δ and α. In the event of unconditional convergence, all these factors should be the same for all countries (Islam, 2003).

Producing the initial growth-level based regression; this means that the sign of β should be negative even if no other variable is included on the right-hand side. The theory opposite to conditional convergence accepts the idea that the steady-state of countries could be different and consequently the regression model should contain other variables than the initial income level. This allows an estimation of the impact of different factors.

3. A BRIEF ECONOMIC COMPARISON OF THE FIVE CITIES

The five cities which are also the major municipal regions are:

- Durban. It is the economic hub of KwaZulu-Natal and the major import/export center in South Africa.
- Pietermaritzburg. It is the second largest city within KwaZulu-Natal and is the capital city of the province of KwaZulu-Natal.
- Richards Bay. It is the home of manufacturing in the province, boasting two world class aluminium smelters and the world's largest export coal terminal.
- Port Shepstone. It covers an area of approximately 90 km^2 of coastline, comprising of 21 beaches, not surprisingly the premier tourism destination in the South Africa.
- Newcastle. Situated in the northern corner of the province, it is has significant coal deposits and agricultural land.

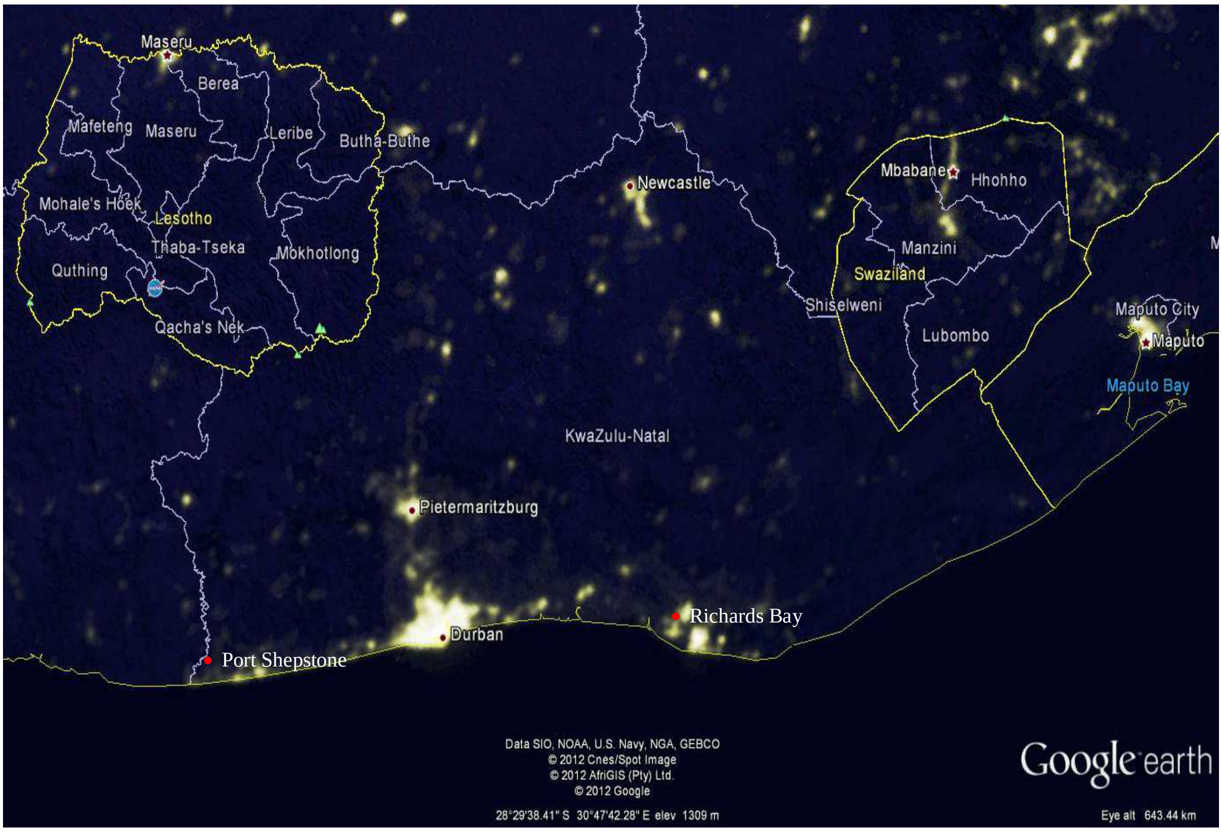
These five cities dominate the economic landscape of the province, for example:

- Almost 50 percent of the provincial population resides in the five cities.
- Almost 80 per cent of the provincial GDP is produced in the five cities.
- Personal per capita income is more than double in the five cities compared to the rest of the province.
- Poverty levels are almost half in the five cities compared to the rest of the province.
- The five cities cover only about 8.5 per cent of the total provincial land cover.
- Population density levels are more than 12 times higher in the five cities compared to the rest of the province.
- The five cities accounted for about 93 per cent, 86 per cent and 78 per cent of all new Office & Banking Space, Shopping Space and Industrial & Warehouse Space from 2001 to 2008.

(Global Insight, Stats SA and Own Sources and Calculations)

The below earth night satellite map clearly demonstrates the dominance of the five cities in the province (map 1).

Map 1: Satellite Map of the Five Cities

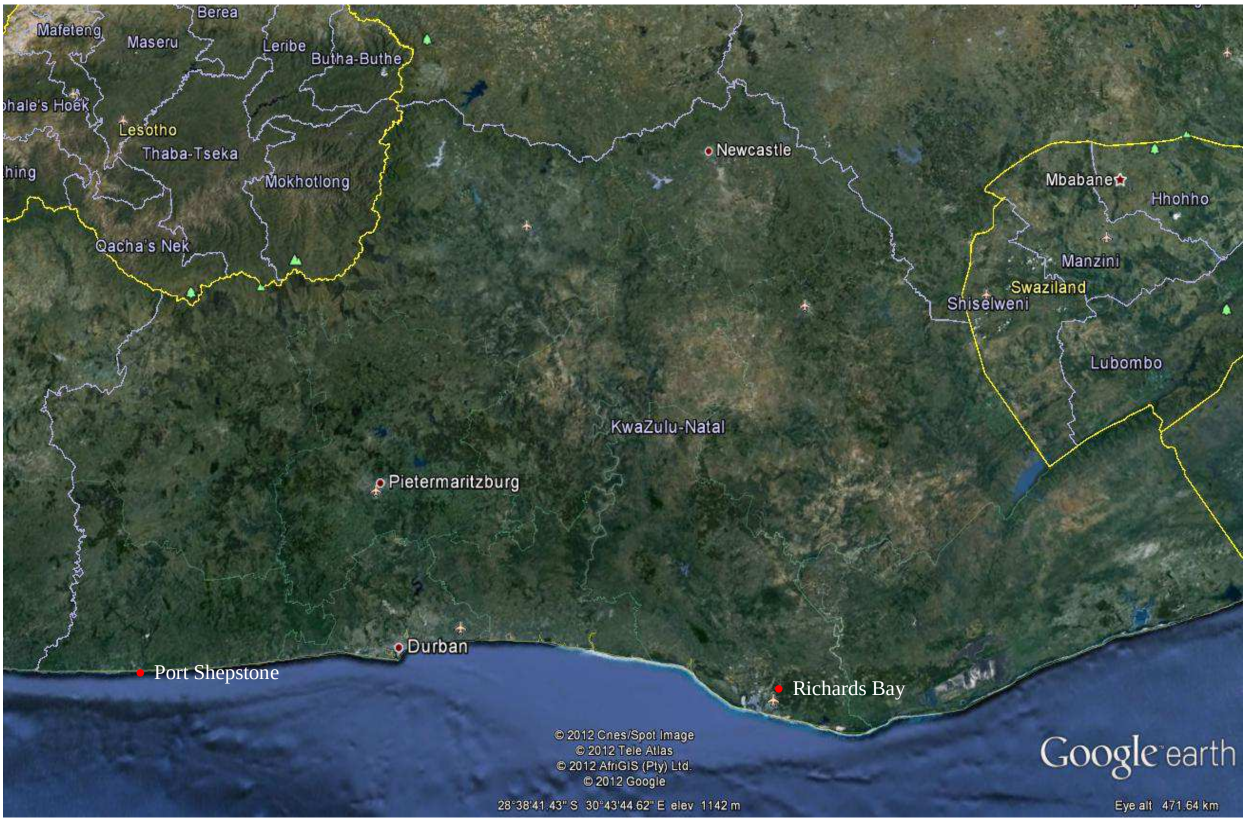


(Google Earth)

The provincial economy is therefore predominantly shaped and influenced by the five cities and therefore the productivity of these cities is crucial to provincial growth, development and welfare. However there are significant and important differences between the five cities. The below map (map 2) indicates the geographical locations of the five cities within the province. Three of the cities are coastal cities whilst Newcastle is located in the far north-west corner of the province. Pietermaritzburg is located inland, but in fairly close proximity to Durban. The five cities differ quite significantly in terms of physical size, i.e.,

- Durban = 1,579km², Pietermaritzburg = 176km², Richards Bay =126km², Newcastle = 103km² and Port Shepstone = 71km²

Map 2: Satellite Map of the Five Cities



(Google Earth)

The cities differ significantly in terms of their population size as well, especially compared to Durban (table 1). Coetzee (2012), however, indicates that the size distributions of the five cities have not changed noticeably over the period, even during the 2003 to 2007 economic boom period. This suggests that the relative population distributions for the five cities have stayed fairly constant over the period.

Table 1: Population Size

	Provincial	Durban	Pietermaritzburg	Richards Bay	Newcastle	Port Shepstone
1996	8 925 871	2 838 009	545 318	201 825	273 803	202 149
1997	9 076 925	2 901 297	548 928	219 394	280 041	205 930
1998	9 219 123	2 962 670	551 887	237 277	286 092	209 616
1999	9 352 457	3 021 955	554 178	255 440	291 939	213 212
2000	9 478 107	3 079 897	555 927	273 884	297 604	216 734
2001	9 595 287	3 136 206	557 078	292 541	303 071	220 144
2002	9 702 622	3 181 687	560 817	310 063	308 283	223 310
2003	9 802 679	3 224 362	564 393	326 249	313 181	226 308
2004	9 894 624	3 263 880	567 748	341 084	317 737	229 100
2005	9 984 049	3 301 343	571 134	354 824	322 139	231 811
2006	10 071 872	3 337 252	574 642	367 582	326 414	234 485

2007	10 160 574	3 372 133	578 362	379 494	330 640	237 164
2008	10 250 388	3 405 633	582 268	390 594	334 817	239 838
2009	10 340 219	3 437 361	586 295	400 887	338 917	242 481
2010	10 428 927	3 467 302	590 385	410 322	342 903	245 054
2011	10 516 181	3 495 604	594 528	418 931	346 773	247 542

(Global Insight, Own Calculations)

These five cities also differ significantly in terms of their economic structure. Table 2 displays the annual average (2006 to 2011) contribution rates for each economic sector for each of the five cities compared to the national and provincial economies. The structural differences are fairly evident, for example Richards Bay and Newcastle are "production" economies whilst Pietermaritzburg and Port Shepstone are "consumer" economies. Durban has a much more diversified economy which is fairly similar to the national economy.

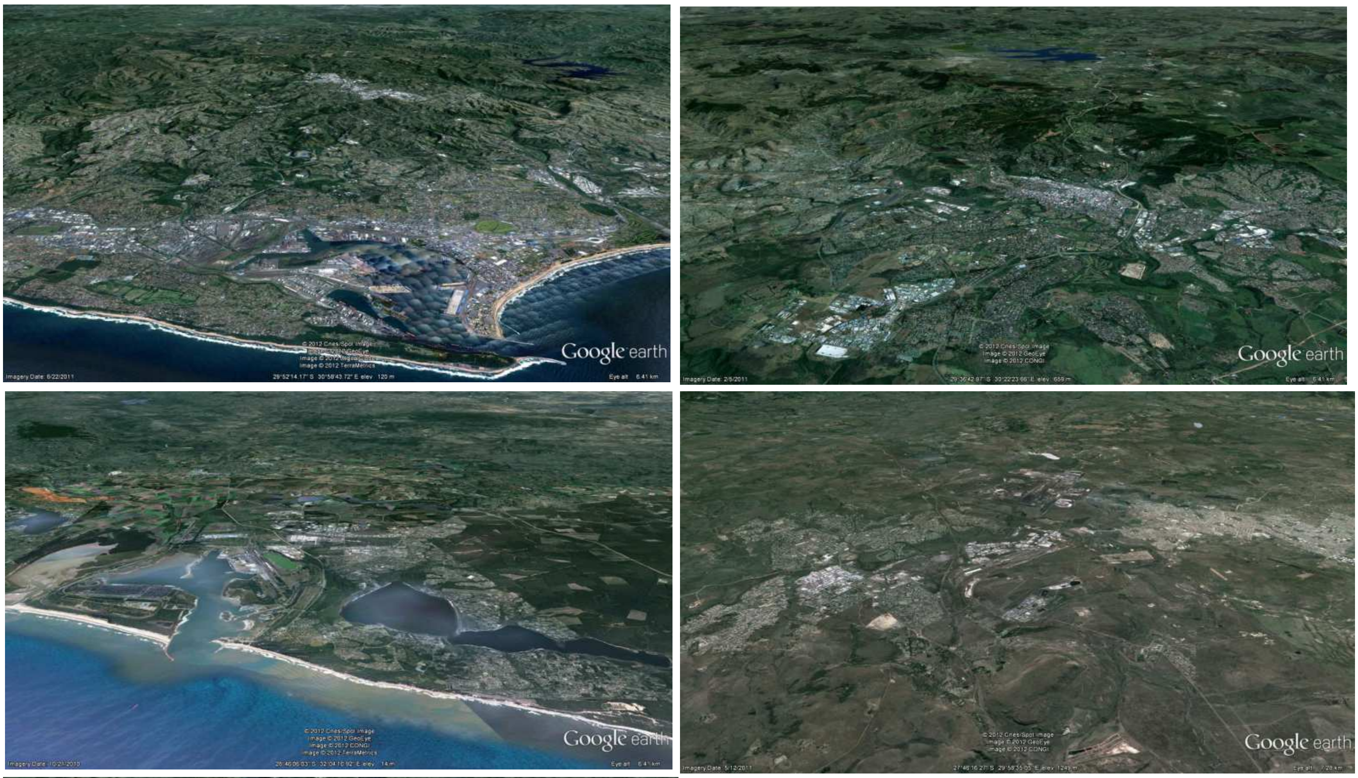
Table 2: Annual Average Contribution Rates (%)

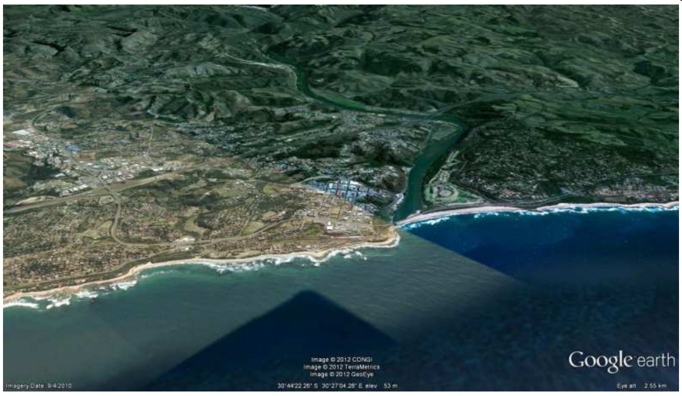
	National	Provincial	Durban	Pietermaritzburg	Richards Bay	Newcastle	Port Shepstone
Agriculture, forestry and fishing	2.44	4.34	1.18	4.25	2.89	2.06	7.66
Mining and quarrying	6.87	1.81	0.27	0.43	8.77	1.22	1.99
Manufacturing	16.39	21.32	21.06	12.81	**39.03**	**31.49**	12.24
Electricity, gas and water	2.09	2.24	2.44	2.77	0.58	2.10	1.69
Construction	2.46	2.34	2.52	2.29	1.93	1.90	4.05
Wholesale & retail trade; hotels & restaurants	12.07	12.43	14.15	11.05	6.00	8.72	16.67
Transport, storage and communication	8.37	11.18	13.05	10.71	9.77	7.72	9.19
Finance, real estate and business services	18.51	15.63	18.06	**19.07**	9.44	13.37	**18.71**
Personal and General Government Services	19.77	17.70	16.30	26.69	9.85	20.44	17.04

(Global Insight, Own Calculations)

The differences in the size of the economies of the cities are very evident in the exhibit below. The economic centres of each town vary significantly from one another, not just in terms of size but also in terms of the layout and location within each city.

Exhibit 1: Satellite Map of each of the Cities





The cities are from left to right and from top to bottom:

Durban, Pietermaritzburg
Richards Bay, Newcastle
Port Shepstone
(Google Earth)

The GDP and economic growth rates of the five the cities has also been fairly varied. Table 3 displays the per annual GDP and average economic growth rate of each of the cities and the national and provincial economies. It seems evident that the differences in total economic output are very big and substantial although the economic growth rate disparities are marginal. It is also interesting to note that the city economic growth rates are much more volatile than the national and provincial growth rates (except for Pietermaritzburg). Coetzee (2012) indicates that the GDP distributions of the five cities have not changed noticeably over the period. This suggests that the relative GDP distributions for the five cities have stayed fairly constant over the period

Table 3: Annual Gross Domestic Product (R'm 2005 constant prices)

	SA	KZN	Durban	Pietermaritzburg	Richards Bay	Newcastle	Port Shepstone
1996	1 185 179	193 602	118 692	13 079	6 953	5 122	3 173
1997	1 216 420	197 534	121 115	13 251	7 570	5 280	3 297
1998	1 222 282	199 181	122 321	13 411	7 927	5 469	3 344
1999	1 250 622	200 955	124 747	13 590	8 190	5 696	3 368
2000	1 301 620	210 289	131 525	13 329	8 823	5 977	3 545
2001	1 337 243	219 618	139 179	13 743	9 063	6 194	3 707
2002	1 386 439	225 213	143 052	14 173	9 262	6 494	3 720
2003	1 427 322	231 382	147 190	14 700	9 299	6 707	3 856
2004	1 492 330	241 770	154 464	15 275	9 629	7 013	4 051
2005	1 571 082	255 670	165 049	16 032	10 039	7 345	4 308
2006	1 659 122	269 797	174 884	16 868	10 527	7 760	4 648
2007	1 751 165	285 616	185 993	17 617	11 029	8 157	5 002
2008	1 814 532	297 115	193 823	18 056	11 265	8 395	5 262
2009	1 786 637	292 637	191 434	18 163	10 531	7 925	5 298
2010	1 838 264	301 554	196 903	18 597	10 934	8 162	5 518
2011	1 895 668	311 123	203 539	19 214	11 164	8 378	5 746
Average	**3.20**	**3.23**	**3.68**	**2.61**	**3.26**	**3.37**	**4.06**
St Dev	**1.89**	**2.07**	**2.25**	**1.88**	**3.46**	**2.65**	**2.40**

(Global Insight, Own Calculations)

The economic divergence of the five cities is also apparent when looking at the per capita income statistics. Table 4 displays the annual per capita income for each of the five cities and the national and provincial economies. The differences between the annual per capita income of the five cities suggest that there has been no or very little convergence between the five cities.

Table 4: Annual per capita income (Rand, current prices)

	SA	KZN	Durban	Pietermaritzburg	Richards Bay	Newcastle	Port Shepstone
1996	10 794	8 072	13 669	10 833	13 646	7 641	9 337
1997	11 953	8 801	14 822	11 884	14 858	8 318	10 404
1998	12 762	9 483	15 861	12 906	15 663	9 088	11 304
1999	13 769	10 084	16 866	13 974	16 390	10 032	12 034
2000	15 136	11 181	18 714	14 852	17 667	10 720	13 438

2001	16 210	12 127	20 333	16 198	18 343	11 580	14 620
2002	17 967	13 477	22 290	18 123	19 602	12 872	15 994
2003	19 248	14 402	23 947	19 569	19 806	13 607	17 062
2004	21 376	16 087	26 682	22 034	21 111	15 190	19 221
2005	23 543	17 159	28 700	23 525	21 396	16 025	20 570
2006	26 065	19 152	31 976	26 248	23 405	17 904	23 309
2007	29 009	21 363	35 510	29 051	25 787	20 344	26 469
2008	31 969	23 597	39 089	31 810	28 087	21 842	29 677
2009	33 771	25 200	41 350	34 166	28 886	23 074	31 692
2010	36 355	27 008	44 142	36 609	30 805	24 396	34 026
2011	39 245	29 034	47 221	39 365	32 602	26 048	36 514
Average	**9.00**	**8.93**	**8.63**	**9.00**	**6.01**	**8.55**	**9.55**
St Dev	**1.89**	**2.07**	**1.98**	**1.96**	**2.85**	**2.64**	**2.64**

(Global Insight, Own Calculations)

3. ECONOMIC INTEGRATION OF THE FIVE CITIES

3.1 Distance Matrix

The table below (table 5) indicates the road distance between the five cities. Durban and Pietermaritzburg are the closest to each other whilst Newcastle and Port Shepstone are the farthest from each other. The two largest cities are the closest to each other whilst the two smallest cities are the farthest from each other as indicated in population per road distance matrix (table 6). The values indicate the number of people per km from one city to another, for example there are 43 400 people per kilometer from Durban to Pietermaritzburg whilst there are only 7 451 people per kilometer from Pietermaritzburg to Durban.

Table 5: Road Distance Matrix

km	Durban	Pietermaritzburg	Richards Bay	Port Shepstone	Newcastle
Durban	0	77	172	117	333
Pietermaritzburg	77	0	272	173	256
Richards Bay	172	272	0	302	417
Port Shepstone	117	173	302	0	429
Newcastle	333	256	417	429	0

(Google Earth, Own calculations)

Table 6: Population per Road Distance Matrix

	Durban	Pietermaritzburg	Richards Bay	Port Shepstone	Newcastle
Durban	0	43,400	19,429	28,562	10,035
Pietermaritzburg	7,451	0	2,109	3,316	2,241
Richards Bay	2,241	1,109	0	1,276	924
Port Shepstone	1,888	1,277	785	0	553
Newcastle	1,008	1,311	873	849	0

(Global Insight, Own calculations)

3.2 Gravity Model

Arribas, et al (2010) state that the gravity model of bilateral trade is of primary importance in empirical analyses of trade patterns. Its simplest version states that trade interactions between two geographically defined economic entities (either countries or regions) are proportional to the size of these entities and inversely related to the distance between them. Some authors such as Leamer and Levinsohn (1995) state that the gravity model provides “some of the clearest and most robust empirical findings in economics” (Leamer and Levinsohn, 1995, p.1384), whereas others such as Rose (2000) note that the gravity model provides a “framework with a long track record of success” (Rose, 2000).

The traditional gravity model drew on analogy with Newton's Law of Gravitation. A mass of goods or labour or other factors of production supplied at origin i, Yi, is attracted to a mass of demand for goods or labour at destination j, Ej, but the potential flow is reduced by the distance between them, dij. Strictly applying the analogy,

$$X_{ij} = Y_iE_j/d^2_{ij}$$

gives the predicted movement of goods or labour between i and j, Xij . The results of the gravity model application are presented in the table below. The value itself does not really mean anything. It only means something on a comparative basis; for example trade between Durban and Pietermaritzburg should be far greater than trade between any of the other cities, especially between Newcastle and Port Shepstone.

Table 7: Gravity Model (GDP per city and distance between cities)

	Pietermaritzburg	Durban	Richards Bay	Newcastle	Port Shepstone
Pietermaritzburg	-	361	39	10	57
Durban	361	-	3	3	5
Richards Bay	39	3	-	1	1
Newcastle	10	3	1	-	0
Port Shepstone	57	5	1	0	-

(Global Insight, Own calculations)

In its most general formulation, it explains a flow Fij (of goods, people etc.) from an area i to an area j as a function of characteristics of the origin (Oi), characteristics of the destination (Dj) and some separation measurement (Sij):

$$F_{ij}=O_iD_jS_{ij},\ i=1,..I;\ j=1,..J$$

Customarily the model is estimated in log-linear form. When applied to flows of goods between countries, by analogy, the model stresses that trade increases with size and proximity of the trading partners. Rewriting the above equation in log form, a vector of bilateral trade flows (exports, imports, total trade) **F**ij is modelled as:

$$F_{ij} = \mathbf{X}\beta + \varepsilon,\ \varepsilon – N(O,\sigma^2)$$

where X is a vector of (logs of) explanatory variables, and ε a white noise error term. In the simplest specification, X contains proxies for the size of the two economies (GDP, population and/or GDP per capita) and the distance between them (as proxy for transportation costs and other obstacles to trade).

The panel specification for the gravity model is as follows:

$$X_{it} = \alpha + \beta_1 Y_{1,it} + \beta_2 Y_{1,it} + \beta d_{1,it} + \varepsilon_{it}$$

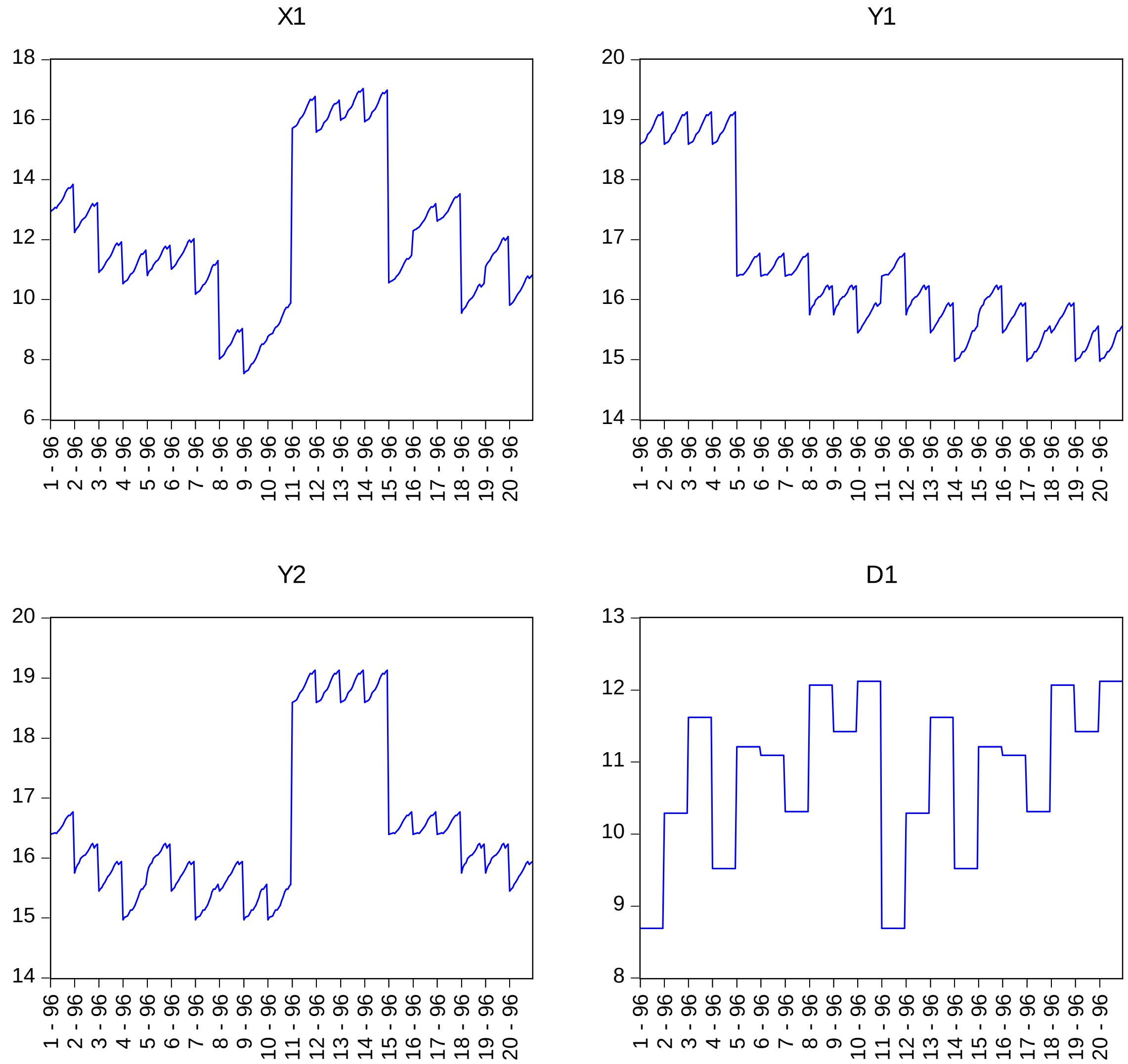
for 1 = i,...N

for t = 1,...T

and cross section identifiers = 20

The panel is displayed in the below exhibit.

Exhibit 2: Gravity Model



The gravity value is an estimated value since no inter-city sales (trade) data exists. It is calculated by multiplying a sales percentage of the host city to the trading city with the GDP of the trading city. The sales percentage is derived from the 2011 business confidence survey where businesses of each city were asked to indicate the percentage sales of their total sales to the other four cities. However this question was only included in the 2011 survey. The 1996 to 2010 values were calculated by deflating the 2011 value with the provincial per annum economic growth rate from 1997 to 2011.

The correlation matrix of the model (panel data of the five cities from 1996 to 2011 in log format) are displayed in the table below. The results support the notion of positive attraction and negative distance, where, X_{1it} = gravity value (sales from city a to city b), Y_{1it} = GDP of the host city, Y_{2it} = GDP of the trading city and d_{1it} = distance between host and trading city.

Table 8: Correlation matrix (i=1..5, t=1996-2011, cross section identifiers = 20)

	X1	Y1	Y2	d1
X1	1.0000	0.0025798	0.91998	-0.58646
Y1	0.0025798	1.0000	-0.22901	-0.41571
Y2	0.91998	-0.22901	1.0000	-0.41571
d1	-0.58646	-0.41571	-0.41571	1.0000

The results of the simple OLS Gravity Model is displayed in the below table.

Table 9: Simple OLS Regression Equation (i=1..5, t=1996-2011, cross section identifiers = 20)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
?Y1	0.257158	0.042639	6.031105	0.0000
?Y2	1.743183	0.042639	40.88265	0.0000
?D1	-0.394433	0.054643	-7.218419	0.0000
C	-16.59016	1.667771	-9.947509	0.0000

R-squared	0.907352	Mean dependent var	12.11618
Adjusted R-squared	0.906472	S.D. dependent var	2.517336
S.E. of regression	0.769859	Akaike info criterion	2.327202
Sum squared resid	187.2878	Schwarz criterion	2.374306
Log likelihood	-368.3524	Hannan-Quinn criter.	2.346012
F-statistic	1031.585	Durbin-Watson stat	0.105679
Prob(F-statistic)	0.000000		

The coefficients indicate that a 1 percent increase in the size of the host economy will be associated with a 1.7 percent per annum increase in trade flows and a 1 percent increase in the size of the trading economy will be associated with a 11.5 percent per annum increase in trade flows, whilst a 1 percent increase in distance will be associated with a 2.5 percent per annum decrease in trade flows. Testing the model indicates that the coefficients are statistically significant and that the residuals stationary.

It must however be cautioned that because of lack of accurate time series inter-city sales data, the model might suffer from statistical problems and therefore further econometric analysis of the panel will not be pursued.

3.3 Regional Input-Output Model

The standard input-output approach can be used to estimate how changes in one city economy affect the city economies linked to it, i.e., to estimate or model inter-regional interdependence. It is therefore possible to construct a regional input-output table on the assumption that the required data is available. Bazzazan et al (2005) state that constructing a survey-based regional input-output table is a difficult task especially if the required data for certain regions have not been already prepared. Bazzazan et al (2005) further state that according to the literature on the constructing a regional input-output table, three main methods have been established: survey base, semi-survey (hybrid or partial-survey) base, and non-survey base methods.

The purpose of a regional input-output table is therefore to estimate or model the inter-relationships that exist between the five city economies. It is based on the argument that the cities are not closed economies but open economies. There is thus a constant flow of goods and services between the various cities so each city buys and sells from each of the other cities. The output of any city economy is needed as an input to many other city economies, or even for that city economy itself; therefore the "correct" (i.e., shortage-free as well as surplus-free) level of city economic output will depend on the input requirements of all the ***n*** city economies. In turn, the output of the many other local economies will enter into the Msunduzi economy as inputs, and consequently the "correct' levels of the other city economies will in turn depend partly upon the input requirements of the particular city economy. This can be demonstrated by the following set of equations:

$$\mathbf{x_1 = \alpha_{11}x_1 + \alpha_{12}x_2 + \alpha_{13}x_3 + \alpha_{14}x_4 + \alpha_{15}x_5 + d_1}$$
$$\mathbf{x_2 = \alpha_{21}x_1 + \alpha_{22}x_2 + \alpha_{23}x_3 + \alpha_{24}x_4 + \alpha_{25}x_5 + d_2}$$
$$\mathbf{x_3 = \alpha_{31}x_1 + \alpha_{32}x_2 + \alpha_{33}x_3 + \alpha_{34}x_4 + \alpha_{35}x_5 + d_3}$$
$$\mathbf{x_4 = \alpha_{41}x_1 + \alpha_{42}x_2 + \alpha_{43}x_3 + \alpha_{44}x_4 + \alpha_{45}x_5 + d_4}$$
$$\mathbf{x_5 = \alpha_{51}x_1 + \alpha_{52}x_2 + \alpha_{53}x_3 + \alpha_{54}x_4 + \alpha_{55}x_5 + d_5}$$

where:

x is the five city economies

$\alpha_{1n}x_n$ is the input demand of the five city economies

d_n is the final demand for its output

After moving all terms that involve the variables x_n to the left of the equal signs, and leaving only the exogenously determined final demands d_n on the right, we can express the "correct" output levels of the *n* city economy by the following system of *n* linear equations.

$$(1-\alpha_{11})x_1 - \alpha_{12}x_2 - \alpha_{13}x_3 - \alpha_{14}x_4 - \alpha_{15}x_5 = d_1$$
$$-\alpha_{21}x_1 + (1-\alpha_{22})x_2 - \alpha_{23}x_3 - \alpha_{24}x_4 - \alpha_{25}x_5 = d_2$$
$$-\alpha_{31}x_1 - \alpha_{32}x_2 + (1-\alpha_{33})x_3 - \alpha_{34}x_4 - \alpha_{35}x_5 = d_3$$
$$-\alpha_{41}x_1 - \alpha_{42}x_2 - \alpha_{43}x_3 + (1-\alpha_{44})x_4 - \alpha_{45}x_5 = d_4$$
$$-\alpha_{51}x_1 - \alpha_{52}x_2 - \alpha_{53}x_3 - \alpha_{54}x_4 + (1-\alpha_{55})x_5 = d_5$$

This can be written in matrix notation as follows:

$$\begin{vmatrix} (1-\alpha_{11}) & -\alpha_{12} & -\alpha_{13} & -\alpha_{14} & -\alpha_{15} \\ -\alpha_{21} & (1-\alpha_{22}) & -\alpha_{23} & -\alpha_{24} & -\alpha_{25} \\ -\alpha_{31} & -\alpha_{32} & (1-\alpha_{33}) & -\alpha_{34} & -\alpha_{35} \end{vmatrix} \begin{vmatrix} x_1 \\ x_2 \\ x_3 \end{vmatrix} = \begin{vmatrix} d_1 \\ d_2 \\ d_3 \end{vmatrix}$$

$$\begin{vmatrix} -\alpha_{41} & -\alpha_{42} & -\alpha_{43} & (1-\alpha_{44}) & -\alpha_{45} \\ -\alpha_{51} & -\alpha_{52} & -\alpha_{53} & -\alpha_{54} & (1-\alpha_{55}) \end{vmatrix} \begin{vmatrix} x_4 \\ x_5 \end{vmatrix} \quad \begin{vmatrix} d_4 \\ d_5 \end{vmatrix}$$

If the 1s in the diagonal of the matrix on the left are ignored, then matrix is simply

$$\mathbf{-A = [-\alpha_{ij}]}$$

where:

α_{ij} = input coefficients

The matrix is the sum of the identity matrix I and the matrix –A. Thus the above equation can be written as:

$$\mathbf{(I - A)x=d}$$

where:

(I - A) = the Leontief matrix

x = city economy vector

d = final demand vector

The annual city economic business confidence surveys that have been conducted since 2005 contain a question relating to the proportion of products and services sold by the city economy to the other city economies. The Newcastle respondents, for example, will therefore indicate the proportion of their total sales to the other four city economies. The yearly proportions have been averaged in order to minimize the risk of outliers and are displayed in matrix format in the table below (table 11). The totals are not equal to one hundred because it excludes the proportions of the total sales that are sold outside the five city economies, for example to the rest of the province.

Table 11: Production and Output Matrix

		Local economy of Production				
		Pietermaritzburg	Durban	Richards Bay	Newcastle	Port Shepstone
Local economy of Residence	Pietermaritzburg	0.400	0.080	0.010	0.010	0.010
	Durban	0.100	0.400	0.050	0.020	0.120
	Richards Bay	0.050	0.020	0.540	0.010	0.004
	Newcastle	0.010	0.010	0.010	0.650	0.001
	Port Shepstone	0.010	0.010	0.010	0.010	0.460
	Total	0.570	0.520	0.620	0.700	0.595

(Own calculations)

For the above matrix the matrix I-A is as follows (table 12).

Table 12: I-A Matrix

0.60	-0.08	-0.01	-0.01	-0.01
-0.10	0.60	-0.05	-0.02	-0.12
-0.05	-0.02	0.46	-0.01	0.00
-0.01	-0.01	-0.01	0.35	0.00
-0.01	-0.01	-0.01	-0.01	0.54

(Own calculations)

The inverse of the I-A matrix is indicated in the table below (table 13). These values are also known as multipliers. This means for example that when the demand for output in the Pietermaritzburg economy increases by R1, the output in Pietermaritzburg, Durban, Richards Bay, Newcastle and Port Shepstone economies will increase by R1.71, R0.31, R0.20, R0.06 and R0.04, respectively.

Table 13: Regional Economic Multipliers

		Msunduzi	Ethekwini	Umhlathuze	Newcastle	Hibiscus Coast
Inverse matrix	Msunduzi	1.71	0.23	0.07	0.07	0.08
	Ethekwini	0.31	1.72	0.21	0.12	0.39
	Umhlathuze	0.20	0.10	2.19	0.08	0.04
	Newcastle	0.06	0.06	0.07	2.86	0.02

	Hibiscus Coast	0.04	0.04	0.05	0.06	1.86

(Own calculations)

The regional economic multipliers suggest that there is a fair bit of inter-regional interdependence, i.e., there is some degree of integration between the five cities. However, intuitively the level of integration seems fairly week except between Durban and Pietermaritzburg.

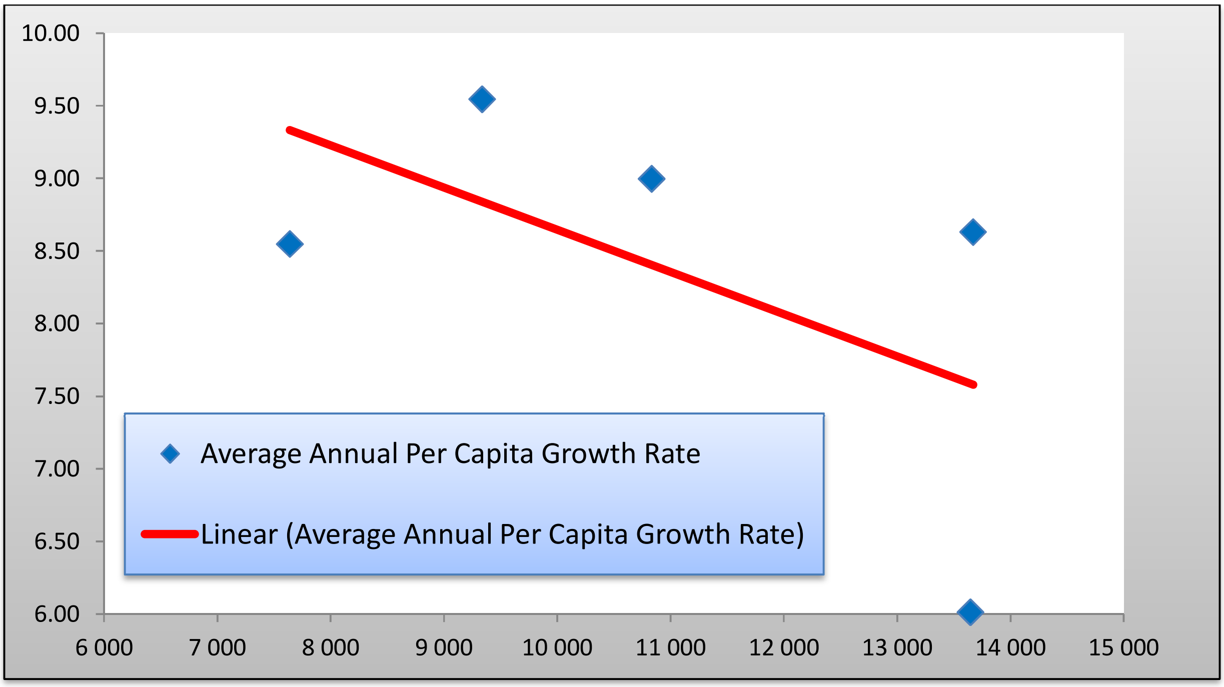
4. ECONOMIC CONVERGENCE OF THE FIVE CITIES

Given the structural, economic growth and annual per capita income disparities between the cities and the fact that the inter city disparities have seemingly persisted, there do not seem to be or have occurred a significant degree of convergence between the five cities. This non-convergence phenomenon or trend occurred despite the fact that there have been trade flows between the cities, i.e., some level of city economic integration. This could suggest that the city integration is still fairly week, i.e., there is some disjuncture between the potential trade flows as suggested by the gravity model and the actual trade flows as suggested by the regional economic multipliers. Gang (2010) argues that in modern industrial, urban, and market-based societies, what may matter increasingly are transport costs, which means that geography can cause deep regional inequalities.

Gardiner et al (2004) state that almost all of the empirical analyses that have been conducted thus far have focused on regional GDP per capita. The analysis is based on the following argument; initially low per capita regions should record higher rates of growth than initially high per capita regions. There should therefore be an inverse relationship between the growth rate of per capita GDP and the initial level of per capita GDP (I will make use of per capita income rather than per capita GDP).

The scatter plot below suggests that such an inverse relationship indeed exists (negative coefficient) and is consistent with convergence theory as supported by the Neoclassical growth model.

Graph 1: Scatter Plot – Average Annual per Capita Income and 1996 per Capital Income

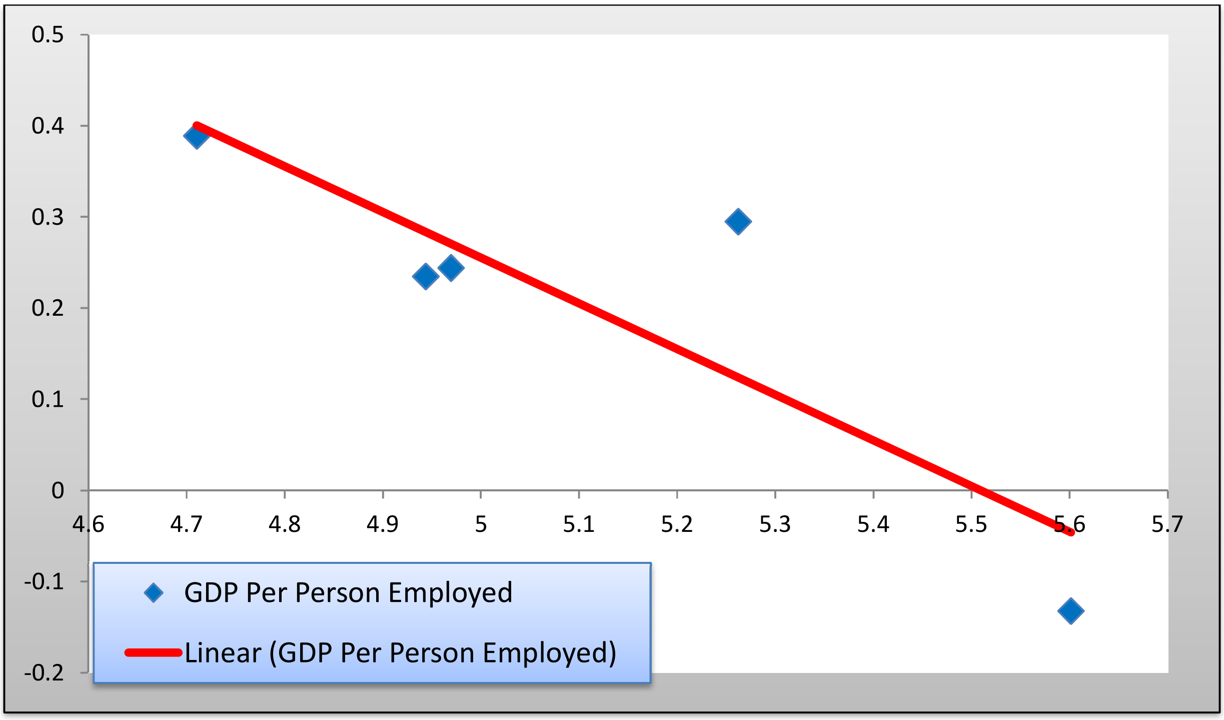


(Own calculations)

A regression fitted to the data in Graph 1 and in log format yields a β-convergence parameter of -0.73, and suggests a rate of convergence of about 4.5 percent per annum (16 years). This would seem to imply that if the city per capita trends are following a Neoclassical growth process, it is an extremely slow one. However the coefficient is not significantly different from zero and therefore the parameter is not statistically significant, suggesting that very little or no convergence has occurred.

Gardiner et al (2004) state that almost all of the empirical analyses that have been conducted thus far have focused on regional GDP per capita, rather than regional productivity. This study will make use of GDP per person employed (log format) as a proxy for city productivity. The scatter plot below suggests that such an inverse relationship indeed exists (negative coefficient).

Graph 2: Scatter Plot – Average Annual per GDP per Person Employed and 1996 per GDP per Person Employed



(Own calculations)

A regression fitted to the data in Graph 2 and in log format yields a β-convergence parameter of -1.49, suggesting a rate of convergence of about 9 percent per annum (16 years). This would seem to imply that if the city GDP per capita trends are following a Neoclassical growth process, it is an fairly slow one. The coefficient is indeed significantly different from zero and therefore the parameter is statistically significant suggesting that some convergence has actually occurred.

Another aspect of regional productivity convergence concerns the impact of economic structure, and in particular the relative importance of traded and non-traded sectors. Because, by definition, a region's export activities are directly exposed to competition from similar activities in other regions, the supposition is that this openness should expose the sectors in question to pressures that make for constant improvements in technology, efficiency, investment, product design and so on if a region's exporting firms are to remain competitive. Regional non-traded activities, that serve local markets, are not exposed to such external competitive pressure. Thus the expectation is that regional convergence in productivity should be faster in traded sectors than in non-traded ones.

Sectoral data limitations at the regional level prevent a detailed evaluation of this issue, in the sense of being able to isolate the export base of individual regions, but a preliminary analysis is possible by recalculating regional productivity separately for two aggregate sectors that correspond in broad terms to ‘traded’ and ‘non-traded’ activities. The former was defined to include agriculture, mining manufacturing, and transport; and the latter to include construction, energy, trade, finance, household services and public sector services. This is obviously only an approximate decomposition, since not all local manufacturing industries need export, while some construction activities and household services are exported out of regions. Nevertheless, these broad divisions should be sufficient to allow us to detect any significant differences in city convergence between the traded and non-traded sectors of the economy.

The results of a regression fitted to the data and in log format yields the following results as displayed in the table below.

Table 14: Convergence Estimates: Traded and Nontraded Sectors Compared

Model	Coefficients	t Stat	Adjusted R Square
Tradeable Sectors	-0.24992305	-2.86096809	0.64238261
Non-Tradeable Sectors	-0.04977385	-0.47245724	-0.24099663

(Own calculations)

The results suggest that city productivity convergence in traded activities has been faster than that in the non-traded sector. The coefficient for the tradeable sector is also statistically significant whilst the coefficient for the non-tradeable sector is not. The β-convergence parameter of -1.49 for the tradeable sector, suggests a rate of convergence of about 15 percent per annum (16 years). The data also shows that city productivity growth rates have tended to be significantly lower in non-traded than in the traded activities.

Gardiner et al (2004) states that both endogenous growth and new economic geography models give strong grounds for expecting productivity to display geographical contiguity. Contiguous regions may have similar degrees of access to transport and other modes of communication; they may have similar proximity to major markets; they may share similar socio-institutional set-ups that influence firm performance and entrepreneurship; there may be localised spillovers of knowledge and technology, through inter-firm networking, employee movement and technology sharing, local trading relationships, access to common technology centres, universities, and the like; and contiguous regions may share similar industrial structures and thereby similar responses to common external demand, technology and policy shocks.

This study attempt to capture any conditioning spatial autocorrelation effects by means of a contiguity/spillover variable defined for each region as the distance weighted sum of all other regions' initial productivity with weights given as the inverse of the distance between the region in question and each other region. The hypothesis is that spatially contiguous regions are more likely to exhibit similar productivity growth than are geographically distant ones. The results are shown in table 15, in which variable 2 is the coefficient on the contiguity/spillover variable just defined. The contiguity/spillover effect is itself not statistically significant, though the overall fit of the regression improves therefore increasing the convergence rate, but only slightly.

Table 15: Regression of Regional Productivity with Contiguity/Spillover Variable

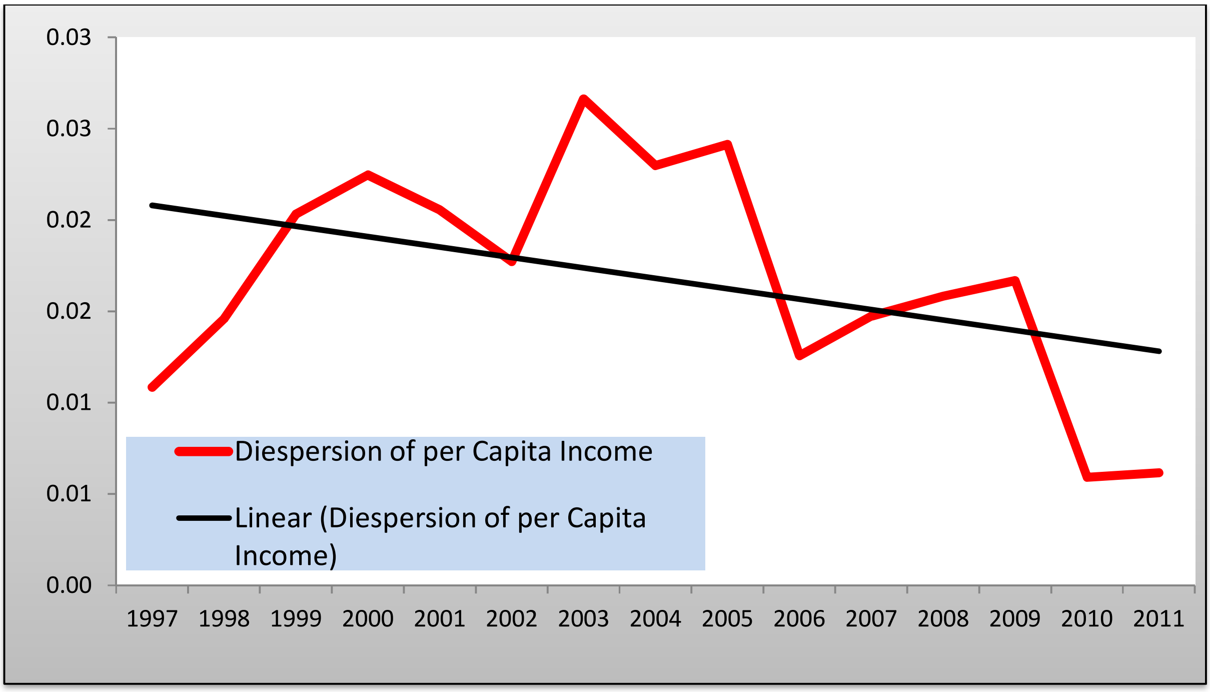
Model	Coefficients	t Stat	Adjusted R Square
X Variable 1	-1.870954727	-3.17194625	
X Variable 2	0.924391399	1.11292197	
			0.68830617

(Own calculations)

Freidman (Jones, 2002) suggested that σ can be more appropriately measured by simply tracking the intertemporal change of the coefficient of variation of the given cross-section country income distribution, that is, a tendency for the inter-county or inter-regional dispersion in per capita income levels to decline over time. The β convergence and σ convergence are of course closely related. Formally, Beta-convergence is necessary but not sufficient for Sigma-convergence. Intuitively, this is either because economies can converge towards one another but random shocks push them apart or because, in the case of conditional Beta-convergence, economies can converge towards different steady-states. The most frequently used summary measures of Sigma convergence are the standard deviation or the coefficient of variation of regional GDP (income) per head.

Using the standard deviation method to measure the σ convergence for the cities yields the results as displayed in the table below.

Graph 3: σ Convergence of per Capita Income

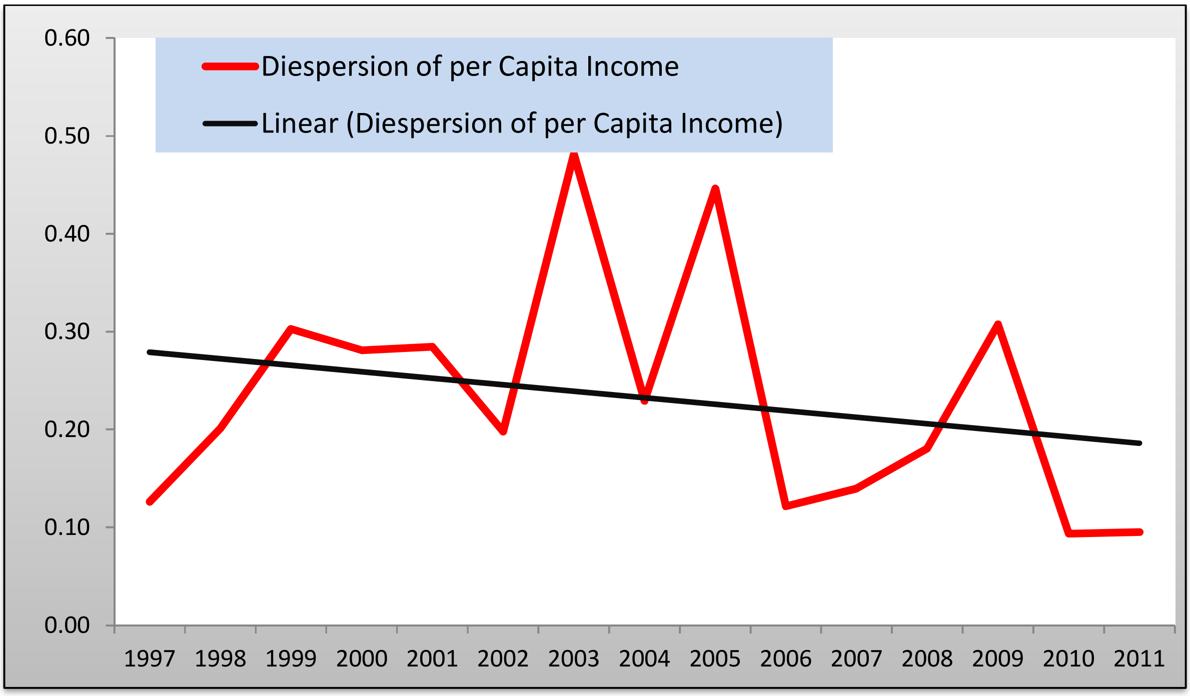


(Own calculations)

The results suggest that the disparities between cities increased up to 2004, but the process since then reversed. From 2005 to 2011, the evolution of disparities among cities indeed shows a clear downward trend, i.e., evidence of convergence. However, the coefficient of variation is often preferred to the standard deviation which has no interpretable meaning on its own unless the mean value is also reported. For a given standard deviation value, the coefficient of variation indicates a high or low degree of variability only in relation to the mean value.

Using the coefficient of variation method to measure the σ convergence for the cities yields the results as displayed in the table below.

Graph 4: σ Convergence of per Capita Income



(Own calculations)

The results suggest that the disparities between cities was very volatile over the period, but in general showed a very modest downward trend, i.e., evidence of convergence, albeit only slightly.

Convergence can also be tested by directly examining the time series properties of various income series where convergence is analyzed as a dynamic stochastic process. This involves the use of either time series unit root or panel unit root tests for stationarity or test for cointegration of various macroeconomic time series across economies. The argument is that once evidence is found in support of the unit root hypothesis for the standard deviations of the natural logarithm of per capita income, it would provide evidence against the convergence hypothesis. However, before the unit root tests will be performed, the descriptive statistics are generated specifically to determine the degree of normality of the two variables (table 16). The results indicate that the probability of the Jarque-Bera statistic is more than 0.05. This indicates that the distribution is normal because "a small probability value leads to the rejection of the null hypothesis of a normal distribution. Normality suggests that the levels of dispersion have stayed fairly constant over the period and therefore there is very little evidence of σ convergence.

Table 16: Descriptive Statistics of the Standard Deviation and Coefficient of Variance

	STDEV	CV
Mean	0.016667	0.232667
Median	0.020000	0.200000
Maximum	0.030000	0.480000
Minimum	0.010000	0.090000
Std. Dev.	0.006172	0.118952
Skewness	0.279508	0.773701
Kurtosis	2.343750	2.721498
Jarque-Bera	0.464478	1.545012
Probability	**0.792757**	**0.461854**

(Own calculations)

Convergence between two series requires that their difference cannot be characterized by a boundless drift. If variables are non-stationary, this statement implies that two series converge when they share a common stochastic trend. This, in turn, means that there is convergence if the difference between the GDP of two countries evolves towards a stationary process. In other words, if a linear combination of two nonstationary time series is stationary, then the series are cointegrated of first order or follow an I(1) process. Likewise if there is a common stochastic trend in a time series, then the series is cointegrated and vice versa. In line with Tirelli (2010), the implementation of the econometric tests associated with this notion of income convergence is based on the following equation:

$$(\ln Y_{i;t} - \ln Y_{B,t}) = \theta (\ln Y_{i;t-1} - \ln Y_{B,t-1}) + \varepsilon_t$$

where Y_B denotes the benchmark per capita income level, which in this case would be measured by the regional average real per capita income; $Y_{i;t}$ real per capita income of country i at time period t, and ε_t is a covariance stationary random error term. Let $x_t = \ln Y_{i,t} - \ln Y_{B,t}$, then the above equation can be expressed as an autoregressive (AR) (p), process, $x_t = \theta x_{t-1} + \varepsilon_t$, where p= 1 and the convergence test amounts to a unit root test on, x_{t-1}, i.e. ($\theta = 0$). The Augmented Dickey-Fuller (ADF) unit root test based on the following equation will be performed:

$$\Delta x_t = \mu + \beta t + \theta x_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta x_{ti} + \varepsilon_t$$

where μ is a drift, β is a trend coefficient and α is the coefficient of augmented lagged differences in per capita income deviation entered to ensure serially uncorrelated residuals. The results of the ADF unit root tests are displayed in the table below.

Table 15: Results of the ADF Unit Root Tests

Model		StDev	CV
Intercept	Augmented Dickey-Fuller test statistic	-2.315535	-3.599961
	Probability (ADF statistic)	0.1806	0.0207
	F-statistic	5.361702	12.95972
	Probability (F statistic)	0.039082	0.003646
Trend and Intercept	Augmented Dickey-Fuller test statistic	-2.398449	-3.942929
	Probability (ADF statistic)	0.3642	0.0393
	F-statistic	3.538436	8.259918
	Probability (F statistic)	0.065085	0.006451
None	Augmented Dickey-Fuller test statistic	-0.661968	-0.646756
	Probability (ADF statistic)	0.4121	0.4175

(Own calculations)

The presence of unit root cannot be rejected implying or suggesting no convergence to the city per capita income mean.

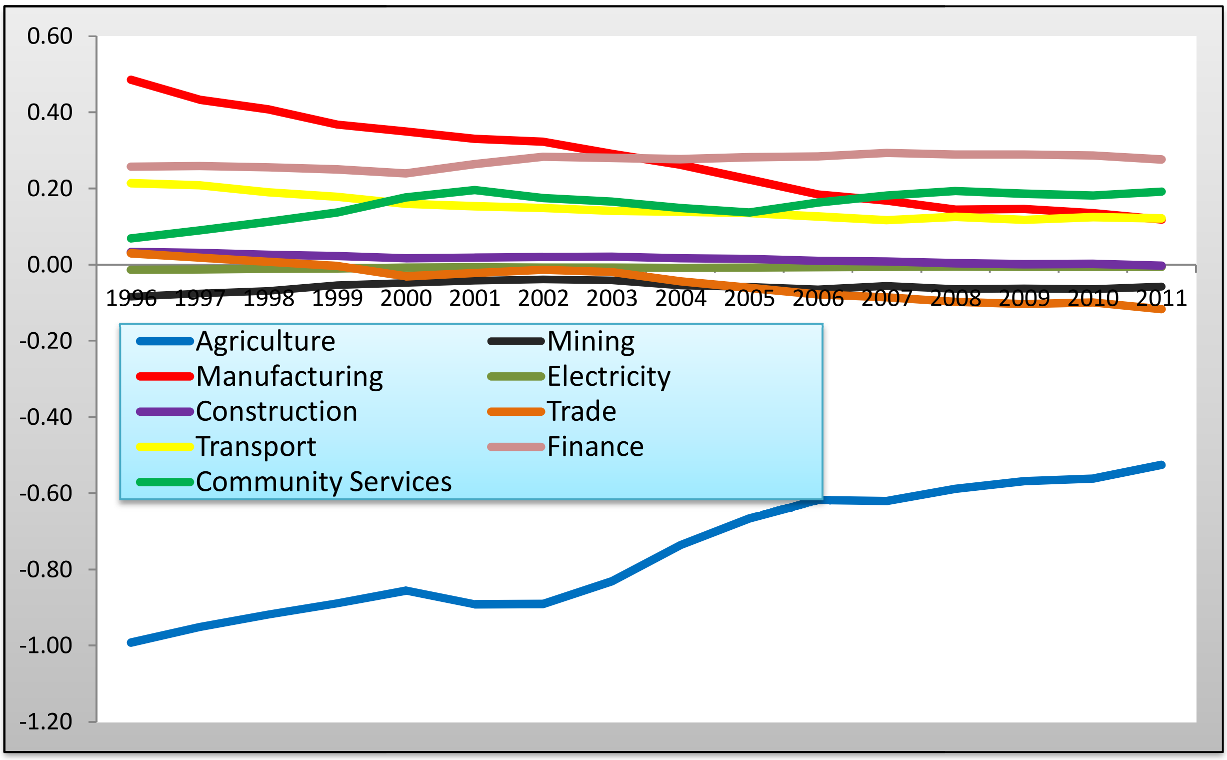
The index of regional specialization captures the differences in the economic structure of regions (cities) (Kim 1998). Regional specialization expresses the regional perspective and depicts the distribution of the sectoral shares in its overall economy, usually compared to the rest of the country. A country is considered to be highly specialized if a small number of industries have a large combined share in the economy of that region. Geographic concentration of a specific industry reflects the distribution of its regional shares. A highly concentrated industry will have a very large part located in a small number of regions.

The index of regional specialization is defined as:

$$SIij = \sum_{i=1}^{n} \left| \frac{Eij}{Ej} - \frac{Eik}{Ek} \right|$$

where E_{ij} is the level of employment industry i = 1, . . . ,n for region j and E_j is the total industrial employment for region j and similarly for region k. If the index is equal to zero, then the two regions, j and k are completely despecialized and the industrial structures of the two regions are identical. Moreover, if factor prices equalize across the two regions, the two regions should also have identical income per capita because each region has the same proportion of its labour force in each of the industries. On the other hand, if the index is equal to two, then the regions are completely specialized and possess completely different industrial structures. Because each region has its workforce in completely different industries, there is no reason for income per capita to converge or diverge even if factor prices equalize.

Graph 5: City Specialization using employment statistics – 1996 to 2011

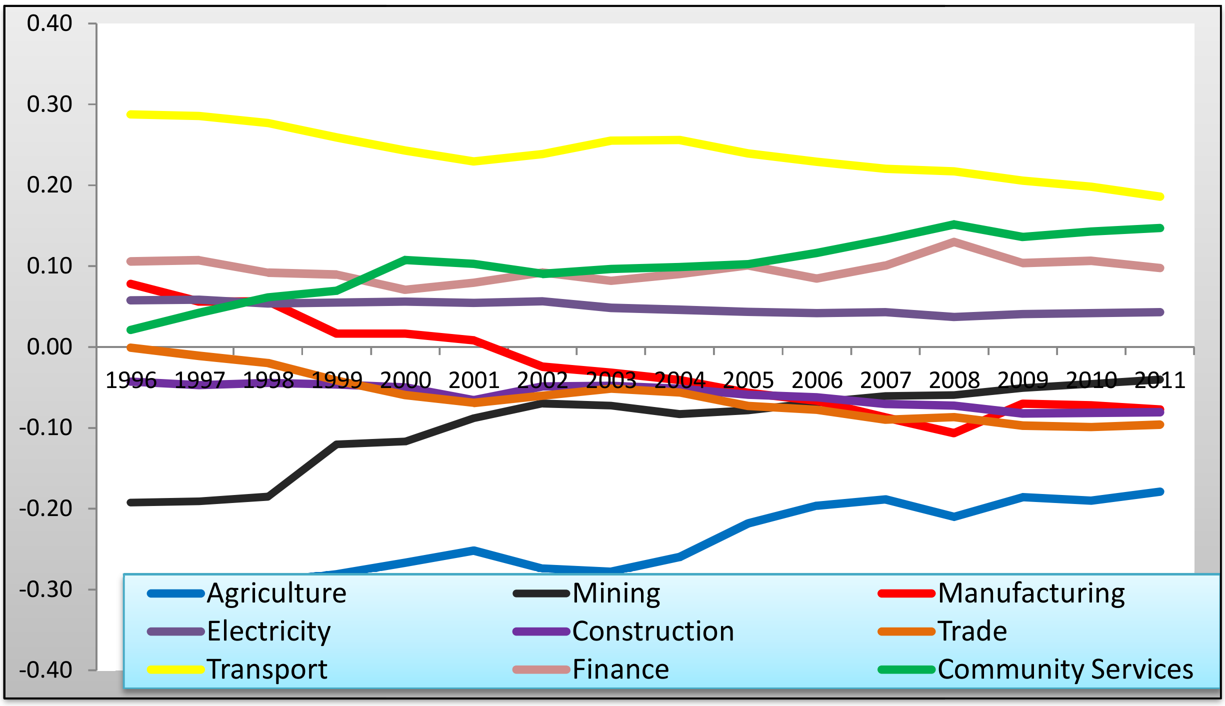


Indexes of city specialization are calculated (using employment statistics) for each of the five city comparisons (of nine census divisions) and these indexes are averaged to derive an overall measure of city specialization. The results are displayed in the graph above (graph 5). The results suggest that regional specialization in the agriculture and manufacturing sectors decreased significantly over the period whilst the city specialization levels in the other sectors have stayed fairly constant. The results also suggest that the city specialization levels are very low, i.e., close to zero.

Using GDP statistics indexes of city specialization are calculated. The results are displayed in the graph below (graph 5). The results are very similar to the results obtained using employment statistics, but emphasizing that city specialization in the finance and community services sectors increased over the period.

The results from both indices support the notion that the cities are fairly despecialized and their industrial structures. However it must be taken into account that the sectors are measured in an aggregate level and therefore does not necessarily take into account the differences in the industry mix per se.

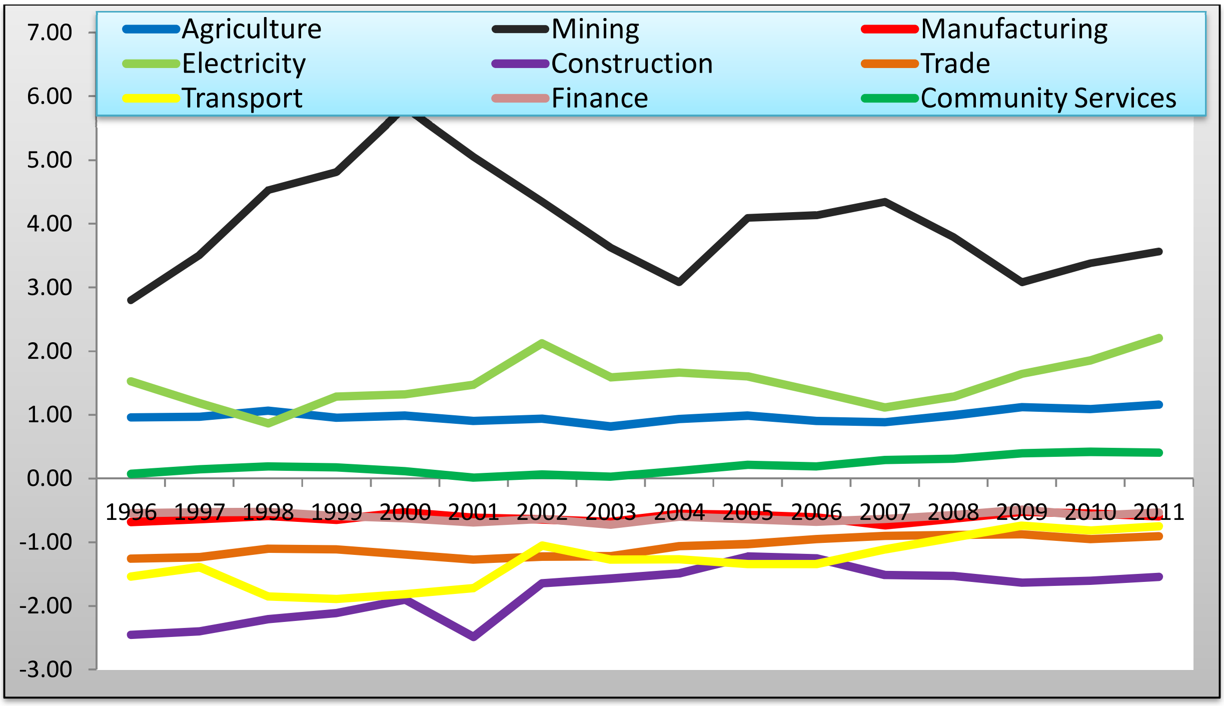
Graph 6: City Specialization using GDP statistics – 1996 to 2011



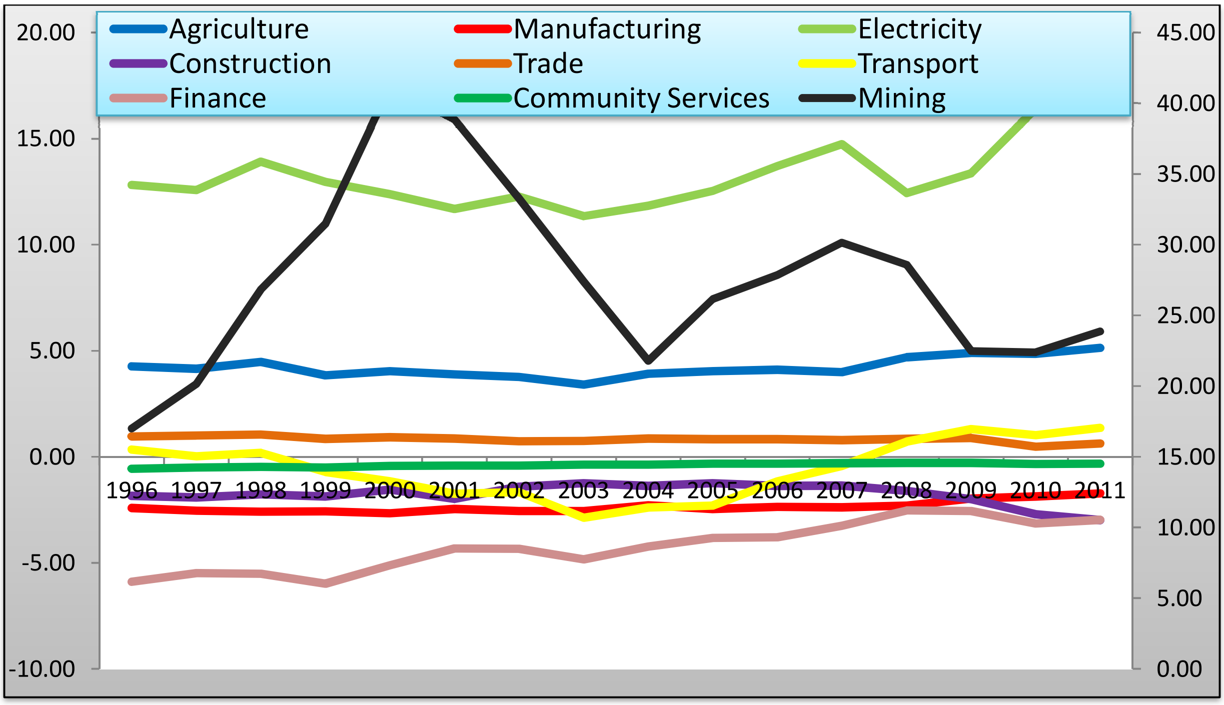
The lack of city specialization should therefore imply that income per capita between the cities should be equal, yet large disparities exist, i.e., if factor prices equalize across the two regions, the two regions should also have identical income per capita because each region has the same proportion of its labour force in each of the industries. As indicated the disparities could be explained by the use of aggregated sector data or, as suggested, by differences in factor prices.

To test for wage differences, an index of city wage specialization is constructed similar to the general city specialization index as per the above. The results are displayed in the graph below (graph 7). The majority of sectors have values close to 2 or -2 suggesting city wage specialization. An index of city gross operating surplus specialization is also constructed and the results are displayed in table 8. The results are similar to the city wage specialization results indicating significant factor price and sub-sector disparities between the cities. The per capita income disparities therefore can be explained by sub-sector industry-mix and wage effects.

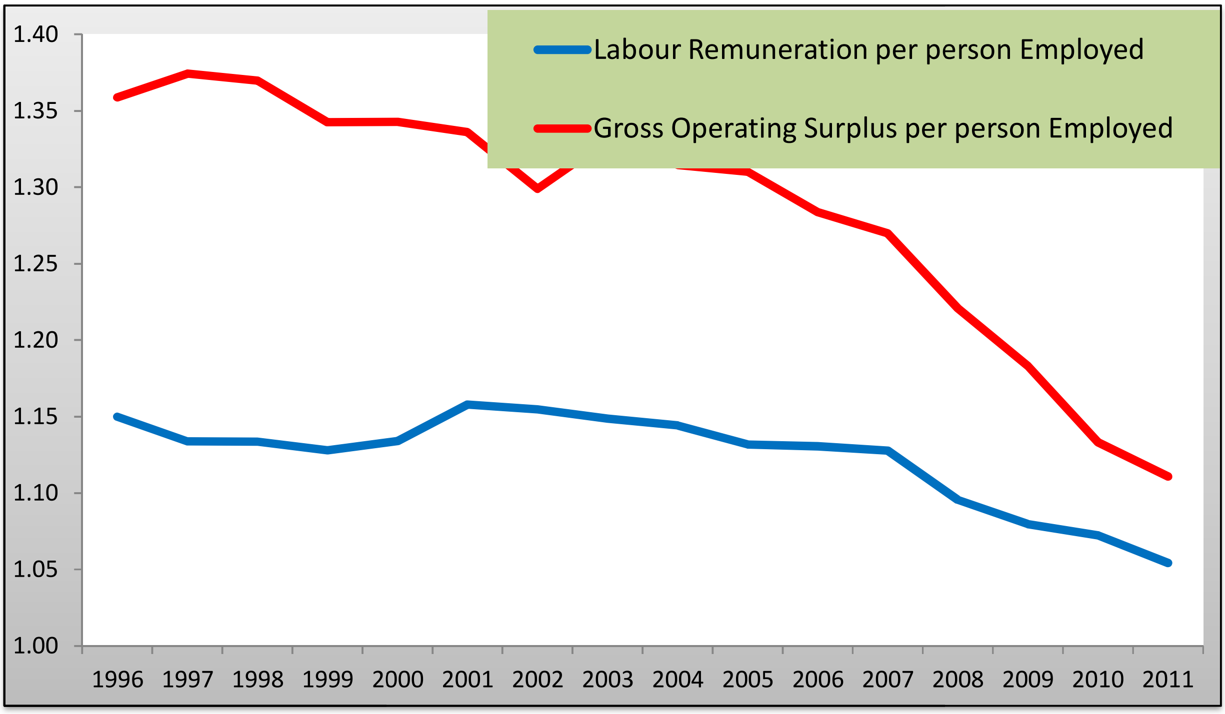
Graph 7: City Wage Specialization using Labour Remuneration per Employed Person – 1996 to 2011



Graph 8: City Gross Operating Surplus Specialization using Gross Operating Surplus per Employed Person – 1996 to 2011 (Mining = right axis)



Graph 9: Average National and City Labour Remuneration per Employed Person and Gross Operating Surplus per Employed Person Compared – 1996 to 2011



The results of the city wage and gross operating surplus specialization are further supported by comparing the average city labour remuneration per employed person and average gross operating surplus per employed person with the average national labour remuneration per employed person and average gross operating surplus per employed person as per the graph above (graph 9).

The graph indicates that average gross operating surplus per person employed in the five cities have been significantly higher than the national average (on average by 28 percent), but have declined over the period, especially since 2004. The labour remuneration per person employed in the five cities is also higher than the national average (on average by 12 percent) and have declined but at a much lesser pace.

5. SUMMARY AND CONCLUSIONS

The economic landscape of the five cities differs significantly from one another. They differ in terms of their population size, their geography, their economic structure, their per capita income and their economic growth performance, for example. What is however very relevant is that they dominate the provincial economy and therefore the productivity and performance of these cities are of paramount importance. The large disparities that exists between the five cities gives rise to numerous questions for example, the level of economic integration or isolation between the five cities, whether or not the disparities are diminishing, amongst others.

The theoretical justification for the convergence hypothesis comes from the Neoclassical growth model developed by Robert Solow (1956). In this class of growth models, economic growth comes from capital accumulation, population growth and technological advances. In a basic Neoclassical growth model, the model assumes all markets are in equilibrium, production exhibits constant returns to scale and diminishing returns. Thus, adding more and more of one input to a fixed amount of all other inputs results in successively smaller increases in output.

Literature reveals that at a broad level there is considerable agreement among the convergence debate. For example, despite differences in approach and methodology, the finding of conditional β-convergence has remained relatively robust. This has been true both for small samples of developed economies and for large, global samples. For developed economies, researchers have in fact often reported unconditional convergence. Similarly, once it is remembered that σ-convergence research generally focuses on unconditional convergence, it becomes clear that results regarding σ-convergence largely agree with those regarding β-convergence. Evidence of σ-convergence is found precisely in those small samples of developed economies for which there is also evidence of unconditional β-convergence. On the other hand, in large global samples, neither unconditional β-convergence nor σ-convergence holds. Finally, time series analysis of both within and across convergence has produced evidence that can be interpreted as of conditional convergence.

There are widely differing views amongst economists as to the determinants of regional productivity and what happens to regional disparities in productivity over time. Standard Neoclassical theory predicts that with increasing economic and monetary integration, low productivity regions should catch up with high productivity regions. However, other economic theories – which emphasise the importance of various forms of increasing returns – suggest that increasing integration does not necessarily lead to regional convergence in productivity and may in fact reproduce or even reinforce existing regional differences, leading to regional divergence or growing core-periphery patterns of productivity and competitiveness.

What is however very important is that the disparities do not undermine and ultimately constrain the economic performance of the five cities. These disparities should either converge in support of the productivity of the five cities or should be as a result of the productivity of the five cities. On the other hand, economic isolation could increase the economic divergence of the five cities, leading to the stagnation and un-competitiveness of the cities. Such a state of isolation and divergence will only lead to the collapse of the cities.

This paper attempted to analyze the level of economic integration and level of convergence in the five cities using the concepts of the gravity model, regional input-output, beta and sigma convergence, and convergence to common stochastic trends for the period 1996 to 2011.

This paper finds evidence that the absolute size of the city economies imply some level of economic integration between the cities and that the level of economic integration is inversely related to the distance between the cities. The cities therefore should not be viewed as isolated islands, but rather as a system of cities where the volume of trade flows between the cities are inversely related to transport costs. City productivity and performance is therefore a function of the productivity and performance of the system as a whole. The actual level of economic integration however is still fairly low, i.e., there is a fairly large disjuncture between potential integration and actual integration.

The paper finds no evidence of β-convergence when using per capital income. However when GDP per capita are used then evidence of β-convergence is found.

Productivity levels are seemingly converging rather than income levels. However the rate of β-convergence is very low indicating a very slow convergence process between the five cities. The β-convergence is also much more profound in the tradeable sector than the non-tradeable sector. This is very much in line with the predictions of the Neoclassical growth model. Cities that are structurally biased towards the tradeable sector will therefore experience higher β-convergence rates (for example Richards Bay) than cities that are structurally biased towards the non-tradable sectors (for example Pietermaritzburg).

The paper finds evidence of σ-convergence, i.e., the existence of a tendency for the inter-city dispersion in per capita income levels to decline over time. The σ-convergence is found when using both the standard deviation and coefficient of variation method. Sigma convergence was also tested by directly examining the time series properties of various income series where convergence is analyzed as a dynamic stochastic process. In this instance the presence of unit root cannot be rejected, implying or suggesting no convergence to the city per capita income mean.

The indices of regional specialization suggest that the city specialization levels are very low, i.e., close to zero, especially in the non-tradeable sectors. The lack of city specialization should therefore imply that income per capita between the cities should be equal, yet large disparities exist, i.e., if factor prices equalize across the two regions, the two regions should also have identical income per capita because each region has the same proportion of its labour force in each of the industries. The index of city wage specialization and index of city gross operating surplus specialization indicates significant factor price and sub-sector disparities between the citiess. The per capita income disparities therefore can be explained by sub-sector industry-mix and wage effects.

In general therefore the evidence of city economic integration and β-convergence and σ-convergence at best seems fairly week. The lack of strong or rapid convergence can most likely be ascribed to the wage and sub-sector mix differences that exist between the cities. These differences in turn could be because of the lack of economic integration between the cities.

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