UNDERSTANDING AND SHAPING THE GREATER DUBLIN AREA AS IRELAND'S EMERGING CITY-STATE OF THE 21ST CENTURY

ABSTRACT

This demographic research focuses on the probability that Dublin's primacy will become more pronounced, and should be so encouraged, and that it will emerge as Ireland's city-state of the 21st century. In doing so – see end Appendix Map 1 – the "core" Greater Dublin Area (GDA) together with the "periphery" Rest of State (RoS) area require radical mindset and strategic policy shifts in traditional governmental thinking, changing the "centre versus periphery" dichotomy, from a *distributive* to a *constitutive* process (NESC 117 of 2008). Likewise, such a shift would promote the transformation of settlement size and distribution towards urban "lumpiness" as articulated in Zoellick (2009), recognising the dynamics of a modern, services-led economy. Consistent with this author's pending PhD, this paper highlights the long-term resistance by successive Irish governments to implement policy strategies for concentrated growth focused on city-based regions. This in turn has prevented the emergence of intermediate-sized settlements of 200,000 to 500,000 populations. There is little evidence of government recognition of the benefits of urban agglomeration, thereby negating the prospects of achieving balanced regional development. Dublin, unopposed, will emerge as Ireland's city-state of the 21st century. A convergence matrix model is developed and used to demonstrate the findings of this study.

The structure of this research paper is as follows: It commences with a description of this author's regional interpretation of present-day Republic of Ireland and of its sharply differing population densities. Ireland's demographic potential is considered, followed by a comparison with Finland's settlement size. A description of the State's weak urban base introduces the potential for deploying a Pareto-like regional solution (after O'Leary, 2003). Then follows an analysis of past regional population growth rates, which in turn provides the background for understanding Dublin's role as the

State's economic engine. This author's membership of the Central Statistic Office's (CSO) Expert Group on Population, Migration and Labour Force Projections has provided insights for the workings behind the published State (2007) and Regional (2008) population growth forecasts, which are used as a basis for formulating a likely scenario for differentiating between GDA and RoS area projections. This author introduces and describes his convergence matrix (HYMOC[1]) model for estimating the time period within which a GDA and RoS area population convergence might occur. This quantitative methodological approach, utilising an Excel spreadsheet, together with its graphical application, is discussed, with focus on its Common and Natural Log variants. The paper's synthesis leads to a final conclusion, that in the absence of emerging rival settlements, unopposed, Dublin will become Ireland's city-state in the latter half of this century.

1. INTRODUCTION

Post millennium and into the 21st century the Republic of Ireland, referred herein as "the State", has developed into two separate and distinct areas – *vide* Map 1 in Appendix. The first is the "core" Greater Dublin Area (GDA) of 6,985 square kilometres, comprising just 9.95% of the Republic's land mass and the second is the "peripheral" Rest of State (RoS) area with 90.05% of the State's surface area. The GDA comprises two NUTS 3 (Nomenclature of Units of Territorial Statistics) planning regions, Dublin City plus County and the Mid-East region, having a 39.21% share of State population in the April 2006 census. The RoS area has 60.79% of the population share and it comprises the remaining six NUTS 3 planning regions.[2]

Since the State's independence from the UK in 1922, successive rural-centric governments have resisted all recommended initiatives or indeed consultants' advice to urbanise. Notable examples include their eschewal of the Buchanan Report (1968)

[1] Hughes Years Matrix of Convergence

[2] Ireland (Republic) is a NUTS 1 region. Three of the six RoS spatial planning regions – Border, Midlands and West – are classified as a NUTS 2 region (47% of total surface area of State) and the remaining three RoS planning regions - Mid-West, South-East and South-West together with the GDA (53% of area) – are likewise designated as the second NUTS 2 region, made primarily for EU administration purposes. However, this artificial construct is to deny the fact that the GDA now accounts for 50% of State Gross Value Added and about 55% of total Taxation revenues.

and that of ERDO (1985). The method of election to government still encourages excessive political clientelism, the pursuit of short-term objectives and a local-focused political mindset typified in the 2003 Budget Speech (McCreevy, 2003), which nominated 53 dispersed locations for public sector decentralisation to be transferred from Dublin but also from Cork. That strategy, now largely deferred or abandoned due to difficulties in the State's finances and strong civil service staff resistance, was largely inconsistent with its own National Spatial Strategy (NSS) (2002), where only 27% of about 12,000 intended job transfers were allocated to the NSS-designated growth centres.[3]

Hence the defectiveness in the State's population density – partly explained by a succession of "scattergun" policy strategies – is apparent from the following demographic data of Table 1. It confirms an extraordinarily low population for a temperate climate fertile land where, unlike Boston or Berlin, golf is playable all-year. Between the first census of Ireland in 1841 and the nadir point of 1961, the State's population more than halved, from 6.5 million to only 2.8 million. Most of that decline had occurred during the British administration but in the light of continuing stagnation, it was not until the 1960s that demographic growth first emerged, shown hereunder in this author's two-region format.

[3] This was intended to comprise 10,300 State and Semi-State posts together with Health Executive and Computer Board specialists.

Table 1: GDA as Percentages of RoS and of State Population (1841-2006):

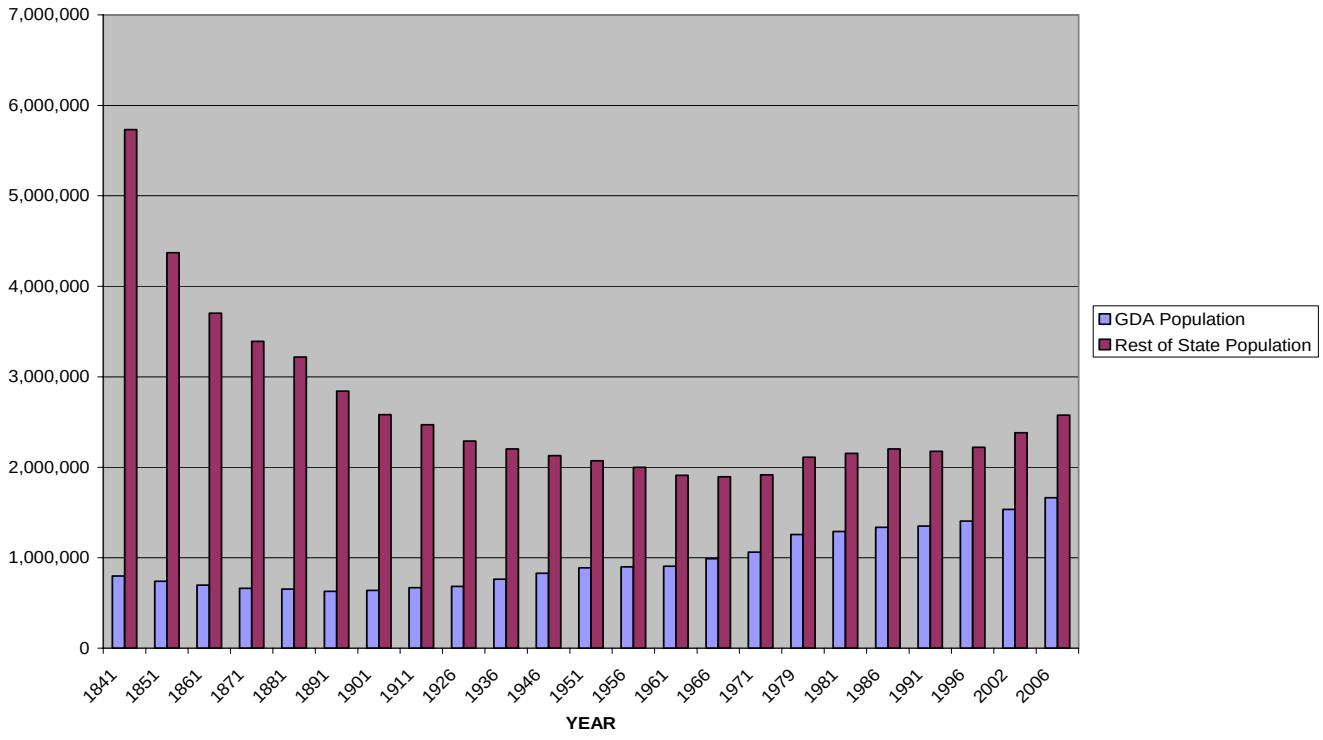
Year	GDA Population	RoS Population	GDA as % of Rest of State	GDA as % of State Population
1841	797,232	5,731,567	13.91%	12.21%
1851	740,597	4,370,980	16.94%	14.49%
1861	698,050	3,704,061	18.85%	15.86%
1871	663,131	3,390,056	19.56%	16.36%
1881	652,569	3,217,451	20.28%	16.86%
1891	628,545	2,840,149	22.13%	18.12%
1901	640,111	2,581,712	24.79%	19.87%
1911	669,625	2,470,063	27.11%	21.33%
The War of Independence - interruption of census taking				
1926	684,242	2,287,750	29.91%	23.02%
1936	764,791	2,203,629	34.71%	25.76%
1946	827,725	2,127,382	38.91%	28.01%
1951	888,386	2,072,207	42.87%	30.01%
1956	898,364	1,999,900	44.92%	31.00%
1961	906,347	1,911,994	47.40%	32.16%
1966	989,202	1,894,800	52.21%	34.30%
1971	1,062,220	1,916,028	55.44%	35.67%
1979	1,255,533	2,112,684	59.43%	37.28%
1981	1,290,154	2,153,251	59.92%	37.47%
1986	1,336,119	2,204,524	60.61%	37.74%
1991	1,350,595	2,175,124	62.09%	38.31%
1996	1,405,671	2,220,416	63.31%	38.77%
2002	1,535,446	2,381,757	64.47%	39.20%
2006	1,662,536	2,577,312	64.51%	39.21%

Source: CSO Census 2006
Analysis: Author Brian Hughes, Dublin Institute of Technology, August 2008.

As is confirmed in the time-series of the inner right-hand column of this Table, the GDA share of population continues to grow, albeit quite slowly during the "Celtic Tiger" years. An appreciation of the convergence of the GDA with the RoS area population is also evident from the following graph (Fig. 1) although, specifically in the decade since 1996, this convergence momentum has been substantially arrested. In that time, all areas, including rural counties – some of which had never previously experienced growth – have begun to add population. The State's population growth

accelerated to over 2% per annum compound since the millennium up to April 2008[4], with net in-migration even outpacing natural growth, despite Ireland having the second highest birth rate to that of France. Currently, the natural growth rate is over 0.9% per annum with Births at 1.6% and Deaths at a very low 0.7%, due to improved health and the State's low median age profile.

Figure 1: Long-Term Graphic Comparison of GDA with RoS Population (1841-2006)



Source: CSO Census 2006
Analysis: Author Brian Hughes, Dublin Institute of Technology, based on Table 1.9 data.

Supporting this author's case for a long-term population convergence of the two areas of State, and of Dublin's potential to emerge as a late-21st century city-state is Figure 1, showing the relentless growth of the GDA.

2. LONG-TERM DEMOGRAPHIC POTENTIAL

Five underlying forces are determining the world's pace of urbanisation: acceleration of population growth; economic growth and development; technological change; large-scale rural to urban movement and net outward migration from cities to nearby towns

[4] CSO Population and Migration Estimates, 2008.

and villages. In Ireland's case, a sixth, reverse movement: re-urbanisation and densification – as it relates to Dublin city – is emerging, albeit weakly. The country's uniquely favourable location within the east-west USA and UK axis, English-speaking, with its temperate climatic advantage and current very low population density, all highlight what this author considers to constitute prospects for significant demographic growth arising from its long-term economic potential.

In order to capture such potential, however, a radical change in the strategic spatial policy mindset is essential. In the first instance there is insufficient recognition of the defectively low density – one that is poorly equipped to address the problems associated with its considerable diseconomies of scale. The State's population density and that of its two areas are summarised as follows:

Table 2: The GDA and RoS Area Population Density as at 2006:

Region	Surface Area Sq. km	2006 Census CSO Population	Persons per Sq. km	GDA = 100 Area/Pop. Ratio
STATE	70,182	4,239,848	60.41	25.37
GDA	6,982	1,662,536	238.12	100.00
RoS	63,200	2,577,312	40.78	17.13

Source: CSO, 2006 census and Ordinance Survey Ireland. State means the Republic of Ireland.
Analysis: Author Brian Hughes, Dublin Institute of Technology

These data show the population density of the RoS area to be just over one-sixth that of the GDA, at under 41 people per square kilometre. This disproportionately low density, its large surface area and its particularly weak urbanisation hierarchical structure create acute RoS area diseconomy-of-scale difficulties, given the "peripheral" area's 90.05% dominance of total State surface area. In contrast to this, the GDA density (2006) almost matches that of Britain and Germany as per the EU-15 for 2002, compared in Table 3, thus:

Table 3: Population Density and Urbanisation for the EU-15 Countries, 2002:

Country	Population Density Persons per Sq. km.	Urbanisation %
Netherlands	476.7	62
Belgium	338.6	97
United Kingdom	243.3	89
Germany	231.0	88
Italy	189.7	90
Luxembourg	172.5	91
Denmark	124.7	72
Portugal	112.8	53
France	109.7	76
Austria	96.4	54
Greece	83.5	60
Spain	81.6	76
Ireland	**57.3**	**60**
Sweden	21.8	84
Finland	17.1	62
GDA (2006)	238.1	87
RoS (2006)	40.8	44

Source: ESRI 59 (2006: 85), taken from Eurostat, *New Cronos* Database, Population Reference Bureau, World Population Data Sheet, for 2002.[5]

Given its land surface, the Republic of Ireland has the lowest density apart from Sweden and Finland, which are Tundra Region countries that have large tracts of uninhabited areas. With the exception of Austria and Portugal, Ireland, together with Greece, has the lowest rates of EU-15 urbanisation – just ahead of Finland. There is a direct interrelationship between density, urbanisation, and, in Ireland's case, its absence of cities. Dublin at 1,046,000 is the only contiguous settlement which exceeds the 200,000 population size definition for a city (*vide* European Commission, 1999).

From the 2006 census figures, the State has four "embryo" cities, three of which – Cork, Limerick and Galway – are in the 50,000 to 200,000 range. Cork at 190,000 is just 18% of Dublin's population and Limerick at 91,000, Galway 73,000 and

[5] The above Table population density data is for 2002. Urbanisation hereinabove is defined as the proportion of the population resident in towns with a population in excess of 2,000 inhabitants – 20,000 in the Netherlands. "Urban" in the Irish sense means towns of 1,500 or more in population. Austria appears as somewhat of an anomaly with its greater density and yet a lower rate of urbanisation due to its larger urban population threshold.

Waterford at 49,000 show how bereft the State is of meaningful settlement size: no evidence here of a Zipf-like conformity. However, with the implementation of the Dublin-Belfast Peace Agreement, the emergence of this inter-city economic corridor with evidence of greatly increased cross-border trading, the populations of Belfast and Derry do serve to reduce somewhat the concavity of the Zipf-distortion in an all-island context.

3. COMPARISON OF IRISH AND FINNISH POPULATIONS AND PRINCIPAL SETTLEMENTS

With their similar aggregate populations and close GDP/ GNP comparisons, it is therefore instructive to compare the size/ rank of Finland's large urban settlements with the Republic of Ireland, based on their respective five largest freestanding urban centres.

Table 4: A Comparison of Ireland and Finland Populations and the Hierarchy of "Five-Largest" Settlements

REPUBLIC OF IRELAND		**FINLAND**	
Principal Cities - Population **(2006)**		Principal Cities - Population **(2006)**	
DUBLIN	1,045,769	HELSINKI	792,609
Cork	190,384	Tampere	204,337
Limerick	90,757	Vantaa	187,281
Galway	72,729	Torku	174,868
Waterford	49,213	Oulu	128,962
Total	1,448,852	Total	1,488,057
Total, excluding Primate City	403,083	Total, excluding Primate City	695,448
State Population	4,239,848	National Population	5,268,331
Urban/ Rural % (see Note)	61/39	Urban/ Rural %	68/32

Source: Principal Demographic Results, CSO, 2006 Census

Source: Government of Finland (Dublin Embassy)

Note: This includes Espoo but excludes other near-contiguous suburbs, which effectively make Finland's capital the same population as Dublin.

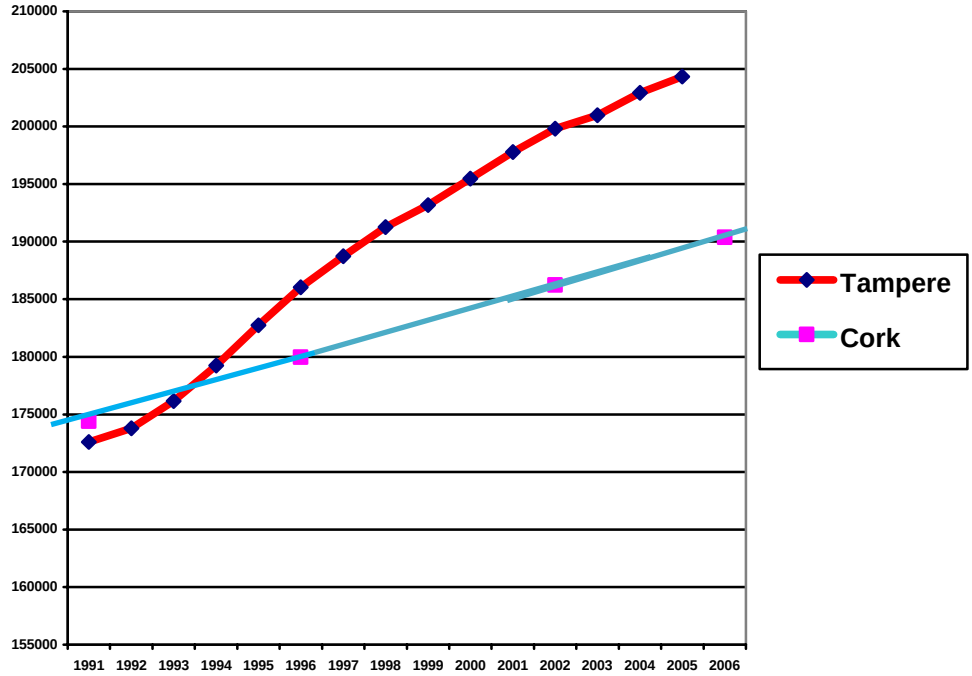
Subject to aforementioned qualification, these figures need to be viewed with caution. In the first instance, Finland has a surface area of 305,500 sq. km, most of which is tundra,

as compared with the 70,182 sq. km-surfaced area of temperate climate Ireland – both areas include their inland lakes. Secondly, Dublin's dominant position in Ireland's settlement hierarchy is less skewed once the urban centres of Northern Ireland, including the towns, are included. Belfast (654,000), together with its surrounding urban "Belfast Plateau" of large towns, and also that of north-west located Derry (104,000), which is somewhat ahead of Limerick in rank-size, assist reducing the extent of skew.

Furthermore, the two national populations in 2006 are quite similar: all of Ireland at 6.06 million versus Finland at 5.27 million. Nevertheless, the contrasting size of the respective settlement hierarchies is stark when comparing the Republic's cities with those of Finland. Dublin and Helsinki are of similar size once Espoo and other contiguous suburbs are included. This comparison serves to contrast the respective aggregate populations of their secondary cities. However, Finland's aggregate is nearly twice (+72.54%) as populous as those of the Republic of Ireland's secondary cities. For example, the population of its fourth "embryo" city, Oulu, at 128,962 is 2.62 times that of Waterford's 49,213, its Zipf rank-size counterpart.

With the exception of Cork's comparison with Tampere, the three smaller Irish "embryo" cities are in a size range of only 35% to 50% of the respective populations of their Finnish rank order comparisons. Also, Finland is more urbanised, although the aggregate urbanisation is not that significantly different to all Ireland: it stands at 68% urbanised whereas Ireland is just under 61%. It is therefore instructive to compare the population growth of Cork with its Finnish counterpart Tampere, in which its 1994 population exceeded Cork's for the first time. Located some 180 km north of Helsinki, Tampere has transformed its economy over the past 15 years, focusing on healthcare, technology and knowledge-intensive activity (Norton, 2008).

Figure 2: Population Growth Comparison of Tampere with Cork: 1991-2006



Source: Statistics Finland, Norton & Hughes (2007)

That author also cites Kautonen (2003), confirming that Tampere is experiencing significant services-sector agglomeration since the mid 1990s. This has enabled that Finnish city's population to achieve a rate of growth of 1.22% per annum compound which is more than twice that of Cork's 0.59% over the 14 years to 2006 – this despite Ireland's stronger in-migration and a more robust overall population growth. If this growth differential were to be maintained to 2020, the end-date for Ireland's NSS, in that 14-year timeframe Tampere would have a population of 242,145 as against Cork at only 206,727. This 2006 population gap of only 6.83% could well more than double to 14.63%, in the absence of any Irish city-centric strategic policy formulation.

This raises the important policy question: how long more can Irish governments afford to neglect their regional cities, denying them of their critical potential to "services-agglomerate" their respective regions, especially given the prospect of more difficult economic conditions for the foreseeable future?

4. IRELAND'S FRAGILE URBAN BASE

In addition to Ireland's five cities, the 2006 census outcome confirmed there were just four towns that had populations greater than 30,000. Six others had between 20,000 and 30,000; a further nine were between 15,000 and 20,000 and fifteen of between 10,000 and 15,000 people, in all comprising 34 "large" towns. In the absence of a clear hierarchy of town size in the RoS area – it having only four embryo cities, only one of whose population exceeds 100,000 and of the other three one is below 50,000 – the political, economic and demographic barriers by default will continue to result in *ad hoc* RoS growth at best. Regardless of public policy intervention, the NSS and its related Regional Planning Guidelines (RPG), Dublin, unopposed, is likely to continue its imperious expansion at a scale different to any other settlement.[6]

As early as the 1950s, the Whittaker-inspired *Economic Development* and the *Programme for Economic Expansion* (1958) had advocated that industry should be sited close to larger centres of population, to external transport facilities, utilities and labour supply. As Bannon and Bradley (2007) note: *This was a challenge which no Irish government, then or since, has been prepared to openly accept or to actively support.*

Despite Ireland's "pork-barrel" political culture such an hypothesis won't just disappear into the ether as the current overbearing rural-centric political establishment might wish. That issue was specifically flagged in Bannon (2000) prior to the publication of the National Spatial Strategy (NSS)[7]. He concluded his paper by warning that in implementing such plans: …*it is crucial that we do not further frustrate the process through ill considered, ad hoc actions and ill-judged decisions, whether in respect of industrial location, government "decentralisation" or pre-emptive land re-zonings. We have the opportunity to make Ireland an exciting, well ordered and*

[6] Such a conclusion is not new. In a lecture to fourth Year Environmental Economics, Bolton Street, of which this author was a student in 1966-1970, Town Planning lecturer Dr Michael Bannon, then also working with The National Institute for Physical Planning and Construction Research (An Foras Forbartha's) "Working Team" on the Buchanan Report, first made this observation. As Emeritus Professor Edward Walsh noted in a radio interview (Radio 1) on Monday 17th May 2004: *Strong regions are based on and require strong settlements*: a conditionality that so often has been ignored in Irish spatial planning formulation.

[7] The key objective of the NSS is to achieve Balanced Regional Development (BRD).

efficient model for the future – let us do it well with inspiration from the European Spatial Development Perspective.

5. ADDRESSING THE REGIONAL IMBALANCE – A WIN-WIN SOLUTION

It has been postulated in O'Leary (2003) that his two scenarios, win-lose or lose-win, for regional growth, when applied to the GDA and RoS areas in turn, may lend themselves to the third and forth-possible outcomes as set out by the author of this paper. The three earlier scenarios including the two postulated in O'Leary are detailed in this paper's Appendix. The fourth one is influenced by the findings in Robert-Nicoud (2006) and is set out thus:

Figure 3: Regional Growth Scenarios: Where "Core" Indicates GDA and "Peripheral" is the RoS Area:

4th Scenario (Author's Pareto-optimality: win-win Hypothesis)

Outcome	"Core" Regions	"Peripheral" Regions
Regional Divergence (***without*** BRD due to City-State)	Agglomeration Economies Dominate	Exploit Catch-up Potential

Source: Author Brian Hughes, Dublin Institute of Technology

The "national growth" thinking behind this 4th Scenario is based on an optimistic premise – including further world population growth – despite the current severe economic downturn, that over the longer timeframe the State will continue to "grow" significant net job-creation. Against this background however, individual regions will tend to exhibit varying rates of growth with the more urbanised ones likely to fare best (*Futures Academy,* 2008). Emerging research on location preferences of Foreign Direct Investment (FDI) combined with long-term expectation of lower levels of job losses in the GDA are cited in support of this view.

However, O'Leary (2003) also notes that: *there is a distinct possibility that the objectives of Balanced Regional Development and improved national growth and competitiveness may not be simultaneously achievable*. Instead, that author states that

both of these "incompatibles" need to be replaced by one unifying strategic objective: namely, one *that combines national growth and competitiveness* – with a focus on Foreign Direct Investment (FDI) firms. In addition to O'Leary (*op. cit*. p. 19), research by Gleeson, Ruane and Sutherland (2006) suggests that it is the particular presence of FDI firms that distinguishes the levels of Gross Value Added at the regional level.[8]

On balance, given the long-term population growth performance of the GDA, in the critical absence of 200,000 to 500,000 populated cities in the RoS area and because of the location preferences of FDI firms, this author believes that the NSS (2002-2020) "key objective" of Balanced Regional Development (BRD) and national economic growth are mutually exclusive and are incompatible. However, if it could be politically accepted, the above Scenario 4 is still possible to achieve and also one that presents an optimistic outcome for the future. Its realisation however, in the judgement of this author, is dependent on an economic momentum which is focused on selecting and developing a small number of heavily supported growth centres, of the intensity and city-weighting as advocated by Buchanan (1969).

In contrast with this, the major failure of the NSS has been its nomination of no less than twenty-three "Gateways" or "Hubs" that have little chance of creating critical mass in any centre, perhaps apart from the city of Cork. Specifically, urban agglomeration will only emerge *after* inflection point "A" in the Alonso (1971) urban economic model (*vide* Appendix). Although that point was thought to be about 100,000 at the time that paper was written, increasingly it is accepted, for a services-based economy, that the model's X axis populations for all five (A to E) inflection points are proportionately much higher in a modern-day context. Accordingly, the resource investment imperative to grow Ireland's secondary settlements to city-sizes of 200,000 to 500,000, and thereby facilitating urban agglomeration, will only permit the selection of two or three potential locations at best.

In support of this judgement it is instructive to examine the benefit accruing from the "core" region city-based demographic growth performance in contrast with that of the

[8] National Radio 24th February 2009 reported that the State, with 0.15% of world trade, received 1.8% of world FDI investment in 2006.

"peripheral" region in the thirty years between the Buchanan Plan and the first "Celtic Tiger" census of 1996, thus:

Table 5: GDA and RoS Population Performance (1966-1996):

	1966 Population	1996 Population	30-year Growth In Population	% Growth	% Per annum Compound
GDA	989,202	1,405,671	416,469	42.10	1.18
RoS	1,894,800	2,220,416	325,616	17.18	0.53
State population	**2,884,002**	**3,626,087**	**742,085**	**25.73**	**0.65**
				Basis Points spread:	**= 65**

Source: Author's analysis of CSO Population Data for 1966 and 1996 censuses

Were this demographic growth differential to be repeated out to the second half of this century, then the GDA's population would surpass that of the RoS area within a period of 70 years, as demonstrated in this author's HYMOC model later in this paper.

The prospect for a GDA - RoS population convergence focuses on whether pre-1996 growth differentials might resume, or whether the much more closely-matched post-1996 population growth performance for the two areas of State will pertain into the longer-term future. The GDA, which in 1966 accounted for a 34.30% share of total population, over the next thirty years had grown at a pace 2.45-times that of the RoS area. In doing so it had accounted for 56.12% of total State population growth. This explains the uplift in the GDA share, from 34.30% to 38.77% of State population over that period.

In late 2008 the CSO Expert Group considered varying projection rates out to 2026 and the probability that the "Traditional" pre-1996 growth of 65 Basis Points (BP) differential that existed in the GDA's favour was consistent with Dublin's future potential and, likewise, in line with the urban agglomeration evidence of other primate European cities. Likewise, such differential is viewed by this author as being consistent with the above-described "Fourth Scenario" optimism. This presents an attractive proposition to replace the traditional, myopic and beggar-my-neighbour thinking. It counter-poses Ireland's local and short-term political *modus operandi*, of overbearing clientelism. That critical reformation has to be implemented wherein the core objective

should be to replace BRD with those of both competitiveness and complementarity in promoting the nation's growth, as suggested in Krugman (1991).[9]

Such implementation requires an appropriate form of governance, viewed by this author as being of central importance in the context of longer-termed policy strategy outcomes. It is not seen as an issue that can be avoided if effective measures are to be put in place to develop true regional-sized cities – which this paper considers to be the missing category in the hierarchy of settlement size in Ireland. The task of reform will require an unimpeded invigoration of Ireland's "embryo" cities and their regions by substituting city-based multi-county regions in place of the dysfunctional rivalry that is endemic in the country's present system of individual county-based administrations with their attendant spate of turf-war baggage.

With the emergence of the "New Economic Geography" (NEG), the trend towards urban "lumpiness" and further unbalanced demographic distribution has become easier to understand and to explain – if not yet readily accepted, politically or otherwise in Ireland. Dublin's emergence as a global metropolitan region and its potential within this century to become Ireland's city-state was identified in Krugman (1991: 487) and, subsequently, in that Nobel Economic Sciences Laureate's economic advice to the State's Industrial Development Authority: *That there exists in time…some index that takes into account transportation costs, economies of scale, and the share of non-agricultural goods in expenditure* [that] *crosses a critical threshold, population will start to concentrate and regions to diverge; once started, this process will feed on itself.*

As to this author's modest involvement and minor influence in these very exciting, yet uncertain demographic "futures", it is observed that the cover page of the CSO Regional Population Projections of 4th December 2008 stated: *this release concentrates mainly on the M2F1 Traditional Variant which combines continuing though declining*

[9] The Krugman 1991 model … *shows how a country can endogenously become differentiated into an industrialised "core" and an agricultural "periphery". In order to realise scale economics while minimising transportation costs, manufacturing firms tend to locate in the region with larger demand, but the location of demand itself depends on the distribution of manufacturing. Emergence of a core-periphery pattern depends on transportation costs, economies of scale and the share of manufacturing in the national income.*

international migration with constant fertility and a return to the traditional pattern of internal migration by 2016.

This confirms the Expert Group's consensus judgement as to the most likely scenario of regional growth out to 2026. It points to a 20-year growth rate of 1.88% per annum compound for the GDA as compared with a corresponding growth of just 1.23% for the RoS area. Accordingly, this CSO 65 basis-points growth advantage is justified in its deployment in the central HYMOC projection hereunder. That advantage is also consistent with the similar BP spread for 1966-1996 as per Table 5 above. However, that particular spread was based on lower respective growth for the two "regions" because non-indigenous in-migration into Ireland had not commenced until the last year or two of that period.

Table 6: Analysis of CSO M2F1 Regional Population Projection to 2026 – "Traditional" Scenario:

	Population in thousands				
	2006*	2026	Projected growth	2006-2026 % growth	% p.a. growth (compound)
GDA	1,662	2,413	751	45.19	1.88
RoS	2,571	3,283	712	27.69	1.23
			GDA Basis Points advantage:		**65**

Source: Author's analysis of CSO's Regional Population "traditional" Projections of 4th December 2008, Table 7.
Note: * The use of the Usual Residence Basis is consistent with the 2007 Projections (2011-2041). This results in a 5,000 lower State aggregate total than that of the census figure.

It will be demonstrated hereunder that in applying these "traditional" scenario data to this author's HYMOC model, the GDA population growth superiority would result in a converging with the RoS population some 69 years after the 2006 census, in 2075. However, reliance on this scenario alone would be to disregard the population pattern for the period of exceptional growth that has occurred since 1996 – a growth that was more evenly spread throughout the State. Hence, the following Table 7 applies the Expert Group's findings for 2026, utilising their "recent" growth scenario, thus:

Table 7: Analysis of CSO M2F1 Regional Population Projection to 2026 – "Recent" Scenario

	Population in thousands				
	2006	2026	Projected growth	2006-2026 % growth	% p.a. growth (compound)
GDA	1,662	2,195	533	32.07	1.40
RoS	2,571	3,501	930	36.17	1.55
			RoS Basis Points advantage:		**15**

Source: Author's analysis of CSO's Regional Population "Recent" Projections of 4th December 2008, Table 7.

Because the extent of in-migration since 1996 has been particular to the RoS area, were that pattern to be maintained to 2026 this CSO projection would result in the "periphery" area enjoying superior growth because its natural growth is also strengthening. Consequently, a GDA population convergence would not occur.

One further analysis is to "finesse" these two contrasting results by showing the mean outcome. This would result in a 25 BP outcome in favour of the GDA, i.e. the average of the two outcomes shown above. An extended HYMOC matrix confirms that convergence would eventually result, albeit after 200 years.

6. RECENT REGIONAL POPULATION PROJECTIONS

Over the past five years this author's membership of CSO's Expert Group on Population, Labour Force and Migration Projection has enabled the writer to gain an understanding of the parameters used in the formulation of the wide-ranging national and regional projections. The recent publication, CSO (2008) Regional Projections, placed emphasis on the 65 BP spread as representing the most likely projection for 2026.

In applying these "traditional" scenario data to this author's convergence HYMOC model it was found that the GDA growth superiority results in a population convergence with the RoS population some 69 years after the 2006 census, in 2075, on the common logs basis (See Appendix). However, reliance on this scenario alone would disregard the population pattern for the period of exceptional growth that has

occurred since 1996. Hence, the following Table 8 applies the Expert Group's findings for 2026, utilising their "recent" growth scenario.

Because of the extent of in-migration since 1996, particularly to the RoS area, if that pattern were to be maintained to 2026 this CSO projection would result in the "periphery" area enjoying superior growth because its natural growth is also strengthening. Consequently, a GDA population convergence would not occur. This possibility was considered by the Expert Group. However, it was concluded that there is little if any recent evidence that supports the possibility of a primate's city *share-contraction* for any European country, (Henderson, 2000). Thus, to eschew the growth momentum of Dublin and the GDA since 1841 makes the "recent" scenario implausible.

7. DUBLIN'S LONG-TERM ECONOMIC MOMENTUM

The new economic geography, applied in ongoing research in University College Dublin's *Urban Institute Ireland*, of which this author had the privileged experience of a recent guided tour, points to the GDA (plus the county of Louth) as experiencing Bifurcation-like growth; one that differentiates the GDA region from that of RoS. The record of some of its major cellular developments, specifically of Dublin's International Financial Services Centre, Port and Airport, its Digital Hub together with the emergence of "super-suburbs" such as Sandyford-Dundrum, in aggregate, present evidence-based research findings that suggest the answer is "yes" to a positive urban agglomeration growth differentiation.

Perhaps the forthcoming period of more muted economic growth will provide the real "test". Under such conditions it will be interesting to see if a greater divergence takes place between the State's "core" and "peripheral" regions and, if so, what will be the "reactive" as distinct from "proactive" public strategic policy implementation. Will such growth promote the population growth differential to the "traditional" 1996-2006 growth advantage of 65 basis points?

At this point of this author's submission of subject PhD thesis, the emergence of the NEG literature in its application to Ireland is heralded in Morgenroth (2008(b):1-18 Draft). Following his earlier 2008a paper in which he applied Krugman's measure of

relative spatial specialisation to ED-level employment data of manufacturing activity, this pioneering research by RSA's Honorary Treasurer utilises geocoding by place of work based on the 2006 census. It finds strong locational preference for specific new types of "work" which tend to be urban-based. Employment location is systematic.

8. MEDIUM-TERM DEMOGRAPHIC PROJECTIONS

The CSO Expert Group's consensus judgement as to the most likely scenario of regional growth to 2026 points to a 20-year growth rate of 1.88% per annum compound for the GDA as compared with a corresponding growth of just 1.23% for the RoS area. Accordingly, this CSO 65 basis-points growth advantage is justified in its deployment in the central HYMOC projection as per the methodology described in Table 8 below. This is noted to be just 22 BP less than the *Twice the Size* (2007: 53) estimate for the GDA for 2020 and 26 BP less than its 2030 estimation. These respective shares of population are summarised in the next table, thus:

Table 8: Summary of Projected Percentage Population Shares as Compared With 2006:

Year	2006	2020	**2026**	2030
Source:	Census	Twice the Size	**CSO**	Twice the Size
Dublin	28.00	28.98	**29.13**	29.76
Mid-East	11.30	13.15	**13.24**	14.68
GDA	39.30	42.13	**42.36**	44.44
RoS	60.70	57.87	**57.64**	55.56
State	100.00	100.00	**100.00**	100.00

Source: *Twice the Size* (2007) projections for 2020 and 2030 by thesis author and CSO Expert Group (2026)
Analysis: Author Brian Hughes, Dublin Institute of Technology

Since independence, and despite its rural-centric focus, Ireland's governance always has been overwhelmingly centralised – one of the administrative and management impediments to realisation of full departmental decentralisation. Likewise has been the overwhelming historical influence of Dublin's Headquarter offices, as detailed in Bannon (1971). The whip-hand of a very powerful Department of Finance is matched by its overbearing, conservative influence on all other organs of State. The local administration of government is the fatally-weakened, outdated, small-scale "county"

administrative system of local government that represents the 23 RoS counties, which average just over 100,000 – a population which is substantially 57% rural in composition.[10]

It is for this reason that without a radically repositioned NSS, Dublin will continue its own independent, urban-agglomeration driven course, as Ireland's potential city-state of the present century. Increasingly detached from the rest of the country and like other primate cities throughout the world, these cities compete and trade with one another. Consistent with O'Leary (2003), this thesis takes the position that there really are only two distinctive areas in the Republic: the GDA and RoS, evidenced in the grounding historic-demography of Table 1 above.

This is the case despite the rhetoric of regional identification and location of other settlements and, critically, an absence of even "embryo" cities in some of the six RoS-located planning regions. The aggregate population of the embryo cities in 2006 was 38.54% of Dublin's settlement size, compared with 32.59% in 1966. This 40-year "convergence" of 5.95% represents 0.145% per annum compound, a rate which this author considers to be far too small to give these cities a realistic chance of narrowing their significant scale-size gap within a realistic time frame. The increasing gap in Dublin's absolute population size compared with that of Cork as set out in the Case Study hereunder is also seminal, in the context of achieving BRD; *vide* the analysis of Tables 9 and 10 and accompanying Tests 1 and 2.

9. DUBLIN AND CORK: A LONG-TERM DEMOGRAPHIC COMPARISON

This Case Study compares demographically Dublin with the State's second settlement, Cork. It analyses their respective contiguous and hinterland population performances over various time periods. In doing so, it confirms the growth benefit of

[10] It is instructive to quote O'Leary (2003: 27): *Regional political representatives typically favour short-term local interests at the expense of long-term regional growth. Thus, for example, the typical response to the closure of a multinational branch plant based in a small Irish town is usually for local politicians to exert pressure to institute a national task force to look for a replacement industry. The extent to which the industry involved is or is likely to be internationally competitive and whether it plays a role in long-term strategic planning of a region is usually ignored in the local debate. The question of whether it might be preferable to expand resources in the urban centre of the region in which the town is located, especially if this is in another county, often fails to be addressed due to local or county political considerations.* There is inculcated a cultural mindset that is unwilling to change: Ireland's centralist "stage" has failed to empower its regional actors.

urban agglomeration (UA) that appears to be confined to Dublin, based on comparative population performance, especially since 1960.

The investigation confirming the existence of UA in Ireland is obtained by a comparative demographic time analysis for both medium and long-terms. A series of tests shows comparative results for Dublin and Cork settlements together with their respective hinterlands. As UA is unique to cities, as distinct from towns, the long-term analysis compares and contrasts the respective population growths for the 80-year period 1926-2006. This is followed by medium-term investigation 1986-2006 which examines the hinterland areas as distinct from the contiguous built-up city areas. This analysis also differentiates between the aggregate towns and their surrounding populations. This case study employs tests followed by an investigation of respective densities. The first task is to set out the research findings as practical "tests" of agglomeration for individual State censuses since the first census of 1926. This concerns the contiguous built-up city populations for both settlements, thus:

Table 9: Comparison of Contiguous Built-Up Dublin and Cork

Census Year	Dublin	Cork	Cork as % of Dublin
1926	418,981	78,490	18.73
1936	507,888	93,322	18.37
1946	550,725	89,877	16.32
1951	634,473	112,009	17.65
1956	649,338	114,428	17.62
1961	665,556	115,102	17.29
1966	736,681	125,824	17.08
1971	801,298	135,456	16.91
1979	900,884	150,059	16.66
1981	915,115	149,792	16.37
1986	921,081	174,109	18.90
1991	929,090	174,400	18.77
1996	952,692	179,954	18.89
2002	1,004,614	186,239	18.54
2006	1,045,769	190,384	18.21

Source: Author's analysis of Censuses of Population, Vols. 1. 1926-2006.

Table 9 confirms that long-term proportionality has been maintained. Over that 80-year period, Cork's population, at 17.6% that of Dublin, had a variance of plus or minus 1.3%. Apart from the obvious fact that built-up contiguous Cork has made little progress in narrowing the percentage size-gap with that of Dublin, over time, this outcome means – in absolute terms – that contiguous Dublin's population size difference has grown by over *half a million* people **more so** than that of Cork. It confirms this author's colleague Professor John Ratcliffe's emphasis for city comparison and *the need to recognise scale-size differentiation rather than just focusing on the relatively modest decline in percentage terms*, in this instance from 18.73% in 1926 to 18.21% in 2006. This population size difference is summarised thus:

…Test 1.

Year	Contiguous Dublin		Contiguous Cork	Size Difference
2006	1,045,769	-	190,384	= 855,385
1926	418,981	-	78,490	= 340,491
			80-year size divergence	= 514,894

Source: Author's analysis of Censuses of Population, Vols. 1. 1926-2006.

The second test for this 80-year period is to compare respective hinterland population changes. So as to maintain consistency in using a comparative size of surface area over that time period, it was decided to measure the GDA with Cork County, exclusive of their respective built-up city areas. Both surface areas are quite similar. Excluding city areas, Cork's hinterland extends to 7,373.85 sq. km compared with the 6,707.84 sq. km area of the GDA. Thus Cork exceeds the GDA Hinterland surface area by just 9.33%.[11]

This test is used to quantify and compare the UA effect. It isolates the respective hinterland populations, i.e. by deducting the built-up contiguous populations from

[11] The basis for author's computation of the respective hinterland surface areas is to add to the official City Council areas a proportion of Cork Rural district (10%) and to Dublin City, for consistency, a portion of its former County Council area (20%) – noting that the GDA also includes all of Kildare, Meath and Wicklow. Both contiguous built-up settlements are then deducted from total Cork plus County and from total GDA areas, respectively.

their respective GDA/ Cork county aggregate at every census date. These data are set out in Table 10, thus:

Table 10: GDA and Cork City and County Comparison

	GDA	less Contiguous Dublin City	= Dublin's Hinterland	Cork County (entirety)	less Contiguous Cork City	= Cork's Hinterland
Year						
1926	684,242	418,981	265,261	365,747	78,490	287,257
1936	764,791	507,888	256,903	355,957	93,322	262,635
1946	827,725	550,725	277,000	343,668	89,877	253,791
1951	888,386	634,473	253,913	341,284	112,009	229,275
1956	898,364	649,338	249,026	336,663	114,428	222,235
1961	906,347	665,556	240,791	330,443	115,102	215,341
1966	989,202	736,681	252,521	339,703	125,824	213,879
1971	1,062,220	801,298	260,922	352,883	135,456	217,427
1979	1,255,533	900,884	354,649	396,118	150,059	246,059
1981	1,290,154	915,115	375,039	402,465	149,792	252,673
1986	1,336,119	921,081	415,038	412,735	174,109	238,626
1991	1,350,595	929,090	421,505	410,369	174,400	235,969
1996	1,405,671	952,692	452,979	420,510	179,954	240,556
2002	1,535,446	1,004,614	530,832	447,829	186,239	261,590
2006	1,662,536	1,045,769	616,767	481,295	190,384	290,911

Source: Author's analysis of Census of Population, Vol. 1. The figures for 2006 are author's estimates based on examination of the Electoral District outturns from the 2006 Census Preliminary Report, Table 4 data.

Since the latter half of the 20th century in the USA and over the last quarter thereof in Europe, "edge city" and polycentric/ centrifugal- type morphological development has resulted in hinterland urban centre-growth. Progressively, this has complemented core area and contiguous built-up city growth. Hinterland growth occurs both by way of town and surrounding peri-urban growth. Accordingly, for the Republic of Ireland another analysis of UA growth is tested by comparing Dublin with Cork hinterlands over the same 80-year time-span. The analysis of Table 10 data is summarised as follows:

…Test 2.

Year	Hinterland Dublin	- Hinterland Cork	=	Size Difference
2006	616,767	- 290,911	=	325,856
1926	265,261	- 287,257	=	-21,996
		80-year size divergence	=	347,852

Dublin's sphere of influence, evidenced in longer commuting, has overspilt, progressively, across the GDA into outer Leinster and south-east Ulster counties. Furthermore, this 2006 hinterland figure of 616,767 for the GDA understates the extent of this "sphere of influence". It discounts population growth spillover into outer Leinster and south-east Ulster counties. This is estimated to be about 15% of the 76,000 figure for aggregate population deflection from Dublin (Williams, Hughes, and Shiels, 2007). An additional settlement analysis not forming part of this paper identifies specific RoS commuter towns that are within Dublin's sphere of influence. It confirms higher rates of population growth for such towns when compared with the majority of RoS towns that are outside of Dublin's sphere of influence.

In summary, Tests 1 and 2, when combined, show an 80-year divergence of 862,746 between Dublin and Cork populations, exclusive of overspill from GDA into outer Leinster and south-east Ulster counties. There is assumed to be no parallel overspill from Cork into other Munster counties.

10. DISCUSSION

The significance of the aforementioned aggregate divergences for Dublin and Cork, amounting to 862,746, can be appreciated in that it represents 68.05% of overall State population growth of 1,267,856 for 1926-2006.

There is tangible justification to support this criteria and resultant re-classification of "regions" as currently defined. The GDA long-term convergence with RoS's population, its share of State natural growth, employment, of GVA/ Taxation, of aggregate Built Environment asset values and a range of other strategic indicators, all providing credibility to the reality of the same two-region conclusion as articulated in

Clinch, Convery, and Walsh (2002: 97).[12] That literature, perhaps influenced by the CSO's earlier regional projections of 2001, had suggested optimistically that *by the fourth decade of this century almost half the population of the country will be living in Greater Dublin.* However, recent evidence of both natural growth and net in-migration trends, if maintained, would refute their view (*op. cit.*, 98) that *the population of the rest of the country is likely to grow by only about 10% over the same period.*

With the benefit of the CSO Expert Group workings, together with the research insights gained from both recent and historic HYMOC model's Basis Points population growth differential analysis, this author takes a more moderate view as to the *timescale for population convergence* between the two areas of State. Since 1996, but especially since 2000, relevant strategic indicators – population, employment and housing growth – all point to a GDA growth thrust that exhibits centrifugal rather than centripetal directional forces for small-scale settlements. Likewise since 1996, as per Table 7 *supra*, it is the RoS area that is experiencing strong demographic dispersal, albeit at the cost of unsustainable, long-distance commuting driven by divergent house prices and consequent residential lack of affordability. Notwithstanding a reduced in-migration share, the level of future demographic growth is still firmly biased towards the east and north east of the island based on natural growth and urban agglomerative influences, as adduced in the principal finding of the *Twice the Size* (2007) research.

Accordingly, the longer-term issue and a central strategic question for Ireland focuses on the distribution of the dividends of post-"Celtic Tiger" population share. Will this benefit RoS more so than the GDA, despite its origin being primarily GDA-driven? This research analysis, particularly on BP growth differentials, would tend to counter the Government's commitment to BRD. The intervention of urban economics and its manifest outcome in terms of the pace of UA, places the GDA in a position of prime advantage, proportional to Dublin's size compared with other Irish settlements. Because of this conclusion, the government and its strategic advisors should be more amenable to implementing spatial policy strategies that are "Pareto-focused" and directed towards exploiting *core plus periphery* mutuality. The research evidence adduced herein confirms that the government and their technical advisors cannot

[12] August 2006-issued CSO data on most recent available GVAs for 2003 confirm little material change in regional disparities.

continue to ignore – as they have so done – the disciplines of urban economics and NEG in any future technical review of the NSS.

Another possibility that relates to less-propitious economic conditions, especially in terms of regional economic performance, is that the indicators of rural decline would become more pronounced, accentuated by rural town industrial decline. In an economic downturn, regions that are not endowed with an extensive urban base are less likely to prosper (*Vide,* Editorial – page 18, *Irish Times* Monday, 17th December 2007).

In the realm of demographic predictions, the prudent course may be to withhold further judgement making until the results of NSS and RPG-implementation are known. However, that is not to ignore the analysis that is resulting from the latest State and regional population projections and their background reasoning. Notwithstanding these expectations of moderate BP rates of GDA convergence to 2041 and 2026, respectively, the cathartic economic upheavals of late 2008 may belatedly serve to concentrate government's focus on strategic financed-based planning as distinct from that which has been traditionally based on short–term political expediency. The prescient questions are: will there be a "Damascus-like" conversion to a city-focused growth concentration? Will a dawning of the "urban agglomeration" potential appear?

11. CONCLUSIONS

The traditional "within the box" approach to strategic planning policy implementation in Ireland has been based on projecting forward *past performance* data. When radical conditions are posited, as for example in the post-1996 intensification of non-indigenous in-migration viewed against a background of up to double-digit GDP growth, there is a corresponding obligation requiring strategists to provide radical "outside the box" strategic responses: thinking processes that confidently enable past paradigms and accepted norms to be set aside and replaced with leading-edge innovations. Such approaches will be formulated outside the constraints and strictures imposed by prescriptive or "supply-led" planning. Sustainable visions of "the future", be it for the world, Europe, the State or for the GDA, must be conditioned not by just

the key issues of today but also prompted by an *anticipation* of the key issues of tomorrow's Ireland.[13]

Hall and Pain (2006: 204), in reference to their "Polycentric Metropolis" study findings of 2004-2005, point to the ineffectiveness of strategic policy: *In Greater Dublin a major issue was that of asymmetry in policy instruments: national governance sets financial policy, makes infrastructure decisions (Departments of Transport, National Roads Authority, Department of Communication, Marine, Natural Resources, Rail Procurement Agency), encourages enterprise (Department of Enterprise, Trade and Employment) and establishes planning guidelines (Department of Environment, Heritage and Local Government), while local authorities (seven in the Greater Dublin region) make development plans for their areas and administer planning decisions on development proposals in this context. These different functions and instruments have little spatial context, and the result is a lack of joined-up policy*. (Stafford et al., 2005: 23).

Those study findings (*op. cit*. p. 205) also note how: *Greater coordination of spatial planning policies at the regional level have been hindered by institutional deficits. While the region is spatially controlled by one set of Planning Guidelines, which promote "self-sufficient" towns in an attempt to curb some of the sprawl of the city, implementation falls to two regional authorities, neither of which is elected or has legislative or fiscal control. In terms of spatial planning, the local authorities control land use management and have a greater number of policy instruments at their disposal than the regional authorities. It is up to these local authorities to implement the Regional Planning Guidelines as they see fit. Thus, any aspirations in Regional Planning Guidelines to polycentric sustainable development are limited*. (Stafford et al., 2005:10).

[13] For example, Hitchcock (2003: 433) points to the dichotomy of *Fortress Europe* – one that is intent on preventing unstructured Third-World immigration and yet one that over the next two decades, requires upwards of five million additional workers in order to maintain its principal economies.

In concluding this paper it is noted that The World Bank, in Zoellick (2009: 39), differentiates between spatial and social equity in appearing not to ascribe to spatially balanced growth. In doing so, they seem to be critical of the EU's territorial policy stance on BRD. Perhaps there is a message in this for Ireland's strategists and politicians alike.

APPENDIX

The O' Leary (2003) Regional Growth scenarios are as set out in the following two cases in his Table 2.3, thus:

Figure 4: Regional Growth Scenarios: Where "Rich" Indicates GDA and "Poor" is RoS:

	"Rich" Regions	**"Poor'" Regions**
1st Scenario (Lose-Win) Regional Convergence or Balanced Regional Development	Urban Diseconomies Dominate	Exploit catch-up potential
2nd Scenario (Win-Lose) Regional Divergence or Unbalanced Regional Development	Agglomeration Economies Dominate	Failure to catch-up

Source: O'Leary, E., *Irish Regional Development – A New Agenda* (2003: 30).

Note: Other nomenclature designations, respectively for "Rich" and "Poor" regions are "Core" and "Peripheral", as, for example, when applied to the econometric "core-periphery equilibrium" sustainability model (Robert-Nicoud, 2006).

O'Leary points to possible combinations of above-table classifications, with other possible scenario outcomes.[14] Co-incidental to this author's early articulation of win-lose versus Pareto-optimality outcomes, logically this introduces two additional but related scenarios. This author's two complementary scenarios are posited herein and

[14] O'Leary advises that neither of these (1st or 2nd) scenarios *would deliver the greatest improvements in national growth and competitiveness. From a national perspective, the ideal outcome would be for agglomerate economics to dominate in the "rich" regions and for the "poor" regions to exploit their catch-up potential. If this is achieved, the result may be either balanced or unbalanced regional development, depending on the relative performance of "rich" and "poor" regions (ibid. p. 31).*

supra, the first of which is unconscionable, especially in the wake of the "Celtic Tiger" period and having regard to post-9/11 employment growth. Logically, however, it is a derivative of the pessimistic scenario as posited by O'Leary, thus:

Figure 5: Regional Growth Scenarios: Where "Core" Indicates GDA and "Peripheral" is RoS:

3rd Scenario (Lose-lose): Outcome	**"Core" Regions**	**"Peripheral" Regions**
Regional Divergence	Urban Diseconomies Dominate	Failure to Catch-Up
(part of 2nd Scenario)	(part of 1st Scenario)	(part of 2nd Scenario)

Source: Author Brian Hughes, Dublin Institute of Technology

It is acknowledged that ongoing Irish governments' continuing pursuance of a laissez-faire approach to spatial planning inherently carries with it the risk of the above third, "lose-lose" scenario outcome, albeit up to mid 1997, masked by the favourable "Celtic Tiger" growth for the following decade. In the longer time frame, it has to be acknowledged that Ireland's past economy has performed indifferently. Prior to the unprecedented growth of the 1990s, little change had taken place in the number of people at work since the first post-independence census of 1926; that is, apart from the sustained reduction in agricultural and its replacement by manufacturing and service-type employment in particular.

Despite the growth of the past fifteen years or so, it is still open to doubt as to whether the current policy of BRD in the absence of cities and their associated urban agglomerative processes is sustainable, for the reasons adduced by O'Leary and, additionally, by the author of this thesis. Warranting particular mention is the fact that the NSS singularly has failed to acknowledge the emergence of the Polycentric Suburb as perhaps the most significant form of settlement-type in the hierarchy of Irish settlements, particularly since the start of the 1990s.

METHODOLOGY

In terms of the "core" empirical analysis it is appropriate to examine author's quantitative methodology for measuring and comparing the respective population growth curves for the GDA and RoS areas. Specifically, this author's following empirical methodology is based on a population convergence time-scale that takes the form of an equation. Convergence of GDA and RoS population is reflected in the time-scale format of "years", whereby the GDA population growth "converges" by way of a faster exponential growth-track, in a graph curve that intersects at a future date with that of the RoS area.

In applying this initial iterative-driven methodology, the following spreadsheet is derived as set out hereunder in Table 13. It is intended for use as a strategy indicator of indicative time frames, for population convergence of the two parts of State to occur, based on a variety of parameters. The second line of results, shown bold, represents the formula outcomes, based on the earlier CSO M1F2 central Regional Forecasts, as published on 25th June 2005. As could be expected, the iterative calculations of the fifty sets of data proved to be both painstaking and time consuming. Furthermore, the competence of such work required a facility for checking and verifying its mathematical integrity. Thus it proved necessary to synthesise the methodology in order to present its underlying formula, presented in the form of a generic equation of a mathematically standardised exponent expression.[15]

A Convergence Table – Where GDA equals Rest of State Population

As described in the preceding section, the principle upon which both sides of an equation is formulated takes the form of the population *growth-rate difference* between the two areas of the State. This is measured in "basis points" (BPs). In the following Table 11, the first line is a "header" which sets out, in percentages, the GDA assumed share of State population. The following lines show differing BPs. For example, the second line set of 33 BPs difference in favour of the GDA is the figure that represents

[15] This author is particularly appreciative of the CSO's invitation to have participated in the Expert Group's deliberations that contributed to the formulation of their 2005 Regional Population Forecasts. That Group was obliged to make their projections, to 2021, on the basis of the December 2004 CSO assumption of a "start-date" 2006 State population total of 4.165 million.

the CSO's (May 2005) M1F2 expectation, out to 2021. The assumption made in the author's indicative spreadsheet is that this growth-rate differential *continues* for the entire period, right up to the date of convergence. The vertical axis comprises a range of five sets of BPs from 25 to 100.[16]

These figures represent the poles of extremity: 100 for example, in a current demographic context, would assume that the GDA Natural Growth advantage, of, say, 25 BPs, is augmented by a favourable in-migration performance difference of 75, as compared with RoS. At the other end of the scale, the 25 BPs of the first row would be just above the 1996-2006 population growth differential that GDA currently enjoys over RoS. The horizontal axis of this set of data, in bold, shows the range of percentages, 39.2% being the 2002 census GDA share of State population and 40.7% representing the CSO-forecasted share in 2021. The resultant matrix of "Years to Convergence" data, as described in the preceding section, shows the array of years to convergence, including a fractional year, where applicable. Those figures in bold would conform to a positive thesis hypothesis: otherwise the "null" hypothesis would prevail.

Table 11: Original 'Hughes Indicator of Years of Convergence' [HYMOC]: When GDA Equals Rest of State Population:

GDA Basis Points in excess of RoS (The GDA assumed start position as % of State Population: 2006 census = 39.21%)

	39.21%	**40.0%**	**40.7%**	**42%**	**43%**	**44%**	**45%**	**46%**	**47%**	**48%**	**49%**
25 Basis Points	178	165	153	133	115	98	82	65	**49**	**33**	**16**
33 Basis Points	135	125	116	100	87	75	62	**50**	**37**	**25**	**13**
50 Basis Points	90	82	77	66	58	**49**	**41**	**33**	**25**	**17**	**8**
75 Basis points	60	55	**51**	**44**	**39**	**33**	**28**	**22**	**17**	**11**	**6**
100 Basis points	**45**	**42**	**39**	**33**	**29**	**25**	**21**	**17**	**13**	**9**	**1**

Source: Author Brian Hughes, Dublin Institute of Technology

[16] Historically, analysis of the GDA's consistently higher population growth, when compared with that of the RoS area, has resulted in a 68 basis points difference (1841-1996) which, if maintained, will result in 21st century convergence, as is shown for this and for other time periods.

Initially, each individual calculation was derived by inductive means. This was based on the exponential and solving the following equation by iterative means, thus:

GDA% Share times (GDA per annum Compound Growth) to the power of (projected) Years is equal to RoS % Share times (RoS per annum Compound Growth) to the power of (projected) Years.

The formulation, in respect of above Table's second line of figures shown bold, is based on deploying the exponent – which represents the time-scale in whole years – to the nearest thereof, which is then applied to the respective growth rate % per annum compound. Then, both sides are multiplied by the start positions, being the respective GDA and RoS estimated population percentages as at the start of the 2006 projection period.

Subsequently, the accuracy of the entire content of the matrix was confirmed based on the results of the formulation, as set out hereunder. This comprised from first principles a standardised generic mathematical formula, which was made with the kind assistance of this author's lecturing colleague, Frank McCann. The formula is shown firstly in common logs and then in natural logs. This author's original concept – akin to Parry's Valuation Tables (1961) as used in the property industry – is to present the resultant matrix in a compounded annually format, as is achieved in the common logs. As with Parry, this approach tends to understate the time-period to convergence. First, we show this calculation:

The *Compounded Annually* Formula:

Mathematically, is expressed as n = log (PROS / PGDA) all over log (1+iGDA / 1+iRoS) where "n" is the number of years to convergence – in this case, where the GDA population will equal that of RoS. In this formula, it is confirmed that log is "standard base ten" as distinct from "natural" log. "P" denotes the start population of the GDA and RoS, respectively, as designated in the formula. Small "i" stands for the rate of compound annual population growth. As confirmed, this formula understates the period to convergence because, conceptually, it is annual in arrears-based.

The *Continuous Compounding* Formula:

This variation, based on the "natural" log – the function whose rate of growth is "itself" – overcomes the problem of arrears compounding and instead accommodates continuous growth. Mathematically, n = natural log times the quotient of the larger populated area and the smaller one. In turn, this is divided by the difference in their populations, expressed thus: ln or "e" (PROS / PGDA) all over iGDA minus iRoS.

The derivation of these formal mathematical statements is as follows:

Firstly, *Annual* Compounding is set out, noting that, in order to test the thesis hypothesis, an assumption was made that GDA's population growth rate "i" would be double that of RoS, i.e. 2 x i versus 1 x i, akin to the example of the 2001 Regional Population Projections showing a calculated differential of BPs. Then, by way of an equation using logarithms, in "n" years time following the 2002 census of population, their respective populations would converge: thus:

$$P_{GDA}(1+2i)^n = P_{Ros}(1+i)^n$$

$$\Rightarrow \left(\frac{1+2i}{1+i}\right)^n = \left\{\frac{P_{Ros}}{P_{GDA}}\right\}$$

$$\Rightarrow n\log\left(\frac{1+2i}{1+i}\right) = \log\left\{\frac{P_{Ros}}{P_{GDA}}\right\}$$

$$\Rightarrow n = \frac{\log\left\{\frac{P_{Ros}}{P_{GDA}}\right\}}{\log\left(\frac{1+2i}{1+i}\right)}$$

For continuous Compounding

$$n = \frac{\log_e\left\{\frac{P_{Ros}}{P_{GDA}}\right\}}{2i-i} = \frac{\log_e\left\{\frac{P_{Ros}}{P_{GDA}}\right\}}{i};$$

where i=annual % growth in Ros

NB : For 25% basis points 2i-i becomes 1.25i-i=0.25i

$$\Rightarrow n = \frac{\log_e\left\{\frac{P_{Ros}}{P_{GDA}}\right\}}{1.25i-i} = \frac{\log_e\left\{\frac{P_{Ros}}{P_{GDA}}\right\}}{0.25i}$$

Given that the population of the GDA based on 2002= P_{GDA} and that the population of the rest of the state (RoS now) = P_{ROS} and $k_{GDA} = 2i\%$ while $k_{GDA} = i\%$ then the two populations will be equal at some time "n" years from now. Using the compounding formula:

$$P_{GDA}(1+2i)^n = P_{Ros}(1+i)^n$$

$$\Rightarrow \left(\frac{1+2i}{1+i}\right)^n = \left\{\frac{P_{Ros}}{P_{GDA}}\right\}$$

$$\Rightarrow n\log\left(\frac{1+2i}{1+i}\right) = \log\left\{\frac{P_{Ros}}{P_{GDA}}\right\}$$

$$\Rightarrow n = \frac{\log\left\{\frac{P_{Ros}}{P_{GDA}}\right\}}{\log\left(\frac{1+2i}{1+i}\right)}$$

Confirming the 2002 census, the GDA=1,535,446 and the RoS=2,381,757.

$$\frac{P_{Ros}}{P_{GDA}} = \frac{2,381,757}{1,535,446} = 1.5511825$$

At this ratio the population of the GDA is 39.1975% of the RoS.

The value of n when the population of the GDA will be equal to the RoS is given by:

$$n = \frac{\log\left\{\frac{2,381,757}{1,535,446}\right\}}{\log\left(\frac{1.02}{1.01}\right)} = 44.6\,years$$

The next task was to incorporate the standardised formula into a spreadsheet format. This enabled the 50 "years" thesis-hypothesis outcomes of the matrix to be compared with this author's earlier individual empirical calculations. These data, obtained from the respective Excel formulae, show to two places of decimals the definitive results in years. Again, verified by this author's lecturer-colleague, Frank McCann, who kindly provided and tested these data as set out in the following Table 12; he confirms the general thrust of the earlier workings and, in doing so, gives affirmation to this

author's original model concept as initially presented to Supervisors and Research Colleagues in the 2005 Annual Evaluation assessment. We now examine the first formula application, that of Common Logs, thus:

fX = LOG((1+I2)/I2)/LOG(((1+$J$1+$A$7/100*$J$1))/(1+$J$1))

The following Table comprises the Common Log Matrix. We select a cell, at random, to show the formula for, say, 100 BP in favour of the GDA, where that region's commencing population is 45.0% share of State. For clarification, 100 sets of BP values *i.e.* expressed in Years to two places of decimals, occupy the **fifth** row data of the spreadsheet and that particular BP percentage population growth gap is located in **column H** of the matrix, thus:

Table 12: Common Log Model

A. Common Logs (LOG):	GDA as % of the State Population						1.00% Col. H				
Basis Points	**0.392**	**0.400**	**0.407**	**0.420**	**0.430**	**0.440**	**0.450**	**0.460**	**0.470**	**0.480**	**0.490**
25	177.54	164.01	152.25	130.56	114.01	97.55	81.17	64.86	48.60	32.38	16.18
33	134.55	124.30	115.38	98.95	86.40	73.93	61.52	49.15	36.83	24.54	12.26
50	88.88	82.11	76.22	65.36	57.07	48.84	40.64	32.47	24.33	16.21	8.10
75	59.33	54.81	50.87	43.63	38.10	32.60	27.12	21.67	16.24	10.82	5.41
100	44.55	41.15	38.20	32.76	28.61	24.48	20.37	16.27	12.19	8.12	4.06

Source: Application of Frank McCann's Common Log Formula to thesis author's Convergence equation.

For demonstration purposes, assuming a BP difference of 100 and a GDA share of 45% of State population, the **fX** (equation) result is for population convergence to take place in 20.37 years' time as shown in the matrix

As already observed, the Common Log formulation overstates a period to convergence by 1% to 1.5%. So as to accord with the continuity of time from "now", the Natural Log formulation is now introduced, derived from the following LN algebra as expressed in Excel, thus:

NATURAL LN FORMULA: fX = LN((1+I12)/I12)/$F$10*$A$17/100

Applying similar parameters as in the previous example and from perusal of the following Table 13, it is noted that the 100 BP cell is positioned on the **fifth row** of this spreadsheet and the 100 set of BP values appear on the **column H** therein. Here **fX** convergence is 20.07 years as shown in the matrix.

Table 13: Natural Log Model

B. Natural Logs (LN):	GDA as % of the State Population						Col. H				
Basis Points	**0.392**	**0.400**	**0.407**	**0.420**	**0.430**	**0.440**	**0.450**	**0.460**	**0.470**	**0.480**	**0.490**
25	175.57	162.19	150.55	129.11	112.74	96.46	80.27	64.14	48.06	32.02	16.00
33	133.00	122.87	114.05	97.81	85.41	73.08	60.81	48.59	36.41	24.26	12.12
50	87.78	81.09	75.28	64.55	56.37	48.23	40.13	32.07	24.03	16.01	8.00
75	58.52	54.06	50.18	43.04	37.58	32.15	26.76	21.38	16.02	10.67	5.33
100	43.89	40.55	37.64	32.28	28.19	24.12	20.07	16.03	12.01	8.00	4.00

Source: Application of Frank McCann's Natural Log Formula to this author's Convergence equation.

GRAPHIC APPLICATION

The CSO (2008) published its latest Regional Population Projections. Its principal one, M2F1 "Traditional" version, projects that out to 2026 the GDA will grow at 65 BP faster than the RoS area. On continuation of that assumption into the second half of this century, the following graph and its accompanying spreadsheet – applying the common logs basis – confirms that the GDA population will match that of the RoS area in a 68.45-year timeframe after the 2006 census, *i.e.* in 2074. Two sets of projections with a 65 BP growth-spread in the GDA's favour are shown, for the purpose of demonstrating that it is not absolute growth rates but, rather, the differential growth rate that is significant.

In this graphical application the pink and blue graph lines compare GDA and RoS populations as growing respectively at the lower rates of 1% and 1.65% per annum compound. Likewise, showing the same growth rate differential of 65 BP, the turquoise and black graph lines portray the higher growth rates of 1.35% and 2.00% for the GDA and RoS area, respectively.

Figure 6: HYMOC Convergence Graph

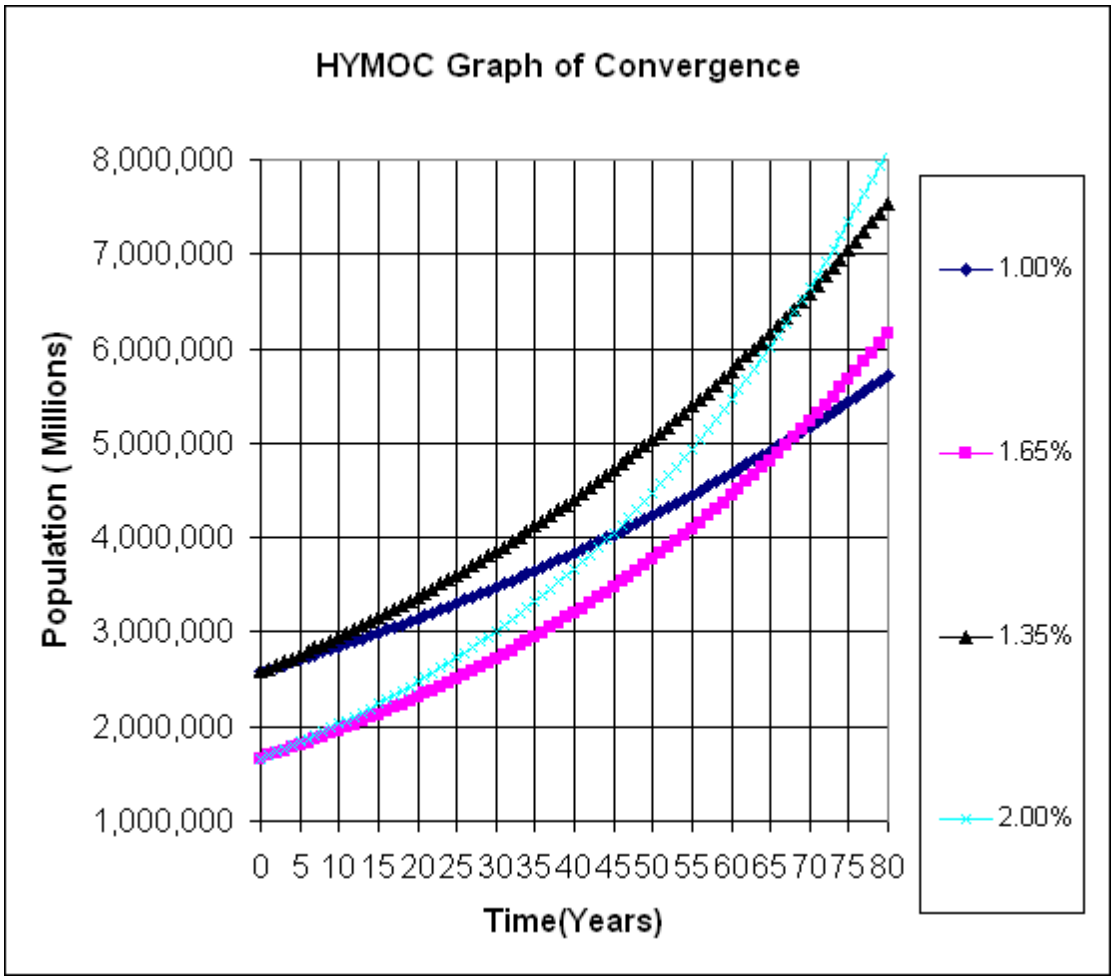


Table 14: Grounding Data for HYMOC Graph

	1.00%	1.65%	1.35%	2.00%
n	1.00%	1.65%	1.35%	2.00%
0	2,577,312	1,662,536	2,577,312	1,662,536
1	2,603,085	1,689,968	2,612,106	1,695,787
2	2,629,116	1,717,852	2,647,369	1,729,702
3	2,655,407	1,746,197	2,683,109	1,764,297
4	2,681,961	1,775,009	2,719,331	1,799,582
5	2,708,781	1,804,297	2,756,042	1,835,574
6	2,735,869	1,834,068	2,793,248	1,872,286
7	2,763,227	1,864,330	2,830,957	1,909,731
8	2,790,860	1,895,091	2,869,175	1,947,926
9	2,818,768	1,926,360	2,907,909	1,986,884
10	2,846,956	1,958,145	2,947,166	2,026,622
11	2,875,425	1,990,455	2,986,952	2,067,155
12	2,904,180	2,023,297	3,027,276	2,108,498
13	2,933,221	2,056,681	3,068,144	2,150,668
14	2,962,554	2,090,617	3,109,564	2,193,681
15	2,992,179	2,125,112	3,151,543	2,237,555
16	3,022,101	2,160,176	3,194,089	2,282,306
17	3,052,322	2,195,819	3,237,209	2,327,952
18	3,082,845	2,232,050	3,280,912	2,374,511
19	3,113,674	2,268,879	3,325,204	2,422,001
20	3,144,810	2,306,315	3,370,094	2,470,441
21	3,176,259	2,344,370	3,415,591	2,519,850
22	3,208,021	2,383,052	3,461,701	2,570,247
23	3,240,101	2,422,372	3,508,434	2,621,652
24	3,272,502	2,462,341	3,555,798	2,674,085
25	3,305,227	2,502,970	3,603,801	2,727,567
26	3,338,280	2,544,269	3,652,452	2,782,118
27	3,371,662	2,586,249	3,701,761	2,837,760
28	3,405,379	2,628,922	3,751,734	2,894,515
29	3,439,433	2,672,300	3,802,383	2,952,406
30	3473,827	2,716,393	3,853,715	3,011,454
31	3,508,565	2,761,213	3,905,740	3,071,683
32	3,543,651	2,806,773	3,958,468	3,133,117
33	3,579,088	2,853,085	4,011,907	3,195,779
34	3,614,878	2,900,161	4,066,068	3,259,694
35	3,651,027	2,948,013	4,120,960	3,324,888
36	3,687,538	2,996,656	4,176,593	3,391,386
37	3,724,413	3,046,101	4,232,977	3,459,214
38	3,761,657	3,096,361	4,290,122	3,528,398
39	3,799,274	3,147,451	4,348,038	3,598,966
40	3,837,266	3,199,384	4,406,737	3,670,945
41	3,875,639	3,252,174	4,466,228	3,744,364
42	3,914,395	3,305,835	4,526,522	3,819,252
43	3,953,539	3,360,381	4,587,630	3,895,637
44	3,993,075	3,415,827	4,649,563	3,973549
45	4,033,006	3,472,188	4,712,332	4,053,020
46	4,073,336	3,529,480	4,775,949	4,134,081

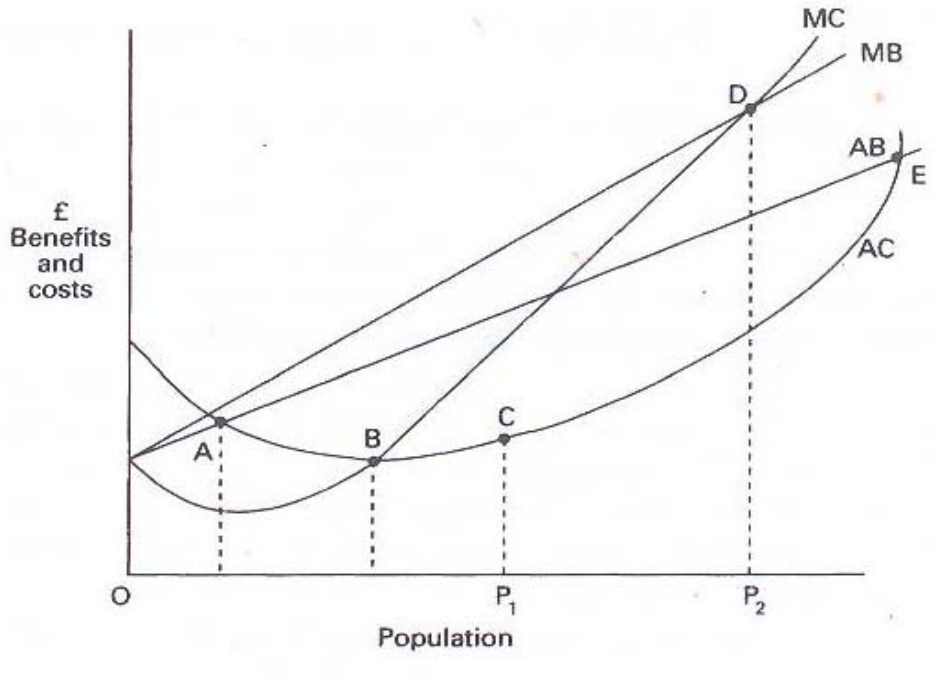
47	4,114,069	3,587,716	4,840,424	4,216,762
48	4,155,210	3,646,913	4,905,770	4,301,098
49	4,196,762	3,707,087	4,971,997	4,387,120
50	4,238,729	3,768,254	5,039,119	4,474,862
51	4,281,117	3,830,431	5,107,147	4,564,359
52	4,323,928	3,893,633	5,176,094	4,655,646
53	4,367,167	3,957,878	5,245,971	4,748,759
54	4,410,839	4,023,183	5,316,792	4,843,735
55	4,454,947	4,089,565	5,388,569	4,940,609
56	4,499,497	4,157,043	5,461,314	5,039,421
57	4,544,492	4,225,634	5,535,042	5,140,210
58	4,589,936	4,295,357	5,609,765	5,243,014
59	4,635,836	4,366,230	5,685,497	5,347,874
60	4,682,194	4,438,273	5,762,251	5,454,832
61	4,729,016	4,511,505	5,840,041	5,563,928
62	4,776,306	4,585,945	5,918,882	5,675,207
63	4,824,069	4,661,613	5,998,787	5,788,711
64	4,872,310	4,738,529	6,079,771	5,904,485
65	4,921,033	4,816,715	6,161,847	6,022,575
66	4,970,243	4,896,191	6,245,032	6,143,027
67	5,019,946	4,976,978	6,329,340	6,265,887
68	5,070,145	5,059,098	6,414,786	6,391,205
69	**5,120,847**	**5,142,573**	**6,501,386**	**6,519,029**
70	5,172,055	5,227,426	6,589,155	6,649,410
71	5,223,776	5,313,678	6,678108	6,782,398
72	5,276,014	5,401,354	6,768,263	6,918,046
73	5,328,774	5,490,476	6,859,634	7,056,407
74	5,382,061	5,581,069	6,952,239	7,197,535
75	5,435,882	5,673,157	7,046,095	7,341,485
76	5,490,241	5,766,764	7,141,217	7,488,315
77	5,545,143	5,861,915	7,237,623	7,638,081

Perusal of this spreadsheet affirms similar time frames, once the growth rate differential is consistent at whatever rate of growth (or contraction) is projected. Thus the robustness of the HYMOC model is affirmed. This graph provides a visual confirmation of the veracity of this formula and a similar outcome occurs when the Natural Log formulation is deployed, with a convergence timescale of just over one year earlier, *i.e.* toward the end of 2073.

In his determination of city size, urban growth and optimality, Alonso's (1971) use of a micro-economic-type formulation and his accompanying graphical format of Figure 7 was posited without the subsequent near-four-decade hindsight which urban economists can now utilise in viewing that pioneering analysis. The major observation might conclude that in considering the impressive size-difference and growth of the world's cities over a 40-year almost parallel time horizon, as researched by Henderson

and Wang (2007), the 1971 model's X-axis population has become elasticated in a right-hand direction. Accordingly, the indicative 100,000 population-level for inflection point A in 1971 (together with that of points B to E, likewise) is likely to have increased considerably. This would indicate that the minimum population threshold at which urban agglomeration commences is probably close to the 200,000 population level, today.

Figure 7: The Benefits and Costs of City Size:



Alonso (1971)

Source: Balchin et al (2005: 43)

MB = Marginal Benefits
MC = Marginal Costs
AB = Average Benefits
AC = Average Costs

BIBLIOGRAPHY

Alonso, W (1971). *The Economics of Urban Size*, Regional Science Association Papers. Vol. 26, 1971

Balchin, PN, Kieve and Bull (1995). *Urban Economics and Public Policy*, London: Palgrave Macmillan

Bannon, MJ, Eustace, JG and Power, M (1977). *Service-Type Employment and Regional Development* National Economic and Social Council No. 28

Bannon, MJ and Bradley, B (2007). *Planning Modern Ireland,* Dublin: UCD Planning, University College Dublin

Buchanan, Colin & Partners (1969). *Regional Studies in Ireland*, An Foras Forbartha – The National Institute for Physical Planning and Construction Research, Dublin

Central Statistics Office (2007). Volume 1: Census 2006: *Population Classified by Area*, issued on 26th April, Stationery Office, Dublin – see Table 7, p 119 accompanying Map 1 in Appendix

Central Statistics Office (2005). Regional Population Projections 2002-2021

Central Statistics Office (2009). Regional Population Projections 2006-2026

Clinch, P, Convery, F, Walsh, B (2002). *After the Celtic Tiger – Challenges Ahead*, Dublin: O'Brien Press

ERDO (1985) The Eastern Regional Development Organisation, Dublin

European Commission (1999). *European Spatial Development Perspective: Towards Balanced and Sustainable Development of the Territory of the European Union*, Luxembourg: Office for Official Publications of the European Communities

Futures Academy (2008). *Twice the Size: Imagineering the Future of Irish Gateways*, The Futures Academy, Faculty of the Built Environment, Dublin Institute of Technology

Gleeson, AM, Ruane, F and Sutherland, J (2006). *Public Policy, Sectoral Specialisation and Spatial Concentration: Irish Manufacturing 1985-2005*, Paper presented to the Statistical and Social Inquiry Society of Ireland on 23rd February, 2006

Hall, P and Pain, K (2006). *The Polycentric Metropolis*, London: Earthscan

Henderson, JV (2000) *The Effects of Urban Concentration on Economic Growth*, National Bureau of Economic Research, Inc., Working Paper 7503.

Henderson, JV and Wang, HG, (2007). *Urbanisation and city growth: The role of institutions,* Regional Science and Urban Economics, Vol. 37, Issue 3, May 2007, pp. 283-313,

Kautonen, M, Kolechmainen, J and Sorarauta, M (2003). *Tampere City-Region, Finland*: *Learning from Competitiveness and Inclusion?* Research Unit for Urban and Regional Development Studies, University of Tampere, Finland

Krugman, P (1991). *Cities in Space: Three Sample Models,* NBER Working Paper 3607, USA: M.I.T

Krugman, P (1991). *Increasing Returns and Economic Geography*, USA: M.I.T

McCreevy, C (2003). *Budget Speech - Decentralisation*, Government Stationery Office, Dublin

Morgenroth, E (2008 Draft). *Exploring the Economic Geography of Ireland*, JEL Classification: R12, R14, R30, ESRI, Dublin

National Economic and Social Council (2008). *The Irish Economy in the Early 21st Century*, NESC No. 117, June 2008

National Spatial Strategy (2003). DoEHLG, Dublin

Norton, K (2008). An honours undergraduate thesis comparing Cork and Tampere, Dublin Institute of Technology

O'Leary, E (ed.), (2003). *Irish Regional Development: A New Agenda,* Dublin: The Liffey Press

Parry's Valuation Tables (1964). London:The Estates Gazette

Regional Planning Guidelines, (2004). Regional Planning Authorities and Department of the Environment, Heritage and Local Government

Robert-Nicoud, F (2006). *Agglomeration and Trade with Input-Output Linkages and Capital Mobility*, Regional Studies Association, *Spatial Economic Analysis*, Vol. 1, No. 1, pp. 101-126: June 2006, ISSN: 1742-1772, New York: Routledge

Stafford, P (2005). *The Polycentric Metropolis*, London: Earthscan Publications

Whitaker, TK (1958) *Economic Development*, Government of Ireland, Dublin

Williams, B, Hughes, B and Shiels, P (2007). *Urban Sprawl and Market Fragmentation in the Greater Dublin Area,* Society of Chartered Surveyors (SCS) Housing Study (2007)

Zoellick, RB, (2009). *Reshaping Economic Geography – World Development Report*, The World Bank – The International Bank for Reconstruction and Development, Washington, DC

MAPS

MAP 1: Map showing GDA, RoS, Cities and 34 Towns >10,000 population; 1-34 towns in descending size order.

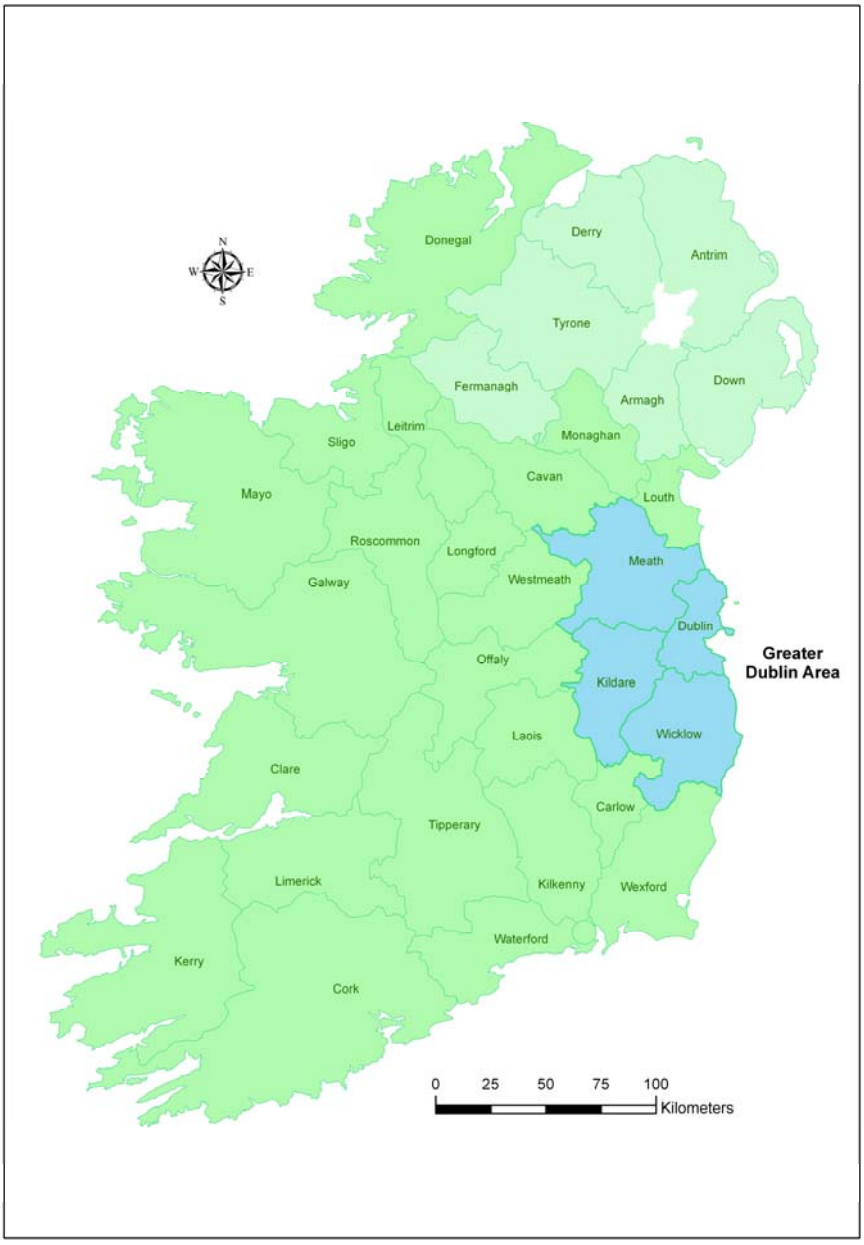
Source: **CSO 2006 Census, Volume 1, Table 7, page 119.**

City and Town Schedule:

Table 7 Persons in each town of 1,500 population and over, distinguishing those within legally defined boundaries and in suburbs or environs, 2002 and 2006

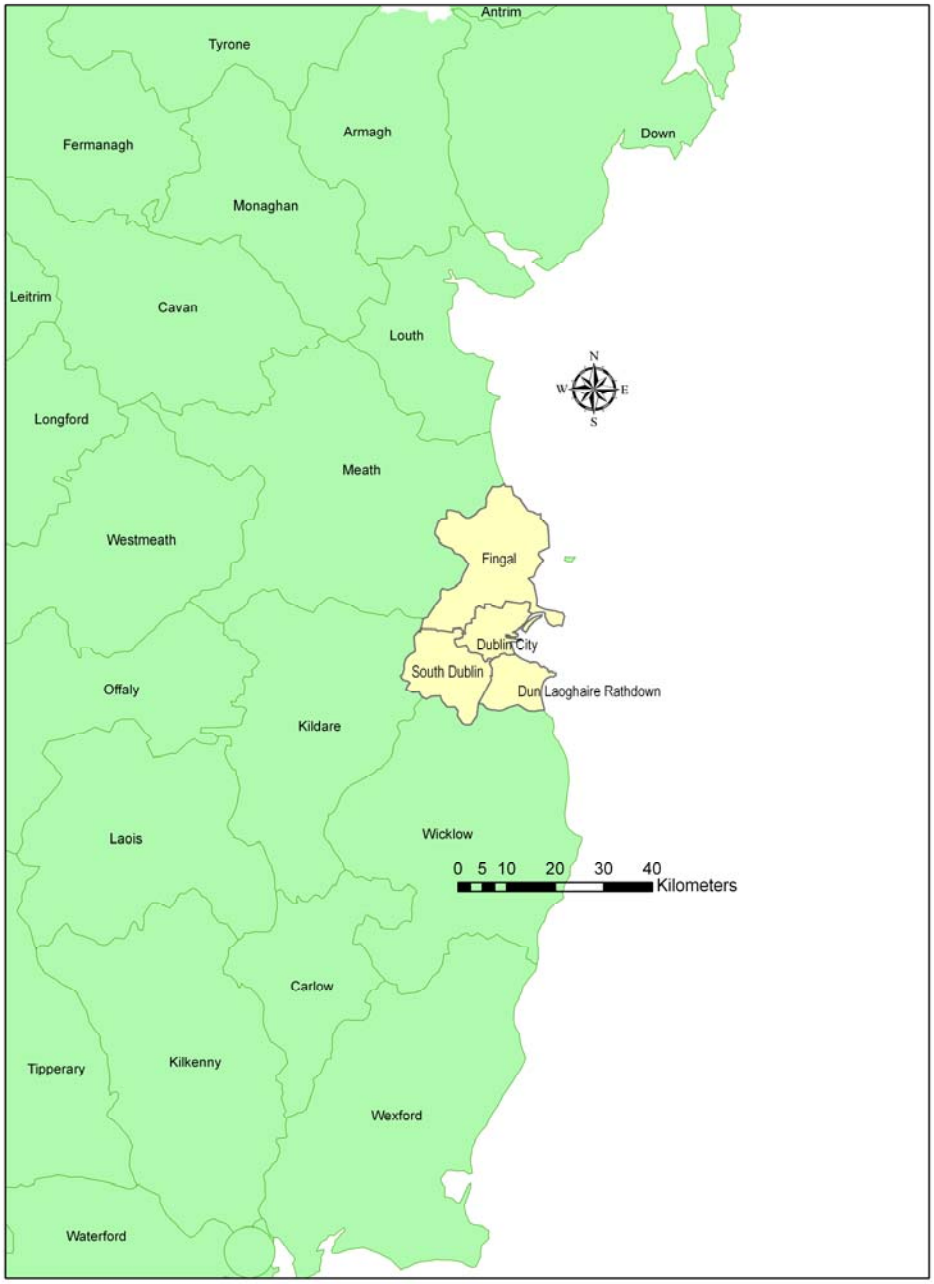
Town	Total population (including suburbs or environs)		Population within legally defined boundary		Population of suburbs or environs		Percentage change in total population 2002-2006
	2002	2006	2002	2006	2002	2006	
Greater Dublin Area	1,004,614	1,045,769	495,781	506,211	508,833	539,558	4.1
Other Cities	386,136	403,083	287,511	290,119	98,625	112,964	4.4
Cork City	186,239	190,384	123,062	119,418	63,177	70,966	2.2
Limerick City	86,998	90,757	54,023	52,539	32,975	38,218	4.3
Galway City	66,163	72,729	65,832	72,414	331	315	9.9
Waterford City	46,736	49,213	44,594	45,748	2,142	3,465	5.3
Towns 10,000 population and over	551,863	615,925	360,419	386,027	113,085	140,151	11.6
Drogheda	31,020	35,090	28,333	28,973	2,687	6,117	13.1
Dundalk	32,505	35,085	27,385	29,037	5,120	6,048	7.9
Swords	27,175	33,998	–	–	–	–	25.1
Bray	30,951	31,901	26,244	27,041	4,707	4,860	3.1
Navan (An Uaimh)	19,417	24,851	3,406	3,710	16,011	21,141	28.0
Ennis	22,051	24,253	18,830	20,142	3,221	4,111	10.0
Tralee	21,987	22,744	20,375	20,288	1,612	2,456	3.4
Kilkenny	20,735	22,179	8,591	8,661	12,144	13,518	7.0
Carlow	18,487	20,724	13,218	13,623	5,269	7,101	12.1
Naas	18,288	20,044	18,288	20,044	–	–	9.6
Sligo	19,735	19,402	18,473	17,892	1,262	1,510	-1.7
Droichead Nua	16,739	18,520	15,749	17,042	990	1,478	10.6
Mullingar	15,621	18,416	8,824	8,940	6,797	9,476	17.9
Wexford	17,235	18,163	9,449	8,854	7,786	9,309	5.4
Letterkenny	15,231	17,586	7,965	15,062	7,266	2,524	15.5
Athlone	15,936	17,544	7,354	14,347	8,582	3,197	10.1
Celbridge	16,016	17,262	–	–	–	–	7.8
Clonmel	16,910	17,008	15,739	15,482	1,171	1,526	0.6
Balbriggan	10,294	15,559	6,631	6,731	3,663	8,828	51.1
Malahide	13,826	14,937	–	–	–	–	8.0
Leixlip	15,016	14,676	15,016	14,676	–	–	-2.3
Portlaoighise	12,127	14,613	3,482	3,281	8,645	11,332	20.5
Killarney	13,137	14,603	12,087	13,497	1,050	1,106	11.2
Greystones	11,913	14,569	10,303	10,112	1,610	4,457	22.3
Tullamore	11,098	12,927	10,270	10,900	828	2,027	16.5
Carrigaline	11,191	12,835	–	–	–	–	14.7
Castlebar	11,371	11,891	10,287	10,655	1,084	1,236	4.6
Arklow	9,993	11,759	9,955	11,712	38	47	17.7
Cobh	9,811	11,303	6,767	6,541	3,044	4,762	15.2
Maynooth	10,151	10,715	–	–	–	–	5.6
Ballina	9,647	10,409	9,478	10,056	169	353	7.9
Mallow	8,937	10,241	7,091	7,864	1,846	2,377	14.6
Wicklow	9,355	10,070	7,031	6,930	2,324	3,140	7.6
Midleton	7,957	10,048	3,798	3,934	4,159	6,114	26.3

MAP 2: Showing counties of Ireland – Republic and Northern Ireland.



Note: Location of County Louth within the Dublin – Belfast Corridor

MAP 3: Showing the four "Administrative Counties" of Dublin



MAP 4: Showing Belfast and Derry

MAP 5: Showing all towns (> 1,500 population)