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GDP and City Population in the Development Performance of City Structures

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Abstract:

A city structure is defined as an evolutionary process determined by its network of functional activities; relationships; capital and knowledge flows which influence its growth and density as it transitions through a series of development stages. The purpose of this research paper is to present the major findings of GDP and City population key drivers in city structure development and provide an evaluative framework and tools. This research focuses on the evolution and development performance of city structures. The evaluative framework (trajectory analysis and compositional aspects of city structure population) and tools (e.g. velocity and economic resilience) are used to examine city structure development performance where GDP and city population synergise and potentiate effects. A fundamental premise for this research is that cities undergo various transitional phases of development and develop at different rates of growth. Ideally a city aspires to remain functionally viable, resilient and dynamic as part of its evolution. City structures are impacted by events (macro/global and country/city) and structural changes. This continuum of city development is nurtured through a dynamic range of forces, influences and a host of networked activities and interactions. The paper aims to provide insights into the development performance of city structure phenomena and suggests how it can be used to better inform stakeholders' decisions and direct structural change on the development of cities.

Keywords:
City structure, GDP, city population, trajectory analysis, compositional aspects, velocity, acceleration, economic resilience, development performance, transitional phases of development, rates of growth, events, structural changes and city structure phenomena.

1) Introduction:

The purpose of this paper is to present the major findings of GDP and City population as key drivers in city structure development. These findings provide the ability to develop an evaluative framework and tools to assess the development performance of city structures. GDP and City Population are two in a wider series of key drivers separately examined in a doctoral thesis.

The paper includes aspects of urban geography and its related categories (e.g. historical, economic, population, planning and quantitative geography (Pacione 2003)).

Four key terms need to be defined:

City Structure: *A city structure is an evolutionary process determined by its network of functional activities; relationships; capital and knowledge flows which influence its growth and density as it transitions through a series of development stages*.

City structures comprise different stages of development – early emerging, emerging, maturing, mature, obsolescence - decline and obsolescence - re-growth.

Physical configuration is not intended to be discussed in this paper as the focus is on the current phase of city structure evolution – knowledge based technologies. This examines networks of functional activities, relationships; capital and knowledge flows. It moves away from the traditional "physical form based" definition of city structure (Black & Katakos 1987).

Economic Resilience: *Economic resilience refers to cities that have a relatively diversified economic base and are able to withstand macro events and/or external influences showing adaptability and responsiveness to changes*.

In this research, Economic Resilience measures the responsiveness of economic prosperity relative to city structure population and is calculated by dividing the GDP velocity by the Population velocity

Economic resilience has the "*capacity to anticipate and respond to major transformations running from global to local scales*" (Douglass 2000). Cities with low/poor economic resilience and poor development performance also create other undesirable effects such as uneven and socially inequitable development, urban sprawl, traffic congestion, poor health, limited access to basic amenities and infrastructure and under utilise capital and resources.

City Structure Development Performance: *Development performance is defined as the manner in which a city structure fulfils and evolves/develops around its functional networks*.

This approach relies on a multi-disciplinary and integrated assessment of a city structure's productivity, capacity, innovation and adaptability. Key drivers such as GDP and City Population can be used to measure these aspects.

City Structure Population: *Measures the total population attributed to that city based on each country's census statistical definition (Oxford Economics) or urban agglomeration over 750,000 people (United Nations)*.

2) Literature Review:

a) City and City Structure

In arriving at what constitutes a city, the literature review revealed an extensive range of definitions and theories. Historically the popular term of "city" tends to be regarded as a subjective representation of the physical form, its functionality and its associated perceptions (Bacon 1978; Krier 1979; Lynch 1960; Mumford 1968).

However recent literature has increasingly focused on the city as a node or a critical meeting place where a wide range of social, political, economic and other activities take place that enables a city to be connected within a wider regional/global network (Castells 2004; Friedmann 2002; Fujita, Krugman & Venables 2001; Sassen 2001; Scott 2001; Taylor 2004).

For the purposes of this research, a City Structure addresses the network of functional activities; relationships; capital and knowledge flows and not the physical configuration.

b) Overview of Formation and Evolution of City Structures

The driving force that separated the city from secondary meeting places such as villages, communes, etc was the higher order level of commerce that took place (Taylor 2004). Historically the formation and development of cities relied on commerce and trade. Settlement patterns were located around trade activities on main caravan/highway routes and sea ports (Benevolo 1980; Morris 1994). This was driven mostly by merchants, traders, industrialists, entrepreneurs and patrons/investors (Benevolo 1980; Fletcher 1938; Pacione 2003).

There are four distinct phases of evolution in cities (**Figure 1**). Each of these phases traces the history of the urbanisation process and represents a successive wave of knowledge/technological and economic progress which drives city structure development (Allen 2004; Beall & Fox 2009).

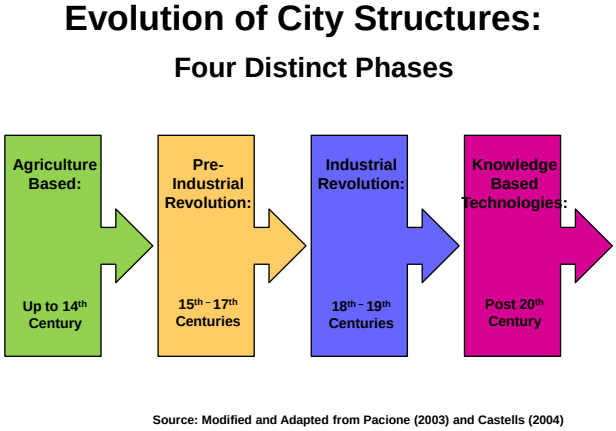

Figure 1: Evolution of City Structures

The first three phases are widely discussed and advocated by Pacione (Pacione 2003) whilst the fourth phase advocated by Castells (Castells 2004) is based on the preposition of knowledge generation and space information flows. Cities enable a greater concentration of resources and activities which allows some cities to evolve into knowledge efficient and innovation systems for transmitting different kinds of knowledge and knowledge interactions (Metaxiotis, Carillo & Yigitcanlar 2010) through industry clusters (Blakely & Bradshaw 2002; Saxenian 1996) and their regional/global networks (Fujita, Krugman & Venables 2001; Scott 2001; Storper 1997).

c) City Structure Development as a Process

City structures evolve from a continual, dynamic and complicated process of activity generation and interaction. Economic, commercial, political and social activities have always driven the city formation process. However emerging trends such as the greater connectedness to global information intensive functions, engendering a greater capacity of knowledge generation and global competitiveness and a greater awareness of the needs of the city's inhabitants are playing an increasing role in shaping the city development process. City structures can be regarded as self organising systems which permit a process of "self-correction" (Allen 2004). Various mechanisms within key sectors (economic, governance, social and environment) are in turn driven by activity and feedback through key drivers and indicators. This makes a city structure a complex, adaptive system.

d) City Population as a Key Indicator

City population can be used as a strong indicator to quantify a city structure's level of development rather than being primarily based on the concept of urbanisation. The disadvantage of using urbanisation is that once a city transitions along the later stages of the Urbanisation Curve, it approaches the terminal stage (around 70-75% of the total population) and significant growth is limited (Brunn, Williams & Zeigler 2003; Pacione 2003). Whilst the urbanisation levels measure the growth in urban areas relative to the total population, growth in city structure populations is a better indicator for city structure development because it explicitly tracks the number of inhabitants in city structures alone. City populations specifically reflect/influence responses to ready access to information and capital networks, opportunities and amenities which affect the development of city structure phenomena.

Urbanisation is the growth of urban areas that results from primarily rural migration to cities and also a suburban concentration in cities (UN-HABITAT 2008). An interesting approach was taken in examining the relationship between urbanisation and urban sustainability, developing a methodology and a model for evaluating sustainable urbanisation for a case study of four medium-sized Chinese cities between 1995-2000 (Shen et al. 2012). In this research, Shen et al determined if the urbanisation process is consistent with sustainable development principles and developed a "*sustainable urbanisation elasticity coefficient*" which could be defined by two parameters - urbanisation velocity and urban sustainability velocity (Shen et al. 2012).

Research into city population agglomerations, urbanisation and urban development trends has been extensively undertaken and support city populations as a key indicator (Beall & Fox 2009; Beall, Guha-Khasnobis & Kanbur 2010; UN-HABITAT 2008; United Nations 2013; World Bank 2008).

It has been effectively argued (Turok & Mykhnenko 2007) the main indicator of urban change is **city population change** because it is an important consequence of and influence on urban and economic conditions. In examining city populations, it is possible to determine different trajectories of change, a consistent pattern of slowdown in the population growth rate, the significance of the city size and that city growth rates no longer relate to urbanisation.

e) Key Drivers

Key drivers were broadly categorised into four sectors - Economic, Governance, Social and Environment. These key sectors are often discussed in government policies regarding cities and their development.

There are a wide range of complex factors that drive the development performance of city structures. However for the purposes of this paper, we will concentrate on GDP (Economic Sector) and City Population (Social Sector).

Economic aspects form a fundamental cornerstone in driving the development performance of city structures (Beall & Fox 2009; Kim & Short 2008; Montgomery 2007). Economic activity dominates the development of city structures where capital, resources and knowledge are concentrated offering inhabitants a greater number of jobs, higher wages, a wider and better range of infrastructure and amenity and other benefits (Allen 2004; Glaeser 2008). GDP is a measure of economic production within a city or country and relates to the majority of indicators selected in the City Structure Critical Indicator Matrix.

f) Development of Research

Contextually, the significance of a macro event such as the Global Financial Crisis (GFC) highlighted the precarious nature of some cities. For cities in decline or transitioning into a state of obsolescence, the GFC served to precipitate their downfall. For example, cities such as Detroit, Athens and Budapest are in a state of decline primarily because they have hit a significant economic impasse and inhabitants are either leaving the city to find better opportunities elsewhere and/or the city is unable to offer strong economic prospects and therefore attract new workers and residents.

There is merit in further examining development trends/trajectories of city structures through population changes. The approach adopted by Shen et al (Shen et al. 2012) is interesting and raised the question of whether this rate of change approach could be similarly applied to city structure population velocity and some key economic development indicators. However Shen et al limited their research to urbanisation and did not examine rates of change within urban agglomerations and the limitations associated with city structures reaching the terminal stage. Therefore in this study, city structure population is used rather than urbanisation levels.

It is also advocated there is strong merit in further examining the concepts of velocity (GDP and city population) and economic resilience because the development of city structures is a dynamic process. It is also important to assess other compositional indicators of population (net migration, tertiary education attainment, etc) to obtain a more comprehensive profile of a city structure.

With regards to the interplay of GDP and City Population in the development of city structures, links have been established. Where more developed cities suffer "*economic distress and population loss*", there are other booming cities which experience "*fast population growth and economic prosperity*"; in contrast, "*mega cities in the developing world...experience large population gains without the rapid economic growth needed to support the increased population*" (Kim & Short 2008).

GDP and City Population were selected because they are universal concepts, data is accessible and they provide a quick comparative analysis between countries and cities. The two key drivers reflect market response to Governance, Economic, Social and Environment influences e.g. political stability, the attractiveness of the investment climate, regulatory transparency, access to skilled labour.

In summary, research will be conducted by examining development trends in velocity and economic resilience with respect to GDP and City Population together with some compositional aspects of city structure population (composition indicators, magnitude, density and benchmarking development trajectories) to evaluate how these collectively describe the development performance of city structures.

3) Data and Methodology:

a) Research Design:

The research design (**Figure 2**) starts with an input of the two drivers (GDP and City Population) to undertake two key analyses (City Structure Development Performance Trajectory Analysis and Compositional Aspects of City Structure Population Analysis) to produce outcomes that explain City Structure Development Performance.

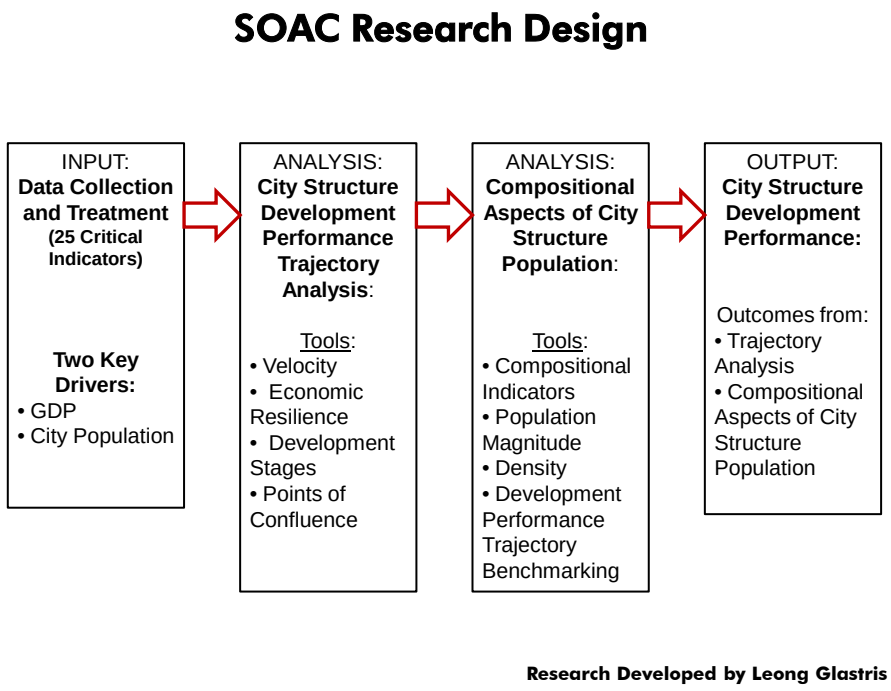

Figure 2: Evolution of City Structures

b) Research Methodology:

The methodological approach develops an evaluative framework and tools for city structure development performance. The process involves:

i) **Data Collection and Treatment Input:** Driver data was collected, compiled, converted, transposed, screened, checked, etc. prior to the analysis stages.

ii) **City Structure Development Performance Trajectory Analysis:** Oxford Economics data was used for the six key Cities (Sydney, Guangzhou, Shanghai, Bangalore, Detroit & New York) in a range of calculations using Gross Domestic Product (GDP) and Population (POP). These calculations and analyses included:

- **Velocities** to examine the change in GDP and POP over time;
- **Economic Resilience** which measured the responsiveness of economic prosperity relative to city structure population and is calculated by dividing the GDP velocity by the Population velocity.
- **City Structure Development Stages:** The historical annual average Population Velocity was calculated for both Oxford Economics and United Nations datasets and compared to evaluate if aspects of city development stages could be quantified. Similarly, the historical annual average Economic Resilience was then calculated for the period 1981-2012 for the Oxford Economics dataset and compared to evaluate if aspects of city development stages could be quantified.
- **Points of Confluence:** An analysis of historical annual averages for Population Velocity and Economic Resilience was plotted to provide a comparison to further evaluate and quantify city structure development stages.

iii) **Compositional Aspects of City Structure Population:** For the 6 key cities, in addition to the analysis outlined above, compositional aspects of city structure population were assessed in order to evaluate how these collectively shape the development performance of city structures. Where pertinent, this was compared against some cross reference cities.

- **Compositional Indicators:** Trends in population density, net migration, total dependency ratio and completed tertiary educational attainment were briefly examined in terms of how they impact city population.
- **Population Magnitude, Density and Development Performance Trajectory Benchmarking**: A comparison of population magnitude, density, population velocity and economic resilience was undertaken and Shanghai was cited as an example of how future development performance could be benchmarked against historical performance.

c) City Selection:

Data was collected for the following six cities and their four respective countries listed in **Table 1**:

City:	Country:	Indicative Development Stage:
Bangalore	India	Early Emerging
Guangzhou	China	Emerging
Sydney	Australia	Maturing
New York	United States of America	Mature
Detroit	United States of America	Obsolescence - Decline
Shanghai	China	Obsolescence - Re-Growth
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Table 1: Key Cities

The six cities above provide a reasonable cross section of city structure development performance at different development stages. The cities were classified into indicative development stages to facilitate analysis and to examine if there are common development performance characteristics. These key cities form part of a broad geographic representation.

d) Data Sources:

Data was sourced from both primary and secondary database sources. These sources include the United Nations, World Bank and Demographia. Where there was insufficient economic data at a city level, customised data for City Total Population and GDP was obtained from Oxford Economics.

e) Data Limitations:

Data limitations included difficulties in:

- Obtaining accurate data;
- Obtaining consistent and reliable data over a significant time series (ideally 20-60 years);
- Obtaining data at a country level and at a city level for a wide range of cities; and
- Different data assumptions and their methodologies from a range of data sources.

Data was compiled from multiple sources; transposed, converted, interpolated; data was updated for each of the indicators in the 31 cities between 1950-2013/2100 for cross referencing purposes.

The data was reasonably reliable given the use of four key data source providers with strong reputations for developing robust research methodologies and for providing reasonably accurate, reliable, timely and consistent data.

In terms of different data assumptions and methodologies, data sources were selected on the basis of strong research credibility (widely recognised and accepted methodology); ability to provide both longer term historical and forecasted trend data; ability to compare assumptions and methodologies in order to select the most appropriate data, etc. Individual country bureau of statistics and/or agencies providing an individual data set for a city/country were avoided as it was preferred to use one single data source to ensure consistent, transparent treatment of assumptions and methodology for each indicator/data set.

It should be noted that where customised data from Oxford Economics was obtained and due to the unavailability of some data at a city level, state or province level data was provided as the next discrete unit level. For example, city level data for Bangalore and Mumbai was unavailable because the *Office of the Registrar General and Census Commissioner India* does not publish data at a city level. Therefore Oxford Economics provided state level data respectively for Karnataka and Maharashtra. Similarly Provincial Level Municipality data was provided for Shanghai and Sub-Provincial City data was provided

for Guangzhou. Where required this was taken into account and noted in the analysis. In comparison United Nations City Population data is based on city urban agglomerations of over 750,000 inhabitants (United Nations 2013; United Nations Department of Economic and Social Affairs 2011) and the UN data methodology and limitations have been documented (Beall, Guha-Khasnobis & Kanbur 2010; United Nations 2013; United Nations Department of Economic and Social Affairs 2011).

4) Results:

a) Key City Overview:

In evaluating development performance trends, there are two key types of events and structural changes that impact cities.

- **Events:**
  The first are macro/global/trans-regional events (e.g. 1930s Great Depression, World War I and II and the 2007-2009 Global Financial Crisis) which led to systemic ramifications globally. The second type refers to country/city specific events such as government political regimes (e.g. Communist Cultural Revolution, etc) or where location specific/localised events (e.g. Olympic Games) may impact on a city structure's city population and GDP.

  In the following analyses, some of the macro/global/trans-regional events can be identified across the six cities examined through signature characteristics such as a large amplitude, aftershocks and/or lag responses.

  Identifying country/city (unique/idiosyncratic) events for each city falls outside the immediate scope of this research.

- **Structural Changes:**
  Another consideration is the impact of underlying structural changes on the economy over a long period of time (e.g. waves of technological innovation, impact of globalisation).

  Evaluating structural change is important, particularly for government and policy strategists wanting to improve a city's output and productive capacity. However the downside of poor development performance has long term consequences. Ghost cities in China's Kangbashi New District and Ordos were constructed in order to drive economic and property development but currently do not have the underlying demand to support development sustainably in the short-medium term (Miller 2012):

It is noted the timeframe for the analyses covers up to 33 years and covers events, structural changes as well as several business/economic cycles. Subsequently development performance determinants such as velocity and economic resilience can more accurately gauge a city's response to macro/global events, city/country specific events and assess longer development trajectories.

In assessing longer development trajectories, future performance can be benchmarked against historical performance and provide a better understanding of the impact of future macro/global events on a city structure's future development performance.

Using a common, integrated evaluative framework, enables a quick, like-for-like comparison across cities in different development stages and geographic regions.

b) City Structure Development Performance Trajectory Analysis

I. GDP and Population Velocity

i) Gross Domestic Product (GDP) Velocities (**Figure 3**) varied markedly. Key cities were all adversely affected by the Global Financial Crisis (2007-2009). A notable example - New York is a global financial centre and took the hardest GFC hit with the tumble of major global investment banks where GDP velocity was severely impacted. Over a longer timeframe, New York's GDP velocity has historically averaged US$16,000M pa. Detroit with its dwindling car manufacturing base and economic woes has struggled along with the lowest average velocity of US$900M pa. Sydney with its diversified financial base and its well regulated banking system has been relatively stable with an average velocity of US$4,000M pa. In Bangalore, velocities averaged US$3,600M pa. Not surprisingly, Chinese high economic growth cities such as Guangzhou recorded an average velocity of US$7,400M pa and Shanghai an average velocity of US$8,800M pa.

From the analysis of these key and cross reference cities over a 33 year timeframe, emerging, early emerging and obsolescence-re-growth cities tended to have relatively higher GDP velocities which reflect their early growth/re-growth stages. In comparison, the more developed maturing and mature cities had lower economic growth rates and relatively lower GDP velocities whilst obsolescence-decline cities had low economic growth and tended to have the lowest GDP velocities.

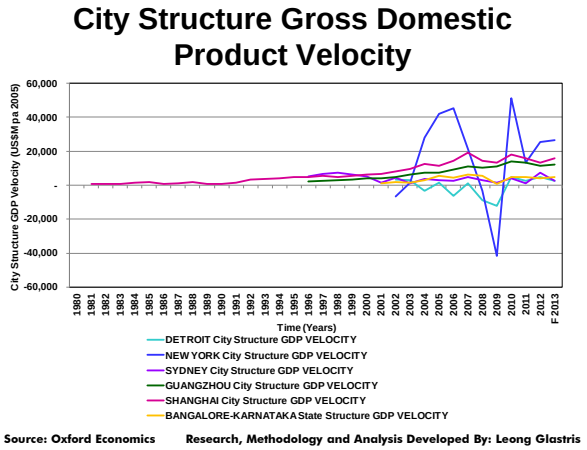


Figure 3: City Structure GDP Velocity

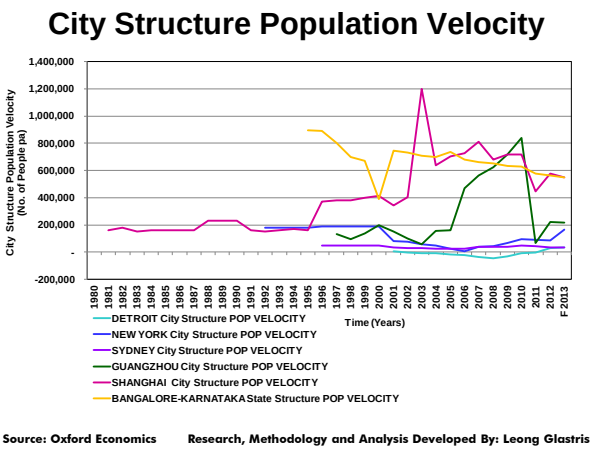
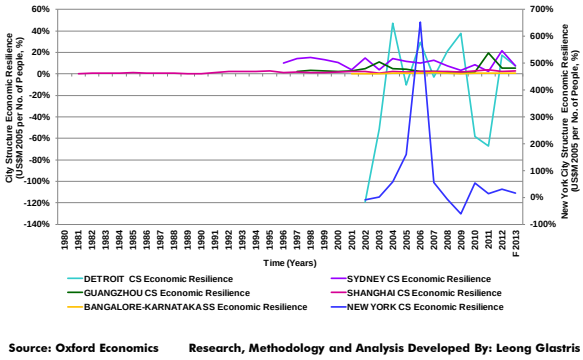


Figure 4: City Structure POP Velocity

ii) **Population (POP) Velocities** (**Figure 4**): the largest fluctuations occurred in Bangalore (Early Emerging stage), Guangzhou (Emerging stage) and Shanghai (Obsolescence - Re-Growth stage). The overall city population velocities have trended upwards for Guangzhou and Shanghai as urbanisation levels rise and more people flock to the cities for better employment and standard of living prospects. Bangalore-Karnataka state has shown an overall downward trend as Bangalore's dominant IT sector comes into maturity and strong growth and employment prospects ease for residents and workers. New York (Mature stage) has seen a prolonged dip/hollowing out in its population velocity (2000-13) attributed to existing residents and workers and new migrants locating to other cities for better employment opportunities – this was further exacerbated by the employment fallout from the GFC. Sydney has exhibited a relatively stable city population trend given the relatively less adverse GFC impacts sustained. For cities in Obsolescence - Decline, Detroit's population velocity has been in the death knell zone recording negative velocities – Manchester and Budapest exhibited a similar trend. The city of Detroit recently filed for bankruptcy and with diminishing employment opportunities and city service provisions, many people are leaving to pursue better opportunities elsewhere.

Similar to the GDP velocity trends, early emerging and obsolescence-re-growth cities recorded relatively high population velocities in light of their early growth/re-growth phases. The more developed maturing and mature cities had lower population velocities with the exception of mega cities such as New York and Tokyo with their significantly large population size. Obsolescence-decline cities tended to record the lowest population velocities. Again, this trend generally held true when tested across a wide range of cross reference cities and the population velocities tended to be more pronounced when comparing mega cities (e.g. New York and Shanghai) of over 20M people.

Key City Structures:
Economic Resilience



Source: Oxford Economics Research, Methodology and Analysis Developed By: Leong Glastris

Figure 5: City Structure Economic Resilience

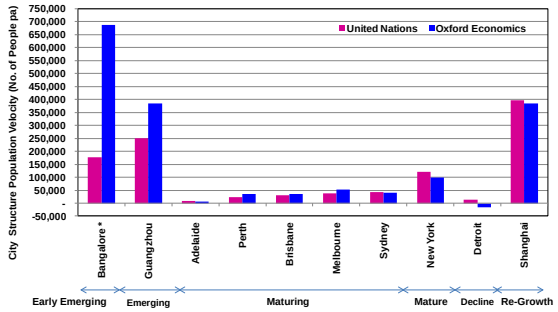
II. Economic Resilience

City Structure Economic Resilience (**Figure 5**) measures the responsiveness of City Structure's Economic prosperity relative to Population (i.e. GDP Velocity / POP Velocity). During 1980-2010, the analysis showed **Obsolescence - Decline** cities e.g. Detroit, Manchester and Athens tended to exhibit greater fluctuations, a slower response/lag time and prolonged periods of negative economic resilience when impacted by a macro event such as the GFC – these cities demonstrated a low negative resilience historical averages. In contrast, cities regarded as **Maturing** (Sydney, Berlin and Toronto) and **Mature** (New York, London, Paris and Tokyo) tended to have higher/high resilience and were able to more rapidly bounce back from the GFC – here amplitudes tended to be relatively large and periods of negative resilience tended to be shorter/short.

c) City Structure Development Stages and Points of Confluence

To provide an indicative gauge of **City Structure Population Velocities**, a historical annual average was calculated for each of the key cities in 1980-2010 for the United Nations dataset and was cross checked against the Oxford Economic dataset. This provided a cross sectional snapshot to determine if there were discernible city structure development stages and trajectories (**Figure 5**). Cities regarded as **Early Emerging** (Bangalore), **Emerging** (Guangzhou) and that underwent an **Obsolescence - Re-Growth** (Shanghai) recorded the highest Population Velocities. In contrast, **least Maturing** (Adelaide) and Obsolescence – **Decline** (Detroit) cities had average velocities below 14,000 people per annum. More **established Maturing** cities (Sydney and Melbourne) averaged 43,400 and 38,200 people per annum. **Mature** cities (New York) still recorded high population velocities of around 120,700 people per annum. If the City Structure was considered a Megacity (City population of more than 20 Million (UN-HABITAT 2008**)**), these velocities were more pronounced in light of the significantly higher population figures. When compared across a wider sample of cities, these trends remained applicable.

City Structure Population Velocities: 1980-2010



Source: United Nations & Oxford Economics
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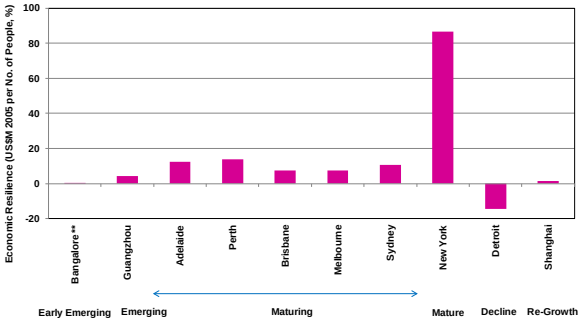
Figure 6: City Structure Population Velocities

City Structure Economic Resilience: 1980-2012 Historical Annual Average



Source: Oxford Economics
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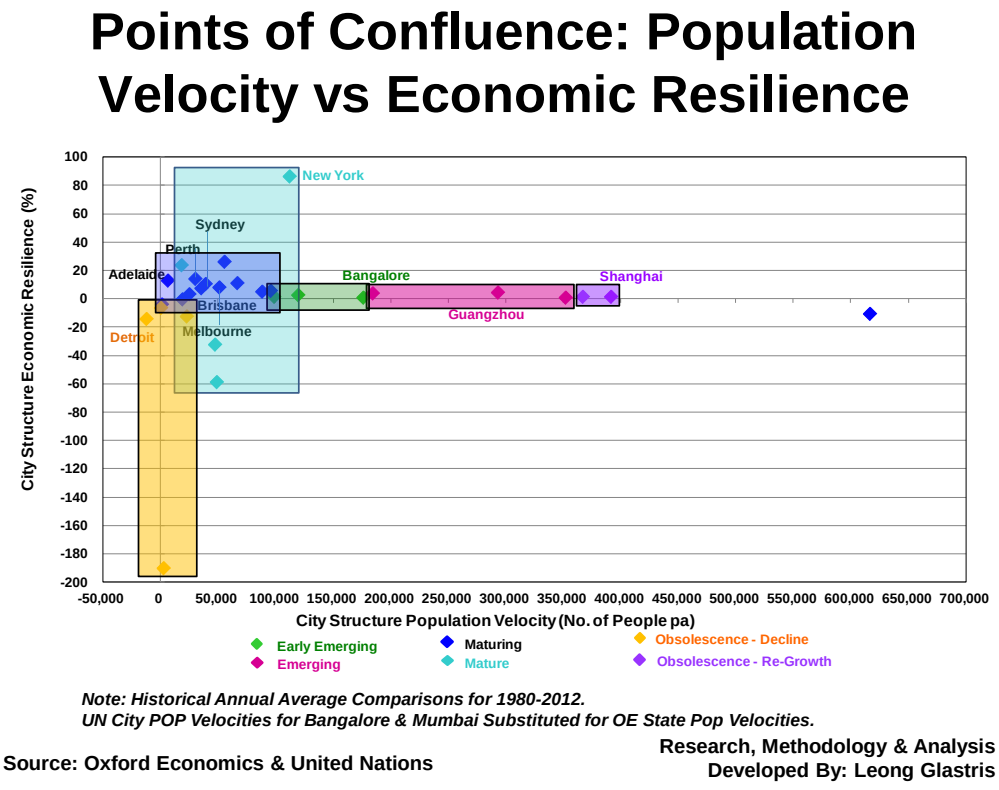
Figure 7: City Structure Economic Resilience

In examining **City Structure Economic Resilience**, a historical annual average was calculated for each of the key cities between 1981-2012 using the Oxford Economics dataset. This also provided a cross sectional snapshot of discernible city structure development stages and trajectories (**Figure 5**). The least economic resilient city structure was Detroit with a historical average of -14% but when compared to other **Obsolescence – Decline** cities, was not as extreme as Manchester (-190%). **Early Emerging** (Bangalore), **Emerging** (Guangzhou) and **Obsolescence – Re-Growth** city structures tended to average positive small economic resilience numbers of around 1-4%. **Maturing** (Sydney) and **Mature** (New York) city structures exhibited greater resilience and responsiveness at 10% and 86% respectively.

The points of confluence graph (**Figure 8**) was used to plot Economic Resilience against Population Velocity to better evaluate and quantify city structure development stages and common characteristics. Data for 31 cities was plotted to more accurately define the city structure development stage parameters. **Obsolescence – Decline** city structures (Detroit) by virtue of their lower Population Velocities and negative Economic Resilience levels were contained within the lower left of the chart, formatted as an orange box. **Maturing** (Sydney) and **Mature** (New York) city structures were positioned further along to the right because of their higher Population Velocities and wider amplitude (i.e. greater responsiveness) on the Economic Resilience axis – formatted as blue and turquoise boxes respectively. Whilst **Early Emerging** (Bangalore), **Emerging** (Guangzhou) and **Obsolescence – Re-Growth** (Shanghai) city structures had higher Population Velocities, they were less able to respond/adapt and were confined to a relatively narrow Economic Resilience band – respectively formatted as green, pink and purple boxes.

Based on the sample cities analysed, the following can be inferred:

- **Obsolescence – Decline** city structures tend to have historical average economic resilience figures that are predominantly negative;
- **Maturing** and **Mature** cities do exhibit negative economic resilience but show an adaptive capacity to bounce back relatively quickly from the adverse impact of a macro/global event. Cities such as New York recorded a larger amplitude but recovered quickly over a shorter period of time compared to **Obsolescence – Decline** city structures such as Detroit, Athens and Manchester which take a longer time and more fluctuations to recover from the aftershocks of the GFC.



Note: Historical Annual Average Comparisons for 1980-2012.
UN City POP Velocities for Bangalore & Mumbai Substituted for OE State Pop Velocities.

Source: Oxford Economics & United Nations

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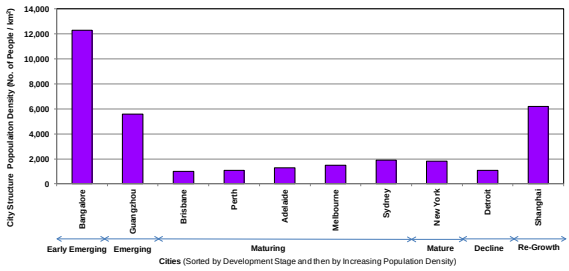
Figure 8: City Structure Points of Confluence

d) Compositional Aspects of City Structure – Building a Comprehensive Profile

Further analysis was undertaken on the compositional aspects of City Structure to build a more comprehensive profile of the individual city structures – these comprised Compositional Indicators; Population Magnitude, Population Density and benchmarking Population Velocity and Economic Resilience performance.

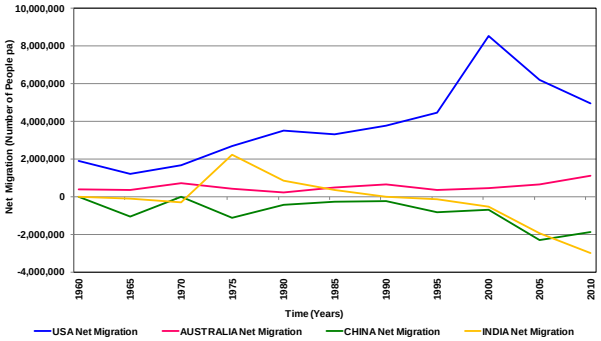
Compositional Aspects: City Structure Population Densities



Source: *Demographia*

Figure 9: Population Densities

Compositional Aspects: Net Migration

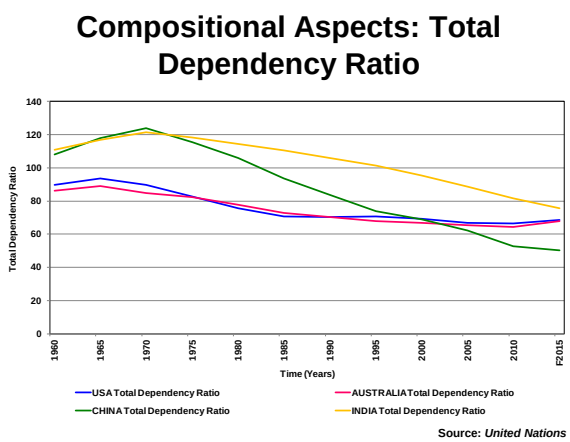


Source: *World Bank*

Figure 10: Net Migration

With regards to **compositional indicators**, city structure and country level indicators were used to build a better understanding of the population demographics. For the purposes of this paper, whilst three of the four indicators selected are at a country level (due to an absence in city level data), larger issues affecting migration; health; ageing and education are often formulated at a national government policy level.

In this instance, **City Structure Densities** (**Figure 9**) Bangalore, Shanghai and Guangzhou had the highest densities as at 2012. In terms of **Net Migration** (**Figure 10**) up until 2012, migration levels have been on the rise in the USA, relatively stable in Australia and generally on the decline in China and India – these trends have clear impacts on city population levels. The **Total Dependency Ratio**, TDR, (**Figure 11**) not only reflects the age composition of the population but also the potential economic and social burden placed on those in the workforce supporting the young and elderly demographic segments – as the ageing demographic becomes the dominant segment in USA, Australia and China, the TDR has turned around and started to rise, only India has a larger segment of younger workers to support the young and elderly segments. An increasing TDR also adversely affects future economic capacity and prosperity unless the fertility rate rises and skilled migration is used to supplement the existing workforce. **Completed Tertiary Educational Attainment** (**Figure 12**) is an important indicator for future economic productivity and prosperity and as countries/cities move towards knowledge based industries which require higher level problem solving and lateral thinking skills from highly educated workers. According to the World Bank, whilst the levels are rising, the USA and Australia have a significantly higher attainment level compared to China and India. Further improvements in Tertiary Education completions will be required to transition the majority of China and India's workforce from manufacturing and low level service jobs to knowledge based jobs.



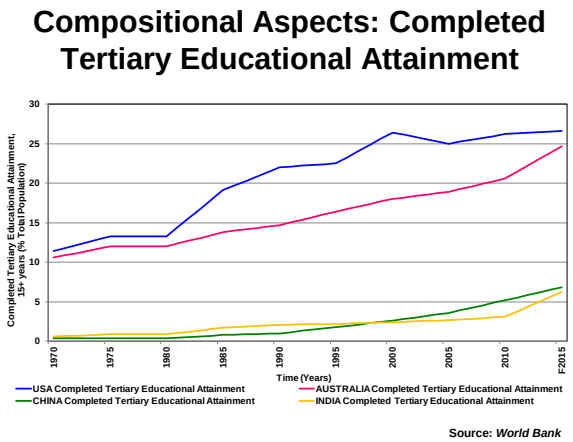


Figure 11: Total Dependency Ratio

Figure 12: Completed Tertiary Education Attainment

Other compositional aspects of City Structures are compared in **Table 2**. Whilst growth rates have been evaluated, it is also important to note the **Population Magnitude** to assess if growth levels are coming off a low base or whether the city structure has Megacity status – in this instance, both New York and Shanghai qualify as Megacities. **Population Density** provides insights into how tightly packed people are inhabiting their city; the reliance of using mass transit or public transport system to move residents, workers and visitors in, out and around the city; and the capacity to absorb higher population levels in conjunction with evaluating existing and future land, housing, infrastructure and amenity capacity levels.

Compositional Aspects of City Structures:				
City Structure	**Population Magnitude[1] as at 2012** (M, No. of People)	**Population Density[2]** (No. of People / km^2)	**Population Velocity[3,4] as at 2013** (No. of People pa)	**Economic Resilience[3,4] as at 2013** (%)
Detroit	4. 6	1,100	33,500	7.2
New York	20.8 Megacity	1,800	163,900	16.3
Sydney	4.7	1,900	33,400	7.7
Guangzhou	11.6	5,600	218,300	5.6
Shanghai	21.6 Megacity	6,200	548,700	2.9
Bangalore	9.3	12,300	549,000	0.9
Sources: United Nations[1], Demographia[2], and Oxford Economics[3], Research, Methodology & Analysis Developed By: Leong Glastris[4]				

Table 2: Compositional Aspects of City Structures

Both **Population Velocity** and **Economic Resilience** can also be used to provide useful benchmark information about historical and future city structure development performance i.e. development trajectories. For example, Shanghai has a historical average Population Velocity of around 397,900 people pa (1980-2010) but in 2015-2025, this forecasted average is expected to trend significantly higher at 590,000 people pa and as its workforce and residential population learns to adapt and become more responsive; its Economic Resilience is expected to significantly improve from 1.5% to 24.1%.

5) Application: City Structure Development Performance

In developing an integrated framework and tools to evaluate city structure development performance, the following has been advocated using the two key drivers, GDP and City Population:

- Assessment of development performance ideally 20-60 years provides a reasonable period to capture city/country events, several business/economic business cycles and gauges how well a city responds to a macro/global/trans-regional event as well as structural changes.
- A better understanding of historical and future development performance trends by undertaking the two key analyses – Development Performance Trajectory Analysis and Compositional Aspects of City Structures.
- Key stakeholders (e.g. Government departments and agencies, lobby and community groups, transnational corporations, investors, planners, developers, etc) can use the proposed research to rationalise and identify challenges and growth opportunities.
- Use of the proposed research enables key stakeholders to have a common platform for use in discussions, further investigations and contributions.

6) Conclusion:

The development of city structures is a dynamic and complex process and an adaptive system responding to a wide range of influences and events. In the evaluative framework and tools for investigating the development performance of city structures, GDP and City Population have proven to be strong key drivers. Together they form part of a retinue of Governance, Economic, Social and Environment drivers as a multi-disciplinary approach to evaluating city structure development performance in the doctoral research.

Development Performance Trajectory Analysis for Velocity and Resilience provides useful insights into historical and future development performance of city structures and the development stages of city structures. Points of confluence (Economic Resilience versus Population Velocity) can be used to evaluate and quantify city structure development stages and common characteristics.

The analysis of Compositional Aspects of City Structure Population builds a more comprehensive profile of a city structure where compositional indicators and development performance benchmarking give insights into the future productivity, capacity and resilience of city structures.

The proposed evaluation framework and tools can be used by stakeholders to better understand city structure phenomena and to improve the future development performance of city structures.

7) References:

Allen, P.M. 2004, ***"Cities and Regions As Self-Organizing Systems: Models of Complexity"***, 2nd ed (Pbk) edn, Taylor and Francis, Amsterdam, Netherlands.

Bacon, E. 1978, ***"Design of Cities"***, 3rd edition edn, Thames and Hudson, London, UK.

Beall, J. & **Fox,** S. 2009, ***"Cities and Development"***, 1st, Paperback edn, Routledge New York, USA.

Beall, J., **Guha-Khasnobis,** B. & **Kanbur,** R. (eds) 2010, ***"Urbanization and Development: Multidisciplinary Perspectives (Unu-Wider Studies in Development Economics)"***, 1st, Hardcover edn, Oxford University Press,, New York, USA.

Benevolo, L. 1980, ***"The History of the City"***, 1st edition edn, Scholar Press, London, UK.

Black, J.A. & **Katakos,** A. 1987, '"***Optimisation Methods and the Classification of City Structure: Theory and Empirical Testing***"', ***"Environment and Planning B: Planning and Design"***, vol. 14, no. 1, pp. pp 93-107.

Blakely, E.J. & **Bradshaw,** T.K. 2002, ***"Planning Local Economic Development: Theory and Practice"***, 3rd edition edn, Sage Publications, Inc; , London, UK.

Brunn, S., **Williams,** J.a. & **Zeigler,** D. (eds) 2003, ***"Cities of the World: World Regional Urban Development"***, 3rd ed. edn, Rowman & Littlefield Publishers, Lanham Maryland, USA.

Castells, M. 2004, ***"The Information Age: Economy, Society and Culture Volume 1 - The Rise of the Network Society"***, 2nd (pbk) edn, vol. Vol. 1, Blackwell Publishing, Carlton, VIC Australia.

Douglass, M. 2000, '"***Globalization and the Pacific Asia Crisis —Toward Economic Resilience Through Liveable Cities***"', *Asian Geographer*, vol. 19, no. 1-2, pp. 119-37.

Fletcher, B.S. 1938, ***"A History of Comparative Architecture On The Comparative Method For Students, Craftsmen and Amateurs"***, 10th Revised Ed (Hbk) edn, B.T. Batsford, London, UK.

Friedmann, J. 2002, ***"The Prospect of Cities"***, 1st edn, University of Minnesota Press, Minneapolis, MN USA

Fujita, M., **Krugman,** P. & **Venables,** A. 2001, ***"Spatial Economy: Cities, Regions and International Trade"***, 1st edn, MIT Press, Boston USA.

Glaeser, E.L. 2008, ***"Cities, Agglomeration, and Spatial Equilibrium (The Lindahl Lectures)"***, 1st, Hardcover edn, Oxford University Press, New York, USA.

Kim, Y.-H.a. & **Short,** J.R. 2008, ***"Cities and Economies"***, 1st edn, Routledge, New York, USA.

Krier, R. 1979, ***"Urban Space"***, Academy Editions, London UK.

Lynch, K. 1960, ***"The Image of the City"***, 1st edition edn, MIT Press Boston, USA.

Metaxiotis, K., **Carillo,** F.J. & **Yigitcanlar,** T. 2010, ***"Knowledge-Based Development for Cities and Societies: Integrated Multi-Level Approaches"***, 1st ed (pbk) edn, Information Science Reference, New York USA.

Miller, T. 2012, ***"China's Urban Billion: The Story Behind the Biggest Migration in Human History (Asian Arguments)"***, 1st ed. edn, Zed Books, London, UK.

Montgomery, J. 2007, ***"The New Wealth of Cities: City Dynamics and the Fifth Wave"***, 1st ed (pbk) edn, Ashgate Publishing, Hampshire UK.

Morris, A.E.J. 1994, ***"History of Urban Form: Before the Industrial Revolutions"***, 3rd ed (pbk) edn, Pearson Education Limited, London UK.

Mumford, L. 1968, ***"The City in History: Its Origins, Its Transformations, and Its Prospects"***, 1st ed (pbk) edn, Mariner Books, London UK.

Pacione, M. 2003, ***"Urban Geography: A Global Perspective"***, 2nd ed (Pbk) edn, Routledge, New York, USA.

Sassen, S. 2001, ***"The Global City"***, 1st ed. (pbk) edn, Princeton University Press, Princetown, USA.

Saxenian, A. 1996, ***"Regional Advantage: Culture and Competition in Silicon Valley and Route 128"***, 1st Ed (pbk) edn, Harvard University Press, Cambridge USA.

Scott, A.J. (ed.) 2001, ***"Global City-Regions: Trends, Theory, Policy"***, 1st ed. edn, Oxford University Press, Oxford UK.

Shen, L., **Peng,** Y., **Zhang,** X. & **Wu,** Y. 2012, '"***An Alternative Model for Evaluating Sustainable Urbanization***"', *Cities*, vol. 29, no. 1, pp. 32-9.

Storper, M. 1997, ***"The Regional World"***, 1st ed. (pbk) edn, Guildford Press, New York USA.

Taylor, P.J. 2004, ***"World City Network: A Global Urban Analysis"***, 1st (pbk) edn, Routledge. , New York, USA

Turok, I. & **Mykhnenko,** V. 2007, '"***The Trajectories of European Cities, 1960–2005***"', *Cities*, vol. 24, no. 3, pp. 165-82.

UN-HABITAT, U.N.H.S.P. 2008, ***"State of the World's Cities 2010/2011 - Cities for All: Bridging the Urban Divide"*** no. ISBN: 978-1-84971-176-0 (Earthscan paperback), Earthscan, London, UK.

United Nations 2013, ***"World Population Prospects: The 2012 Revision"***, United Nations - Department of Economic and Social Affairs, Population Division, New York, USA.

United Nations Department of Economic and Social Affairs, P.D. 2011, *"Population of Urban Agglomerations with 750,000 Inhabitants or More in 2009, by Country, 1950-2025 (thousands)"*, in UN-HABITAT (ed.)2011 Revision edn, New York, USA viewed 14/4/2012, <http://esa.un.org/unpd/wup/CD-ROM/Urban-Agglomerations.htm>.

World Bank, T. 2008, ***"World Development Report 2009: Reshaping Economic Geography"*** World Bank, The, Washington USA.