Investigating the malleable socioeconomic resilience pathway to urban cohesion: a case of Taipei metropolitan area

Tzen-Ying Ling¹

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Abstract

It is known that globalization has led first- and second-tier cities' urban restructuring trajectories, excreted pressures, and caused tremendous socioeconomic volatility. This resulted in marginalized communities in dire of social empowerment, employment structure variance, and industry sectoral adjustment. Moreover, recent successive climate and health crisis unfolded and affirmed the state of our urban incompetence to sustain socioeconomic resilience or otherwise; lacking swift responses in providing critical management and services, cities are facing multifaceted challenges. Urban well-being and resilience are at stake. Although the environmental and health dimensional effects are apparent, this study ascertains that the transept multi-scalar analysis within the urban socioeconomic structure is crucial in sustaining core resilience to foster health and well-being of the community. As an integral part of the investigation, the revised DPSIR assessment framework is applied to evaluate the sectoral shift; spatial structure disarray and urban codependence degree are examined within the Taipei metropolitan area (TMA), a medium size but densely populated metropolitan area in Taiwan. The place-based DPSIR analysis ascertained the states and impacts in TMA: (1) A population decline speeded the restructuring of the urban core, while the impact of demographic aging and shrinkage rate mandates proper management and planning responses to the decline process; (2) the socioeconomic state effect is determined but does not critically affect the periphery zone, while an uneven demographic shift within the urban core necessitates dynamic adjustment responses to appropriately provide intergenerational services; (3) the uneven sector redistribution stimulated the core's spatial and structural inter-dependency with peripheral zones, requiring governance with tighter cross-administration cooperation among respective public sectors; and (4) facing the sector/temporal and demographic pressure, urban cohesiveness in the TMA is greatly affected, which in turn disrupts the resilience pathway toward a cohesion. The study ascertained that the revised DPSIR framework could provide cities facing pressing socioeconomic drivers with effective analysis to allocate pressures, states, and impacts and formulate the necessary responses. To assure the socioeconomic resilience and urban cohesiveness, planning policy should carefully monitor and evaluate socio-demographic and sector redistribution factors to promote the urban resilience.

Extended author information available on the last page of the article

Keywords Urban structure · Socioeconomic effect · Taipei metropolitan area · Resilience pathway

1 Introduction

The current socioeconomic, environmental, political, and health instability in the urban areas conspired a relentless restructure cycles piled by a multitude of uncertainties and risks. Aside from impact of globalization and the digital revolution, sudden crisis like the recent pandemic considerably altered the socioeconomic structure, lending to more urban inter-dependencies, more considerable complex structure, and rapid acceleration of change in most sectors within our societies and economies (UN 2020); in light of such impacts, cities must learn to cope and overcome critical, emergent uncertainty and threats to attain resilience and accommodate the inhabitants. As the urbanization continues, UN estimated that by 2050, two-thirds of the world population will be living in the urban area (UN 2020). Cities, then, must seize lead in driving economic growth, health, and social–culture morphosis (Ma et al. 2020; UN 2020; Meerow et al. 2019; da Silva et al. 2019; Zhang and Li 2018; Meerow et al. 2016; Lechner et al. 2016; Elmqvist et al. 2014; Storper 2013; Wink 2014; Castells 2011; Sassen 2009). This clustering effect of human activities overburdens the natural and social progressions, brings significant mutation to the socioeconomic dimension, and causes an increasingly polarized and spatial restructure in the urban system. Every so often, this process triggers unequal gentrification and segregation in communities and income groups, especially in the distribution of urban services, civic spaces, public health, and other essential amenities (Duggal 2020; Ling et al. 2020; Sharifi and Khavarian-Garmsir 2020; Ilgen et al. 2019; Quintana-Romero et al. 2019; Krefis et al. 2018; Ling and Lin 2018; Lechner et al. 2016; Vale 2014).

When facing unexpected challenges and threats, cities must incorporate resilience in the implementation of urban plans and policies to respond to shocks, stresses, and uncertainties (Ling et al. 2020; UN 2020; Meerow et al. 2019). For example, UN has already stressed that approximately 95% of COVID-19 cases have taken place in urban settlements, with over 1500 cities affected worldwide (UN 2020); therefore, any processional solution must substantiate the social, economic, health, and territorial facets (Sharifi and Khavarian-Garmsir 2020; Meerow et al. 2019; Urso et al. 2019; Sanches et al. 2018; Haase et al. 2014). The course of actions taken will trigger a complex urban–rural restructuring and poses numerous challenges for urban development, economic sustenance, and sustainable development agendas. Undeniably, it must accommodate and quickly integrate the sociospatial network through system interactions that acquire the exchange of materials, water, energy, capitals in many forms, and new thinking in public health and urban planning (Sharifi and Khavarian-Garmsir 2020; Ling et al. 2020). In broader patterns of urban change, notably increased segregation within cities and the impact of shifting patterns of work and consumption should be alerted (Hall and Burdett 2017). It is in this context that resilience debates increasingly focus on the relationship between development, socioeconomic transformations, adaptability, and empowerment (Ruiz-Mallen 2020; Ling and Lin 2018; Lechner et al. 2016). If successive sprawl and urbanization persist, intensifying the urban environmental pressure, the continuous dilapidation of the living conditions requires an introduction of an alternative model of urban development (Ling et al. 2020).

As multifaceted adaptive systems profess to foster the necessary capacity to resilience, they must disseminate into a complex sociological system and able to attain

sustainable management (Ruiz-Mallen 2020; Meerow et al. 2016; Arup 2014; Pickett et al. 2013). The community or society exposed to hazards or challenges must attain the capacity to resist, absorb, accommodate to, and recover from the effects of vulnerability, through the preservation and restoration of the key essential structures and functions (Sanchez et al. 2018; Ling and Lin 2018; Merow et al. 2016; Boyd et al. 2015; da Silva and Morera 2014; Schewenius et al. 2014; Froy et al. 2012). The need to secure adequate housing stocks, jobs, and urban services and the balance of these local conditions contributes to the resilience of the urban system. The social and economic institutions (both formal and informal) must efficiently respond to the external shocks and internal pressures in urban centers.

The resilience concept has been discussed broadly in the empirical contexts or including the implication to urban planning strategies (UN 2020; Sharifi and Khavarian-Garmsir 2020; Krefis et al. 2018). The urban systems where we live are characterized by a low level of resilience and, therefore, require synergistic actions for the enhancement and effectiveness of responses to stimuli and urban adaptation and mitigation (Moraci et al. 2020; UNISDR 2016). Facing rapid aging in many cities, the range of experiences associated with gentrification or lack of resilience has become exceptionally important given the emphasis in public policy on what has been termed “aging in place,” defined as helping people to remain “living in the same community, with some level of independence” (Buffel et al. 2019). It must maintain the necessary desired functions in the face of social and economic transformation to adapt to change and to respond accordingly to affirm for future adaptive capacity. Population density, necessary urban services, economic activities with diverse livelihoods, employment opportunity as well as solid urban administrative structure should be integrated in assessing resilience (ALNAP 2017); further, long-term mitigation and adaptation strategies to encounter social, economic, health, and environmental challenges should be taken account of (Ma et al. 2020; da Silva et al. 2019; Krefis et al. 2018; Ling and Lin 2018; Mehmood 2016).

Aside from the environmental and locational attraction, the convergence of urban economic activities propels the influx of new inhabitants to urban areas and solicits prompt responses and adaptation strategies to the growing anthropogenic transformations. In the process, cities could encounter adversities causing urban shrinkage, often characterized by the economic decline and population loss (Richardson et al. 2014). With such malleable traits, the high connectivity and flow, risks attached have been outstretched; urban areas become vulnerable to a range of foreseeable and unforeseeable threats from risks, infrastructural loading, and uneven demographic or sector shift (Sharifi and Khavarian-Garmsir 2020; Moraci et al. 2020). The infrastructural over-loading, uneven demographic, and sector distribution affect cities in attaining urban sustainability (UN 2020; Malliet et al. 2020; WEF 2017; UN 2015; Work Bank 2013). Significantly, the effects of demographic change and urban morphological transmutation remain a complex and multi-dimensional process, distressing the transitional course and disrupting the socioeconomic development restructuring sequence. Socially, exclusion in local communities and regions created mismatches in level of unemployment and skill necessary to perform these jobs, marginalizing the community at large, forming indiscriminate spatial and densely populated landscape constantly in the path of restructure. Economically, urban areas are no longer dependent on mass production or assembly lines and no longer necessary for labor-intensive industries (Churski et al. 2017; Frey and Osborne 2013; Phelps et al. 2006). This fundamental shift contributes positively to the service sector growth, reshape of the urban fabric, and, more importantly, generating new city structures or restructure (Deguchi 2017; Assuncao et al. 2015; Dejardin 2009; Fujita and Thisse 2004). The effect from firms’ choices and

employment trade-offs stimulated the agglomeration economies and affected the local labor markets, impacting the productivity and linkages toward the resilience.

Considering such events, urban and dynamic resilience offers multiple assessment for urban resilience; the strategies, assessment framework, and toolkits have been developed. These are operated to evaluate and determine urban social or economic resilience, adding indicators for composite indices with the aim to devise resilience strategies and planning policy options appropriate for a city (Wan et al. 2018). This study takes the DPSIR causal framework method (e.g., driver, pressure, state, impact, and response) to investigate the interactions between a multitude of driving forces, like society and the environment (EEA 2006). We empirically examined the onset of the urban restructuring process in Taipei metropolitan area (TMA); the correlation in the socio-temporal restructures is examined with the revised DPSIR (driver, pressure, state, impact, and response analysis) framework, focusing on the factorial change in the population and the sectoral employment, chiefly consisting of local service industry jobs. To allocate the pressure, state and impact of system restructure, the socio-temporal dimensional attributes are taken into factor; the assessment of Gini coefficient affirmed the restructuring and disparity effect in TMA core (Taipei, New Taipei, and Keelung City) from 2001 to 2016 (the prior industry and commerce census period). We determined that the sector/temporal state in the metropolitan exhibited a convergence in the service; the correlation of demographic change and tertiary sector employment is apparent with specialization coefficient analysis. The result shows the resilience capacity toward a cohesion within the TMA but diverges according to the dimensional dissimilarity in the processes of urban spatial stretching and structural interdependence. The paper is arranged as follows: Sect. 2 presents the study site, data, variables, and the empirical model. Section 3 presents the result, followed by Sect. 4 on the discussion, and Sect. 5 concludes.

2 Materials and methods

2.1 Study area

Taiwan was ranked 13th on the Global Competitiveness Report released in 2018, by the Geneva-based World Economic Forum. Taiwan is at the top of the World Bank's 10 countries most exposed to multiple natural hazards, exposing the country at the risk of multiple hazards. Taipei Basin is a naturally formed basin after long years of sedimentation (Taipei City Government 2014); Taipei City is the capital city, engulfed geographically by the regional cities of New Taipei and Keelung. TMA is loosely bounded by Taoyuan County and Hsinchu County, which could arguably constitute considered part of the metropolitan area but excluded in this study. Four principal rivers are in the Taipei Basin: Tamsui River, Keelung River, Dahan River, and Xindian River. Taipei, New Taipei City, and Keelung comprise the three primary cities of the Taipei metropolitan area (TMA) in Taiwan. (Fig. 1).

To expand the in situ (contextual) understanding in the TMA, we investigate the urban development, planning policy, and knowledge of the study site; Taipei metropolitan area justifiably comprises the most populated metropolitan area in the western corridor of Taiwan urban system. This belongs historically to the northern core of the western corridor of Taiwan. The urban agglomeration centered with Taipei, New Taipei, and Keelung City (TMA) has resulted into a megacity with a population of 6,850,000; this is comparable to

Fig. 1 Taipei metropolitan area (TMA), the core of the western corridor of Taiwan, comprises Taipei, New Taipei, and Keelung City and areas under flood and soil liquefaction risk (Source dmap.ncdr.nat.gov.tw and this study)

Hong Kong or Bangalore in India. Besides Taipei City itself, the Taipei metropolitan area consists of the townships and rural district jurisdictions of 1. Taipei City: 12 districts are designated metropolitan core; 2. New Taipei City: 29 districts which include Panchiao district with 550,000 persons and Oolai district with an area 55 times more considerable than Panchiao but only accounting for 5000 residents; 3. Keelung City: 7 districts on the eastern side of Taipei City, surrounded by New Taipei City on three sides, and the ocean on the eastern side of the city (Fig. 2).

Fig. 2 Population density in Taipei metropolitan area (persons/km²); Source DGBAS (1986–2016) and compiled by this study

Most urban centers in Taiwan are highly urbanized with high population density. The complexity of urban–rural shrinkage poses numerous challenges for industrial development, job creation, and sustainable development agendas (OECD 2012). This is seen in the post-industrial development in the Taipei metropolitan area, with a decrease or shrinkage in the supply of able workforce. Considerably, the declining birth rate has reduced the natural increase in population, signaling a spatial and demographic shrinkage condition affecting beyond the economic doctrine. Aside from the environmental risk, changes in the urban structure and uneven demographic fluctuations have led to shift in the population density (person/km²) from the period of 2003 to 2019 in the TMA; the shift is uneven and varies across the year, hence triggering the decision of the study site. The current urban planning attains to fully integrate the natural disaster management and spatial planning; unfortunately, there is minimum effort in the comprehensive cross-disciplinary coordination in the current urban governance.

From 2012 onward, Taiwan began to implement and assess the adaptation strategy to climate change; the disaster prevention policy proposal was titled “Resilient Cities under Extreme Disasters” by Ministry of Science and Technology, while Ministry of Interior had also promoted the concept of resilient community; however, most efforts concentrated on disaster prevention and lack the necessary attention on socioeconomic resilience as well as the needed budgets, plans, and project plan. Moreover, most implementation still needs to coordinate the numerous central and local agencies, making the efficient implementation difficult. Thus far, there has been nevertheless an urgent need for a coordinated effort from the public and private sector alike to formulate and implement adaptable measures to mitigate urban environmental and socioeconomic challenges.

2.2 The causal DPSIR framework for urban resilience

Cities adapt to change and rapidly transform systems that limit current or future adaptive capacity and provide insights mediating the complex socio-ecological systems and their sustainable management. The interdependence across spatial and temporal scales looks into the socio-temporal dimensional effect; this study proposes an all-inclusive structure framework, taking the driver, pressure, state, impact, and response, also known as DPSIR criteria, into the framework to determine the causal relationship between the socio-temporal environment and human activities (Ling et al. 2020; Ling and Lin 2018; Elliot et al. 2017; Patrício et al. 2016; Smith et al. 2016; Lewison et al. 2016; Meerow et al. 2016; Gari et al. 2015; OECD 2012). Measures to cope with urban stress and achieve the objectives of a resilience strategy concern various sectors and disciplines such as spatial planning informed to the reduction in land consumption and the development of large area, regional and provincial planning, the management of the vulnerability (Moraci et al. 2020; Urso et al. 2019). Significantly, resilience must incorporate the socio-ecological system within the urban development and mitigation strategies.

Urban resilience emerges as a complex and multi-dimensional process in need of governance and pre-amped planning; the aim is to secure the continuous provision for the livelihood of the population and to facilitate their ability to learn, adopt, and adapt, and increase the cohesiveness in the resilience buildup. Fostering resilient urban systems requires distinct measures of adjustment toward a desirable state; it operates in non-equilibrium and recognizes manifold transformative pathways (driver, pressure, state, and impact) that may achieve a suitable result; conceptualized as entities embedded in broader linkages toward

the desired anticipated state, resilience is usually predisposed by the “desirability” judged by the originators, who often become the sole beneficiary. They determine the agenda and prioritize the process, and the result may only benefit those few. The designated prioritized domains and sectors will vary according to the local contextual factors; the local temporal and spatial traits shape the urban socioeconomic, ecological, governance networks, or sub-systems. Certainly, factors that affect the livelihoods and capacities of the urban citizens should be considered (Urso et al. 2019; Beckers et al. 2018; Meerow et al. 2016; Chelleri et al. 2015; Pearson and Pearson 2014; Resilience Alliance 2007).

The axiomatic thinking holistically involves the socio-temporal drivers to the natural and human system into consideration; this posed a need to follow those pressures, thus needing assessment to act and to minimize or compensate those pressures and achieve the set goals (Elliott et al. 2017). The adaptive DPSIR (drivers–pressures–state–impact–response) approach adopts the assessment of the causes, consequences, and responses to change. The resilience capacity acquired maintains a temporal emphasis, contingent on whether the focus is on gradual or sudden pressure imposed on the state of the urban system. References are considered chiefly to the human/environment dimension that can be measured by their attributes. Impacts, however, reflect the changes in the intensity and functioning process of the socioeconomic state. Significantly, this framework was frequently adopted, within the human contextual perspective to evaluate the responses and changes incurred from the socio-temporal pressures. In this study, the DPSIR model’s parameters are defined as follows (Fig. 3):

The literature indicates multiple pathways to a resilient state, depicting the social, ecological, economical, or governance dimensions (Sharifi and Khavarian-Garmsir 2020; Wardekker 2018). Ultimately, the multi-scalar attributes trigger changes and transformation to the urban system (Moraci et al. 2020; Meerow et al. 2016; Chelleri et al. 2015). The causal DPSIR framework identifies primary drivers that generate a set of pressures impacting the current state, or persistence that settles into a new state or transitions (Ling and Lin 2018; Elliott et al. 2017). EEA (2007) considers the driving forces as “the social, demographic and economic developments in societies and the corresponding changes in lifestyles, overall levels of consumption and production patterns.” The technology-induced societal forces affect the human activities (population growth, social structure, and job opportunities). In turn, these drivers initiate relevant pressures and impacts (urban expansion and industry convergence), consequently tracing the pathway to resilience in each urban center. This assessment could aid cities to implement strategies to maintain or rapidly return to a preferred function provider status upon and after every disturbance event or pressure (Ling and Lin 2018; Smith et al. 2016; OECD 2012). The critical framework provides information and relationship to the causal DPSIR process as well as the effect of the responses (Fig. 3).

- *Driver (D)* Social, demographic, and economic factors affecting the urban system
- *Pressure (P)* The sector redistribution and demographic changes as pressure to the urban continuity–change process
- *State (S)* Economic/temporal and social structure shift modified the continuous or change the trend in the urban system.
- *Impact (I)*: The changes in urban socioeconomic structure increase the impacts on the residents’ livelihood (employment choices) and place attachment to the urban coherence.
- *Response (R)*: Actions were taken to respond to driver, pressure, state, and impact that builds skill.

Fig. 3 Key socioeconomic dimension and effect on the urban pathway to resilience. *Source* compiled and drawn by author

To comprehend the changes within, the drivers of social redistribution and economic factors come to play. The causal relationship triggers the socio-temporal shift as co-coupling influence toward urban resilience. The social dimension analyzes how demographic change can be uniquely determined at the local level: that of population trajectories and aging indexes as the economic opportunities for the silver sector and/or local services dedicated to the 65-and-over population; this is reflected both in the quantity and especially in the structure shift of employment in urban centers. Factors affecting the demographic development after the baby boom is characterized by accelerating population aging; the relatively considerable numbers of the baby boom come out of working ages, while the low fertility rate could not sustain a steady population share.

The decrease in demographic affects the social, education, and health service density; one by one, the changes influence the infrastructure, urban transportation demand, adequate housing stocks needed, and accentuate regional disparities as well as education opportunities (Mastroratti and Cavallo 2020; Mehmood 2016; Meerow et al. 2016; Dimian et al. 2016; OECD 2014, 2012; Venhorst 2012; Mantale et al. 2011). A higher socioeconomic condition could contribute to better social competitiveness and relates to maintaining high-quality human capital; with the increase in the elderly population, the tilt in service demand poses concerns about the social and economic sustainability in urban centers. Further, given that the aging process in the metropolitan proper continues, the demand for goods, services,

and resources must deal with swift structural change amid the demographic re-allocation. The spatial dimension has a noticeable centrality in social and recognition inequalities; this represents a powerful lever of fear and anger and, for example, finds a recognizable expression in the acts of vote and preference decisions (Mastronardi and Cavallo 2020).

The temporal dimension looks into the economic–spatial changes in the urban areas as they are no longer dependent on secondary sector's mass production base with expansive assembly lines; this represents that labor-intensive jobs are diminishing in scale of local growth by level of output, employment, population, and migration. This fundamental change contributes positively to the service sector growth, reshaping of the urban fabric; more importantly, it efficiently generates new urban structures as the causal effect of the job creation as the positive (negative) net employment adjustment converges or diverges (Mastronardi and Cavallo 2020; Deguchi 2017; van Dijk Edzes 2016). Edzes et al. (2015) found that regional factors receive significant impact on the decision whether to maintain education, and on the likelihood of getting a job (Venhorst 2013). The geographical concentration of education facilities could stimulate the likelihood of jobs. Certainly, the geographical density is positively associated with regional productivity and growth attributed to the regional knowledge stock (patent) and regional new firm formation. Specifically, it affects toward the service sector, demarcated by either the shrinking urban areas or by a population loss of more than 0.15% p.a. (Haasse et al. 2013). This framework aims to facilitate settlements to assess, adopt, and able to implement integrated actions toward resilience. We underscore the effect within the socioeconomic dimension in urban centers. By absorbing and accommodating extreme shocks without any significant change, city is able to create in a prompt manner toward the new socioeconomic structures to maintain the population activities expressed through the spatial density.

2.3 Analytical framework for socio-temporal urban resilience assessment

The resilience assessment framework proposed involves the DPSIR system to assess the socio-temporal factors. Mainly, the focus is on the drivers that prompt the changes in the urban system. The revised DPSIR (driver, pressure, state impact, and response analysis) framework engages the change in the population and the sectoral employment, by allocating the driver, pressure, state, and impact of restructure process. The temporal dimension investigates the changes through time as it becomes more unpredictable during the urban structural shift. This is achieved through employment of the locational quotient. The socio-temporal dimensional attributes are taken into the factor and the assessment of Gini coefficient. Employment workforce aging process and adjustment should consider the upgrade of necessary skills and demand for the workforce to acquire during the technological advancement process; at the same time, the retraining plans also must adjust accordingly. The decreasing birth rate and a soaring aging urban resident aided the emergent demand in allocation of services and infrastructure; in addition, migration triggers the net exodus of laborious working population, accelerating the process of decline in urban centers. The overall focus is on resource and allocation change as an input in the socio-temporal dimension of the urban continuity–change system (Fig. 4).

Other governance-related issues such as the need to better consider urban–rural linkages in urban governance and the desirability of strengthening global networks of cities that can facilitate experience sharing and mutual support have also been noted (Duggal 2020). The key issue brought forth, hence, remains on the urban resilience capacity changes within the socioeconomic state as the status of social and economic criteria is analyzed. The demographic

Fig. 4 An urban continuity–change system conceptual model indicating the linking and feedback between socioeconomic dimension toward the sector shift, spatial restructuring, and urban co-dependency capacity in the urban system. *Source* compiled and drawn by author

transitioning of the aging society and the sectoral and spatial restructure are accounted. The clustering of firms in space of the same or related industries can be deemed as the process of localization and urbanization economies (Mastronardi and Cavallo 2020; Beckers et al. 2018). As these industries agglomerate, the local labor markets in cities must examine both productivity impacts and linkages within the growth process (Zhang and Xie 2019; Venables 2007). A shift of employment distribution and the effect on the spatial sprawling or shrinkage is considered. From the impact position, we do not look for the population increase or decrease according to the sectors' employment opportunity within the urban centers; key issues like employment, disparity in regional development, and spatial restructure affect the cohesion of the urban center must be noted. The decline in the local population remains an early sign of urban structure change; the most critical strategy to mitigate the demographic shift would be precisely to expand the labor pool. Further, a widening gap in the female labor force participation rate or the aging sector remains crucial factors in this demographic change. To condense, we defined the two essential typological dimensions in the urban resilience table (Table 1) as:

2.3.1 Sector/temporal state

The indicators include the sector convergence/divergence and spatial expansion/shrinkage. The Gini coefficient of specialization is employed to determine the sector structure (Mastronardi and Cavallo 2020; O'Donoghue 2000). The higher the coefficient value (between 0 and 1), the higher the numerical value. This study denotes that the level or state is given a sign value as low (1) for coefficient value of 0 to 0.3, medium (2) for coefficient value of 0.31–0.7, and high (3) for coefficient value above 0.71 to 1.

2.3.2 Social (demographic) state

The indicators include median age/ageing population and labor pool diversification. For the median age/aging, it is given a numerical value of low (+1), medium (+2), and high (+3). For the labor pool diversification ratio, a numerical value of (1) is provided for service sector ratio higher than that of TMA and (–1) for lower than that of TMA,

Table 1 The socioeconomic dimension in the urban resilience assessment index. *Source* compiled by this study

Issues	State	Value
Sector/temporal state (Economic)	Sector/temporal convergence/divergence Method: Gini coefficient (1–3)	Low (1) for coefficient value of 0–0.3 Medium (2) for coefficient value of 0.31–0.7 High (3) for coefficient value above 0.71–1
Social criteria and structure state	Labor pool diversification ratio in service industry Method: median age/aging population (1–3) The age difference from one period to the previous period	Service sector ratio > TMA, value of 1 Service sector ratio < TMA, Value of – 1 Low difference (1) for median age differences Value 0–1 Medium difference (2) for median age differences value 1.1–2 High difference (3) for median age differences above 2
Urban cohesion Co-dependency state	Sector/temporal state + Social state	Low (+ 0 to + 1) for low balance and co-dependency Medium (+ 2) for average balance and co-dependency High (+ 3) for high balance and co-dependency

2.3.3 Urban cohesion co-dependency state

The indicators examine the component of socio-ecological/technical networks; this includes the temporal and spatial scales for the urban coherence. It is given a numerical value of low (+1), medium (+2), and high (+3).

Therefore, the assessment for the urban resilience is as follows (Table 1):

- The resilience of the urban center is measured in twofold, by the sector distribution within the economic dimension (convergence/divergence level (–)) and the population change through employment persons and aging factor (employment level (+ or –) and aging level (+ or –)). The resilience refers to the ability to be able to self-sustain the function of the urban system. However, the level is given a numerical value to represent negative or certain status needing attention. The numerical values correspond to the socio-temporal dimension in urban resilience, reflecting the economic structural change, and the social structure shifted level for a continuity–change capacity in the urban centers. This study assigned three states: negative (–1), ambivalent (+0), and acceptable (+1).
- *The labor pool indicators* comprised labor age and divergence in labor pool. These are given a numerical value of negative (–), ambivalent (+0), and acceptable (+1).
- *Urban resilience*: This study included the indicators of the sector distribution and population/demographic change. The levels are defined as low (+0), medium (+2), and high (+3). The urban resilience in this study is defined as the state in which urban centers and all its component of socio-ecological/technical networks span the temporal and spatial scales to maintain or rapidly return to a balance status for the urban coherence. The sustainable development and social responsibility remain the crucial strategic issues to assess, especially for firms across the sector distribution (Asuncao et al. 2015; Fiskel 2006), toward the assurance of subsequent resilience in the urban system.

3 Result

To identify how the metropolitan area performs, we define Taipei City as the core of the TMA, with New Taipei City and Keelung City as the neighboring cities comprising the metropolitan area. The result is divided into three sections. The first section shows the sector/temporal state in the metropolitan, followed by the social criteria and structure change; at that point, we analyzed the correlation of demography and tertiary sector employment and, lastly, the resilience capacity toward a cohesion within the TMA by the codependence correlation.

3.1 Sector/temporal state: the convergence/divergence

As the study result shows, the Taipei metropolitan sector exhibits a divergent pattern; the sectoral shrinkage happened in Keelung City; the increases are in Taipei and New Taipei City. The industry composition shifts to the tertiary sector. We observe that this development seems to continue, as demographic changes and rate are adjoined by an increase in

Fig. 5 Comparative coefficient of specialization—by geographical division of Taipei metropolitan area

Fig. 6 Taipei metropolitan service sector employment demarcations 2011–2015; *Source* Statistics DGBAS and compiled by this study

aging population, and signs of economic decline and job losses; the suburbanization and demographic shift are present in TMA.

From the Gini coefficient (Fig. 5), we observe a convergence of employment mostly in Taipei City, while New Taipei City maintained an even coefficient of 0.26. In 2011, Keelung City's Gini coefficient of 0.85 meant that the sectoral specialization presented a significant convergence, while the coefficient of 0.24 in Taipei and 0.57 in New Taipei exhibited stable level. The service sector exhibited a convergence toward Taipei City (Fig. 6), especially in the retail and trade and finance sectors.

The existence of specialized service sector employment coupled with an aging population compounded together as the decisive agent of change for the metropolitan area of Taipei. The correlation between tertiary sector development and population evolution in the TMA is obtained with Pearson correlation analysis within the tertiary sector employment ratio; with succeeding time frame population change, the correlation has been extremely significant for the tertiary sector. For employment of 2001, the correlation coefficient (R) is 0.43; the period of 2006 showed that the correlation coefficient (R) has been 0.53. Since 2011, the correlation coefficient (R) was 0.56. This denotes a slight increase from 2001 to

Fig. 7 Taipei metropolitan demographic demarcations 1996–2018; *Source* Statistics DGBAS and compiled by this study

Fig. 8 Taipei metropolitan area population median age shift 1996–2016. Computed in the period of 1996–2006; 2006–2011; and 2011–2016. *Source* Taiwan Ministry of Interior and compiled by this study

2011. Still, the correlation coefficient (R) shows a weak to moderate strength, which signifies there are inherently other factors that influence population growth or decline.

3.2 Social criteria and economic structure change

Demographic change, measured by the ratio of working-age population to the non-working-age population, as well as the number of colleges or higher graduate annually is extracted and compared within the population shift which depicts a rapid change from 1990 to 1996 and slowing down from the period of 2003–2007 to 1990–2018 (Fig. 7).

The population aging is measured as a decrease in the ratio of the working-age population to the non-working-age population; we considered the ratio of the population aged between 15 and 64 to the population below 15 years and above 65 years of age (UN Population Division 2002). This is defined as the potential support ratio. The overall aging pattern could be observed from Fig. 8, which shows that from the time of 1996 and 2016, Taipei metropolitan's population median age has risen, an increase in median age of 33–41 for New Taipei City, 32–39 for Taipei City, and 30–37 for Keelung City. The aging process indeed is happening in the Taipei metropolitan area.

In terms of education level, the statistic shows that the number of graduates for college level or above has more than double for the years 2005–2019, which are the years that the statistic was compiled by government. Clearly, Taipei metropolitan maintains the most significant concentration of higher education institutions, which in turn provide steady higher educated candidates to the labor market. For the three cities of Taipei metropolitan, the number of graduates for higher education is more than double for the period, which means that there are abundant candidates for the job market during the period (Fig. 9).

Fig. 9 Taipei metropolitan area population median; *Source* Taiwan Ministry of Interior and compiled by this study

3.3 Correlation of demography and tertiary sector employment

A high population growth implies that a younger-aged population exists and is determined by the analysis of the local tertiary sector employment and median age in Taipei metropolitan area (Fig. 10). Evidently, the hypothesis partially confirmed the development in New Taipei City, as the population growth of New Taipei City correlates with a younger average median age of the TMA and in accord with the time period in this study. New Taipei City's service sector ratio measured lower than the average ratio for the TMA; this could be argued as a result of the growth of the population which is directly untied to the higher service sector ratio observed. Taipei City, along with Keelung City, exhibited a higher median age than average and with a higher service sector ratio.

The median age Pearson correlation analysis (p) was performed on the cumulated dataset. The result shows that the correlation is stronger for the period of 1996–2001 and weaker for the period of 2011–2016 (Table 2).

For New Taipei City, the Pearson correlation between the median age and tertiary sector is 0.967; for Taipei City, the p value is 0.926; and for Keelung, the p value is 0.821. Service sector is dominant in the Metropolitan area; for the period of 1996–2006, the service sector only accounts for 43% of the total employment in New Taipei City, but for Taipei City, the ratio accounted for 81% and 75% for Keelung. For the period of 2006–2011, New Taipei City's tertiary employment rose to 51%, while Taipei City remained with a robust 83% and Keelung with a stable 75%. By the period of 2011–2016, New Taipei City's tertiary sector concentration has already climbed to 64%, which means that the manufacturing

Fig. 10 Service sector ratio comparisons within the TMA

Table 2 Median age Pearson correlation results

Median age Pearson correlation	2001	2006	2011
TMA (Taipei, New Taipei, Keelung City)	0.972	0.976	0.68

Fig. 11 Urban service sector employment assessments

Fig. 12 Sector-temporal/demographic assessments toward urban resilience in Taipei metropolitan area

employment has decreased; Taipei city's concentration has arrived at 88%, while for Keelung, most of employment comes from the tertiary sector, accounting for 99% (Fig. 11).

The Taipei's service sector ratio is set; the study obtained a result of New Taipei and Keelung's service sector ratio, which are below the core minimum. In Taipei City, the period of 2011–2016 exhibited population growth higher than TMA average; and at the same time, Taipei City shows the service sector ratio also higher than TMA average. However, New Taipei City consistently stayed even headed. From Fig. 12, we observed that New Taipei City exhibits a robust populating growth that is not highly related to the service sector growth; it relates to lower-than-average service sector ratio when compared to the TMA. Keelung City, however, exhibits a service sector ratio higher than the TMA average for the three-time period compared, though the population growth is lower than the TMA average.

The rising employment population reflects the growing sectors in the metropolitan area due to a boost in job opportunity, indicating the presence of sector distribution change. For the metropolitan Taipei, this trend can be observed first in New Taipei City, especially for the period of 2006–2011. A change in the growth of population in the metropolitan area is exhibited. A stable or even a slight decrease in the population, indicating a consequence of tertiary sector specialization, is exhibited for Taipei City. The population decline indicates the causal consequence of negative birth rates and net migration count; further, coupled with the increasing aging population in the coming decade, the demand for urban services and infrastructures should continue to drop. This will affect the economic productivity in the metropolitan area.

The sectoral shift does impact the land use in urban centers. As the tertiary sector convergence continues to be present, the land development in TMA concentrated on residential and mixed-use buildings. Most of the manufacturing buildings relocated to another region or to the border of TMA. The socio-temporal effect is measured through the sectoral/temporal and the social state level in the metropolitan area of Taipei (Fig. 13).

Based on the sector–temporal/demographic assessment, the sector convergence/divergence and spatial expansion/shrinkage effect in Taipei metropolitan area is indeed present. New Taipei City and Taipei City both scored 1.29, which meant a low-to-medium state of convergence/shrinkage rate. Keelung scored higher, with a numerical value of 1.58; this meant that Keelung’s convergence/shrinkage rate is higher than the other two cities in the metropolitan area. The sectoral/temporal convergence in Keelung City signals a need for the city to diversify the sectoral composition; a convergence toward a singular sector could cause an uneven distribution in the labor market, deterring the possibility for divergent sectoral mix within the urban boundary.

For the social state, we compared the labor pool ratio in the service industry and the median/aging age ratio. The TMA exhibits a bipolar state. New Taipei city scored a numerical value of -1 for the labor pool ratio, which means that the service sector population is lower than that of the TMA. Taipei and Keelung both scored a numerical value of 1 , which means that the service sector population is higher than that of the TMA. Concerning a median age/aging population assessment, the study compared the age difference from one period to the previous period. New Taipei city scored a numerical value of 0 , which is in part with the TMA; Taipei City scored a numerical value of 2 , reflecting a higher median age than the TMA average; and Keelung City scored a value of 1 , which is still higher than the TMA. Overall sector–temporal/demographic assessment exhibits a divergent pattern within the TMA. Taipei City needs to respond to the aging demographic, followed by Keelung, while New Taipei City has a -1 numerical value, reflecting a much younger demographic in the population; this is in part due to the out-migration from the urban core. Due to expansive new housing development in the area, younger population tend to move into New Taipei City due to lower housing cost and convenient public metro transportation. Keelung City, however, has much direct metro link, making the commute a time-consuming and a much harder feat.

3.4 Urban resilience and cohesiveness

The result for the urban resilience level in TMA exhibits a difference among the three cities. New Taipei City scored the lowest with a value of 0.29 ; this is followed by Keelung City with a value of 3.58 . Taipei City scored the highest with a value of 4.29 . This means

Fig. 13 Urban resilience levels in Taipei metropolitan area

that Taipei City exhibits the highest cohesiveness for resilience, followed by Keelung; New Taipei City has the lowest cohesiveness for urban resilience. The conditions in TMA show that labor population is not only tied directly to the coherent employment conditions but also to the capacity of industrial development differentials, leading toward the presence of tertiary sector convergence; this causes a decline for factories buildings in industrial zone and a boost for service facilities. The state in which TMA's socioeconomic networks span the spatial scales varies across the three cities; while the changes of employment opportunities affect the ability to self-sustenance to maintain a balance status, the aging population, sectoral redistribution, and population density change also affects the public facilities service capacity, such as education, health care, and local governance. Some primary schools in Taipei City encountered a sharp decline in a total students' count, followed by the secondary, and university students count. Further, the demand for senior care has been on the alert as well as the provision of job opportunities. Taipei City bears the greatest cohesion and resilience capacity; Keelung, being a port city, carries a specific employment source, which encourages either residents to live there, and work in the TMA or join the local workforce. New Taipei City, however, exhibited a disparate result, as the city accommodates many aging residents, while the younger population choose to live further south while working within the TMA. Therefore, New Taipei City's cohesion is much lower than the other two urban centers.

4 Discussion

4.1 The urban place: changes in structure composition

The multi-scalar scopes within the social, temporal, and relevant subsystems have ramification beyond the reach of the city proper. One of the essential urban characteristics like the spatial structure is represented through the urban economic concentration or also referred as convergence; this is exhibited through industry specialization, defined as the uneven distribution of activity as urban places are developed through the movement of population, industry, and capital. Issues of intense competition, knowledge, and technical skills acquired by the working residents can hinder or accelerate the restructuring process. A robust concentration of technical and higher education facilities tends to increase the likelihood of engaging people to attend or prepare for degree learning or job training; TMA has a higher prospect than other cities in Taiwan.

The concentration of the service industry in the Taipei Metropolitan exhibits a clear specialization in the tertiary sector. These firms constitute a localized industry interconnected with high information flows, regarding its regional economic structure, institutions, cultures, and histories. The smaller and independent service firms, characteristic of the industry makeup in Taipei Metropolitan, induce the rise of small establishments that are essentially being affected by the restructure process, essentially affecting employment growth, which is concentrated in the service sector, shapes the urban structure to concentrate toward the tertiary sector, and alters the composition of industries makeup within the TMA. Unlike industrial activities, services have few negative externalities and more modest space demands and, thus, are highly amenable to city center environments. The traditional expectation from the small to medium local businesses in previous growth time has been impacted and compromised by the globalized competition, between factors like advances of the technology and external corporate dominance. In this case, the three

administrative areas have yet to react on a proactive basis to the current change; to formulate the necessary policy and management toward this condition, it requires a cohesive action.

Noticeably, Taipei City exhibits the most robust resilience, followed by New Taipei City; Keelung City trails behind. The availability and development of skills in its workforce combine the employer vs. employee expectations and demand a transitional dynamic as well as an intense matching process in employment market; ultimately, it must adapt to societal and economic needs. Significantly, the academic opportunity and incentive present are crucial in providing qualified labor pool. Since the tertiary industry such as retail industry is known to merit the value of seniority and the extensive knowledge intensity, the need to adapt to an aging or increase in women workforce can present a severe challenge to the industry. Obviously, certain measures will need to be considered for the aging workforce or employment structure; measures such as the lifelong learning opportunity installment and ability to use technology-based tools should be placed to encourage employees to pursue the personal to professional learning. Flexibility in the work hour and workplace choices to better adapt the needs of the workforce is also in demand.

The metropolitan Taipei has become even more uneven and unequal. The increases in the spatial division exhibit the inequality in sector development and demographic distribution, while the growing gap is consistent compared to other major urban centers worldwide. Out-migration and the sector clustering indeed affect the Taipei metropolitan area. The phenomenon of sector redistribution and the decline of the secondary employment are observed. Aside from the obvious cost of living in the urban core, the growing spatial constraints like outdated infrastructure and debilitated community buildings in need of revitalization deter the will of migrating in. As firms' convergence generates knowledge, skills, and novel technologies, the result promotes productivity growth and enhances industrial competitiveness within the service sector. If the job market cannot fulfill the market demand, local governance must formulate strategies to respond to the demand. The focus should be placed on the communities and groups that have become disadvantaged and vulnerable to the changes, either through re-training or learning of new skills. A labor market policy for the creation of new jobs needs to start from the firm perspective; the core objective should be to solve the labor market related to the firms' concentration in urban system. A qualified labor pool is critical for firms in the urban center. All these measures could subsequently create post-retirement opportunities to retrain workers and life-goal planning. Ultimately, the process of the divergent restructuring pattern in Taipei metropolitan area seemingly represents an ongoing trend. The declining population, whether it is a persisting uprise or a reduction to a lower and stabler, scale needs to be given more attention. We observe that population decline is typically associated with the absolute and a relative decline in employment diversity, as TMA's service sector continues to converge in the urban core driving the manufacturing sector out of the core loop to periphery areas. The result authenticates the fact that the service sector employment ratio does affect the natural population growth. Simultaneously, this stimulates the migration boost for the metropolitan area of Taipei.

4.2 The intergenerational pathway finding: the social implication and perception

Society can exert pressure on the governments and counteract those corporate interests defending the status quo (Ruiz-Mallen et al. 2020). Mainly, this is influenced by the perceptions as residents' opinions and attitudes toward changes that can be predisposed

through mutual observation and interaction; we defined population as a general indicator of urban dynamics. The will in adjusting to a more sustainable future can encourage the population to cope with and adapt to stresses, such as social and environmental change; this underlines both the environmental sensitivity and human adaptability, consequently affecting the local place and people's input toward the practice of resilience. The human, or cultural issues embedded in a city relate to urban sustenance and how a city could cope with risks. Place attachment and familiarity play a role in the choices made regarding commuting and migration behavior (Venhorst 2013). City and "hinterland" are highly interdependent, making clear delineation of urban boundaries problematic (Meerow et al. 2016). Not all stakeholders could equally benefit from resilience-based measures; sometimes, these concepts could have been used to promote other means while maintaining the inherent systemic inequality within.

Certainly, labor markets employ an intrinsically sensitive operation and regulation within the urban system, which makes it a place-based issue in need of evaluation. It is projected that in about three decades, global population over 60 would account for a total of two billion people. The demographic transition toward an aging society affects individuals and groups alike. Proper assessment of such impacts must be conducted from more than one perspective, mainly through a multi-scalar methodology. A steep increase in the share of elderly persons in the population leads to a steep decline in their prime working-age population. The pathway is led by the debates on human–nature-dimensional drivers that affect the steady advancement toward a sustainable future. The issue of intergenerational equity raises concerns to the current socioeconomic system. Essentially, Taipei City's employment age rises as the elderly population increases. Customary, senior workers are often associated by their seeming incapacity to incorporate new technology to increase the productivity potential. Industries will need to adjust to the employment market accordingly as the total senior workers' number escalates. Considerably, the massive entry of women in the labor force has sustained the standards of living for most households (Castells 2011), through a multitude of uneven economic events in the past decade; the numbers of working women continue to increase, fostering a new form of social strata and lifestyle in many urban centers. Employment choices are affected due to the elderly citizen's desire or need to work to sustain his/her lifestyle, or by women who consciously choose to work. Therefore, the impact of the aging population and increase in women workforce in many cities has been observed; the existing definition for the total cessation of work or retirement or family lifestyle should be re-examined.

Population aging is hither to stay; coupled with the increase in women workforce, the shift has impacted the labor force and presents a significant challenge for the sustenance in urban resilience (Dimian et al. 2016). The mandatory retirement provision for workers should be reviewed to accommodate the current population decline and increase the women and more senior workers' participation rate. The inclusive-based policies could allow the resilience in the labor market; as the lifting of the retirement age and work-hour flexibility could facilitate and loosen legal obstacles to employ more seniors to extend their working age or women workers on their first time employment; in turn, this raises the chance to improve the supply of workers in the market. Labor market legislation changes allow workers the flexibility of choosing the workplace and better social security. The extended active life is crucial in relieving the aging population financial pressure. A certain push and pull factors exist for the aging population and the reshuffling of the workforce. On the push side, the health factor and mandatory retirement age should be reconsidered. Among the pull's factors, the lifestyle choices constitute a significant reason to retire. The increased income becomes a fundamental reason to accept part-time employment; the retirement

path for employees of diverse sectors should be considered individually. The option of part-time employment brought forth a labor market duality, especially in Taipei City; as the political and economic center, Taipei City accommodates most of the non-manufacturing employment, with the concentration in the tertiary sector. Most young workforce choose to work part time, allowing a flexibility and freedom to maintain an atypical work schedule. The rising living cost has also pushed many women to maintain a working schedule, as the tertiary sector provides an opportunity for a stable and mostly steady work hours.

A coherent policy that addresses the health needs for the aging group could foster older workers' will to stay employed, thus solving the ameliorating shortage of labor supply and promoting the urban resilience in the Taipei Metropolitan. Moreover, one cannot assume that population decline is invariably consistently maintaining the course. In certain scenarios, population decline or outflow might be advantageous for some demographic or for the environment, like in reducing crowding, in stimulating other sector growth, or perhaps attracting "creative" populations that would thrive and grow faster than others; this includes artists, architects, urban designer, etc., or in reducing a local environmental overburden carrying capacity.

4.3 The urban resilience—malleability and empowerment

Building resilience demands urban citizens to acquire flexibility and adaptability or adaptive capacity to a broad range of threats, rather than becoming highly adapted to specific risk. Integrated urban governance and community awareness are critical to withstand and rebound from the shock (Duggal 2020). Resilience of individuals, employers, industries, and regions need to adapt to changing and intermittent conditions; and it must become the key in the socioeconomic advancement of the urban centers (Beckers et al. 2018). Resilience, however, is a problematic yet promising concept in the city planning; it has been systematically solicited as an abstractly "malleable" state or settings to attain; in a city, it can allow a flexible adaptive process inclusive of diverse disciplines and stakeholders (Meerow et al. 2016). Further, it requires steady cooperation among and between stakeholders, who, perhaps, may lack critical resilience knowledge or thinking; the process allows a sense of empowerment to all stakeholders alike.

Resilient urban systems are able to adjust to risks by degrees of mitigation maneuvering and alteration intensity; thus "transitional," "incremental," or "transformational" changes may all be relevant (Ling et al. 2020; da Silva et al. 2019; Meerow et al. 2016; Chelleri et al. 2015; Pearson and Pearson 2014). Structurally, cities face many uncertainties and risks, ranging from extreme climate, health crisis to the financial markets' volatility, causing fundamental changes within the system that residents must adapt with. City's perspicacity must be demonstrated not only in the management of the emergency phase, but also in the long-term process, as an ability both to adapt to the ongoing transformations and to respond to intergenerational challenges, ready to remodel, to withstand any external strain, to the bitter end (Moraci et al. 2020). Nevertheless, without the resilience thinking, the future sustenance of the urban system remains a question. Evidently, the most adverse upside to attaining resilience is perhaps lacking necessary flexibility to appropriating interconnections among the domains in risk. Second, engagement in urban resilience often feels like being in an uncertain course, involving stakeholders' motivations, majority dominance, and trade-offs during the process, being enacted across the spatial and temporal scales. In the TMA case, the labor market, the spatial mobility, and the commuting distances are in need to be considered as they are affected by time and living cost constraints; if one is

to consider permanent relocation of labor, the cost entailed through migration could be deemed too costly. Yet, the TMA's population decline in one area has surrendered the place to the rise in the other area. It seems that the residents outweighed the cost migration with that of relocated living cost in an alternative location.

The malleable effect within the socio-temporal dimension clearly affected the "urban system." As migration toward the urban center causes a rise in demand for housing, inequality in the affordability within the urban core and the market-oriented mechanism accelerate the social disparities further, pushing residents to look for affordable housing elsewhere; finally, the urban system settles into a spatial discrepancy. This effect indeed happened in TMA. The housing prices continue rising in Taipei City, and a clear migration pattern is generated as the younger population can only afford to reside in New Taipei City and Keelung City, avoiding the urban core entirely. Undoubtedly, some effects can only be visible after a time lag. Therefore, strategic navigation planning calls for spatial planning through resilience thinking (Hillier 2011) and stresses the importance of assuming the change and explaining stability. Other forms of displacement like gentrification, defined as a process where new residents of a neighborhood are drawn from a higher social status than current or previous ones, might have the potential to undermine forms of place attachment (Buffel et al. 2019). This is quite disruptive to proper urban governance. Active adaptation to the changing condition and state is part of the systemic practice; it becomes critical in the resilience pathway buildup. It is recommended that the more inclusive and multidisciplinary understanding that emphasizes a more formidable social dimension should be taken into account. The urban region needs a restructuring of spatial allocation of resources or stern implementation of policies to assure the opportunity to prosper and diversify; at that time, a more proper look at the creative destruction and the innovative growth of private firms in the TMA is needed to analyze further.

5 Conclusion

Urbanized areas have witnessed the combined effect of increased intensity and frequency of multiple crises; an aging population has aggravated the resilience capacity even further. The issues of sectoral and demographic cohesion toward resilience in Taipei metropolitan area exemplify the compressed socioeconomic activities in urban development linked to the processes of spatial stretching and interdependence. Population change and regional competition are both present at the base of the ongoing pressures from sectoral redistribution as industries are under the force of a market economy. The socio-temporal dimension issues clearly stimulated the continuous change pattern in the urban center. As the sector began to emphasize acquiring recent knowledge and skill, the redistribution of living and labor choices affect the labor mobility and the community structure. Significantly, the participation of the aging workers is witnessed, but the labor policies and urban planning strategies have not responded to the changing state. In succession, the urban core of Taipei began shrinking; with over-supply of qualified labor pool, the demand for skilled workers decreases. The TMA witnessed an out-migration to follow job opportunities. Socioeconomic conditions have affected the urban spatial-temporal state. The convergence of industries meant that only certain employments are in demand. In a constant changing state, industry convergence presents a risk and the governance must integrate the socioeconomic challenges to stabilize the local communities.

Crucial policies to encourage the higher education as well as sustain the spatial infrastructure is critical in maintaining the location bonus for qualified labor pool for the human capital bonus; the market does not support such high supply of available employees. The communities under socioeconomic blight are often abandoned by their residents. The restructuring process is faced with the severe spatial-temporal impact like Brown-field sites, vacant buildings, darkened retail front, and other socioeconomic symptoms of blighted neighborhoods. Whatever the priorities of the independent area be, labor and business community will need addressing openly the resource allocation and possible divergence in the business composition.

In this study, we investigated the TMA's sector convergence and/or divergence, as well as the social effect brought forth. The current policy of "forward planning" should be redefined; one must address the parallel correlation between the population evolution and the effect on the tertiary sector convergence. The study provided the assessment to affirm such effect and focused on the criteria for the socio-temporal shift and ascertained the conditions within the TMA. The content of planning paradigm and policies are needed to counteract the shrinking phenomenon in sector composition; it is recommended to include such measures as a strengthened role for the public sector's governance, cooperatives, and private stakeholders' participation.

Increasingly, emphasis has been placed on strengthening the resilience of cities to mitigate the unprecedented changes from rapid urbanization. A place-based policy and planning can be proactive toward the multifaceted drivers faced by the urban system. A clear example would be the health issue; it represents a unique concern for job consideration. This is evident through the comprehensive management plan implemented during the pandemic crisis in the metropolitan area of Taipei; the TMA retained and preserved the necessary lifestyle, by having civic cooperation from residents; the government implemented a swift mask provision and regulated the use of mask in public space. This malleable measure and empowerment of residents to self-enforce the use of mask have proven to be crucial to avoid further social distancing or lockdown measures. Cities should foster residents to maintain social links, to achieve visibility within the community and to achieve a civic consensus to attain resilience. Contextual factors also shape the temporal and spatial scales at which urban resilience is applied, and the aim is to focus on the issues of the socio-temporal dimension, fostering general adaptive capacity; the adjustment is engaged according to the particularity and sector emphasis from city to city.

This study emphasized demographic and sectoral-based parameters affecting urban cohesiveness and resilience; additional detailed study can determine the comprehensive cause-effect to urban resilience and to present probable strategies to amend the condition. Further, environmental, or recent health-related impacts could be integrated in future research. Other localized socioeconomic variables such as median income or household statistics can be incorporated into the comprehensive study. If the restructuring follows the shrinking city's pattern, measures to counteract such patterns should be analyzed. Finally, for cities to be indeed resilient, the pathway should be grappled through an inclusive and participatory dialogue. With proper analysis framework, this finding will provide a valuable reference for government policymakers and urban planners to underpin the casualty evolved in the pathway, specifically on changing demography and sector restructuring toward the urban resilience.

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Affiliations

Tzen-Ying Ling¹

✉ Tzen-Ying Ling
Atelier.j.l@gmail.com

¹ Department of Architecture, Tamkang University, No. 151, Yingzhuan Rd, Tamsui District, New Taipei City 251, Taiwan