GROWTH OF CENSUS TOWNS IN INDIA: AN ECONOMIC ANALYSIS

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By

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<u>Certified that the Thesis Entitled</u>

Growth of Census Towns in India: An Economic Analysis submitted by me for the award of the degree of Doctor of Philosophy in Arts at Jadavpur University is based upon my own work carried out under the supervision of Dr. Vivekananda Mukherjee, Professor, Department of Economics, Jadavpur University. Neither this thesis nor any part of it has been submitted before for any degree or diploma anywhere/elsewhere.

……………………….

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“Statement of Originality”

I *Saumyabrata Chakrabarti* registered on *2nd August, 2015* do hereby declare that this thesis entitled ***“Growth of Census Towns in India: An Economic Analysis”*** contains literature survey and original research work done by the undersigned candidate as a part of Doctoral studies.

All information in this thesis have been obtained and presented in accordance with existing academic rules and ethical conduct. I declare that, as required by these rules and conduct, I have fully cited and referred all materials and results that are not original to this work.

I also declare that I have checked this thesis as per the “ Policy on Anti Plagiarism, Jadavpur University, 2019”, and the level of similarity as checked by iThenticate software is less than 1%.

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Signature of the Candidate

Dated:

Vivekananda Mukherjee

Certified by the Supervisor

(Signature with date, seal)

Dedicated to,

My parents Smt. Keya Chakrabarti

and

Dr. Chittabrata Chakrabarti

My supervisor Dr. Vivekananda Mukherjee

My teacher Late Dr. Sarbajit Chowdhuri

My wife Jukta Ghoshal

My sister Debalina Chakrabarti

for their tireless support and guidance to shape my aimless life

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CHAPTER 1

INTRODUCTION

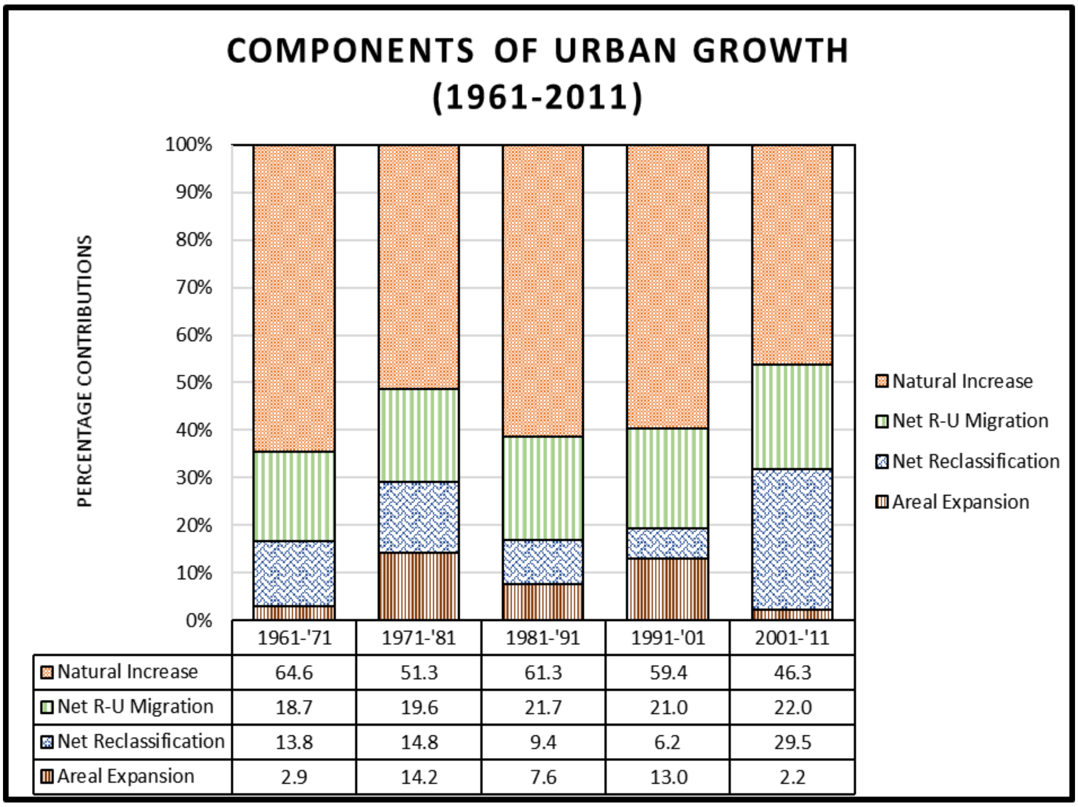
1.1. Motivation

The present thesis investigates the sudden unprecedented growth of Census Towns (CTs) during 2001-2011 which was insignificant before the said period. In economics literature, urbanization is understood to be a by-product of industrial development, driven by growth of employment opportunities in urban areas as a result of industrial investment during 'take-off' of economic development. Around the world the process of urbanization is relentless and remarkable since 1990 as the urban dwelling has increased from a yearly average of 57 million between 1990-2000 to yearly 77 million between 2010-2015.According to World Cities Report (2016) in 1990, 43 percent (2.3 billion) of world's population lived in urban areas; by 2015, this has grown to 54 percent (4 billion). However, the increase in urban population is not evenly spread across the regions of the world. While no region in the world can report a decrease in urbanization, the highest growth rate between1995-2015 was clearly in the least developed part in the world with Africa being most rapidly urbanizing. There has been emergence of large cities and megacities, particularly in the low and middle-income regions in the world. In1995, there were 22 large cities and 14 megacities in the world; by 2015, both categories of cities had doubled, as there were 44 large cities and 29 megacities with most megacities located in developing countries. But, the fastest growing urban centres had not really been the large cities and megacities; they were small and medium cities which account for 59 percent of world's urban population. The global experience of urbanization states that as the countries develop, the pace of urbanization acclerates due to rural-urban migration.The deceleration occurs because of congestion when the degree of urbanization usually is as high as 50% of population share in an economy.

The Indian story of urbanization, however, does not conform to the global trend.The patttern of Indian urbanization showing a different trend with new urban growth coming away from metroplitan dominance which is not in conformity with its previous top-heavy pattern of urbanization.It is possibly because of job diversification away from agriculture owing to the growth of transport infrastructure, generation of agricultural surplus reinvested in non-farm activities, unplanned construction activities in suburban areas, outmigration from big cities etc.According to the official statistics, migration in India has never achieved the expected pace and remained almost stagnant for the last three decades. The Census (2011) reports that only 31% of its population live in urban areas.

Urbanization in India can broadly be divided into four components, namely a) urbanization due to natural increase in population; b) urbanization due to net rural-urban migration; c) urbanization due to reclassification from rural to urban settlement and d) urbanization due to areal expansion. Figure 1.1 shows different components of urban growth in India for the last five decades.

Figure 1.1: Components of Urban Growth in India (1961-2011)



	1961-'71	1971-'81	1981-'91	1991-'01	2001-'11
Natural Increase	64.6	51.3	61.3	59.4	46.3
Net R-U Migration	18.7	19.6	21.7	21.0	22.0
Net Reclassification	13.8	14.8	9.4	6.2	29.5
Areal Expansion	2.9	14.2	7.6	13.0	2.2

Source: Census of India (1971,1981,1991, 2001 and 2011)

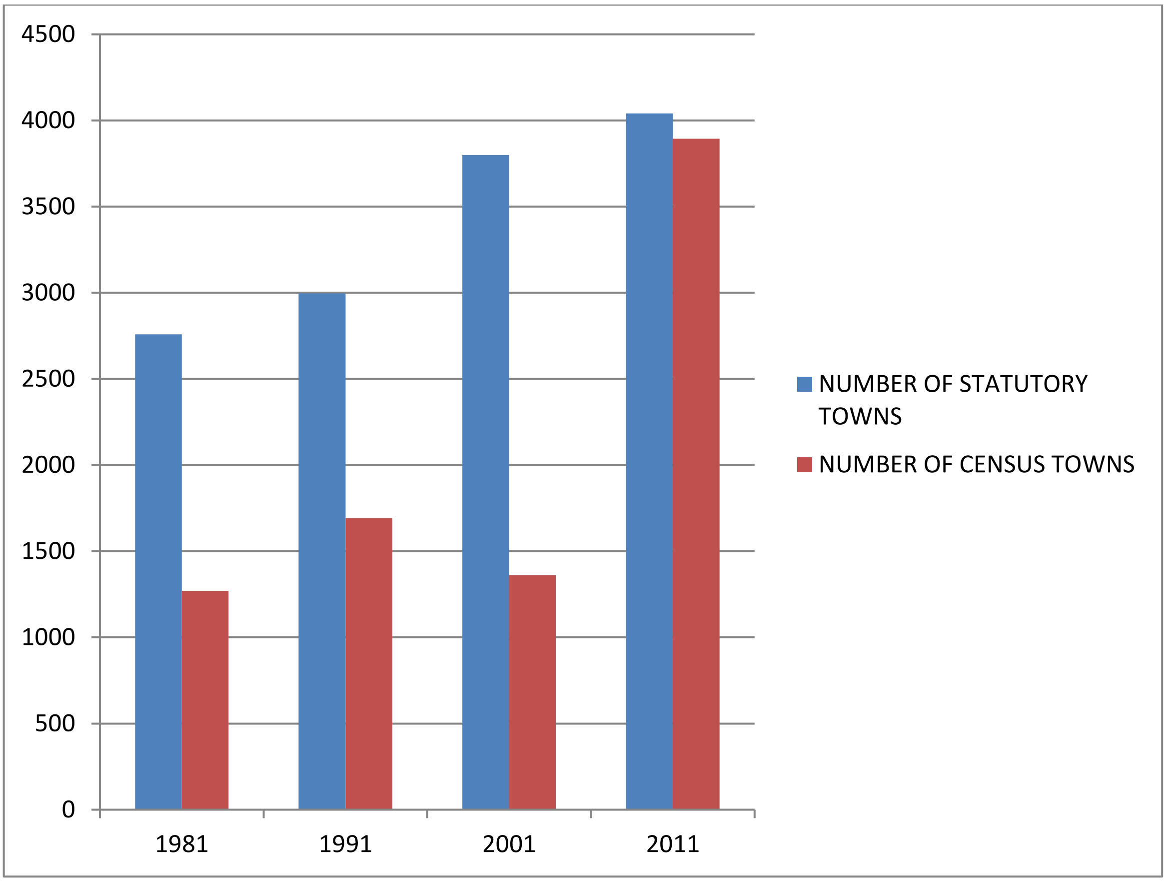
From Figure 1.1 it is evident that the urbanization out of natural increase in population always remained the biggest component of urbanization in India with the migration-driven urbanization staying almost constant for the last five decades. On the other hand, reclassification-driven urbanization whose role remains marginal before 2001-2011, has become the area of interest in recent times. The areal expansion remained insignificant in 2001-2011. The present thesis focuses on the causes of the reclassification-based urbanization in India in 2001-2011. Specifically the present thesis investigates the causes of reclassification of large number villages to CTs during 2001-2011 in terms of development of city/ST in the neighborhood of villages, improvement of village specific amenities and development of transport infrastructure.

In Indian Census the reclassification of villages in small towns (called Census Towns (CTs)) happens if a village satisfies the following criteria: (1) it has a population of 5000 or more;(2) its population density is at least 400 per square kilometer; and (3) 75% of its male main workforce working in non-farm sector. The CTs are administered by rural local governments[1]. Figure 1.2 shows the number of Statutory Towns (STs)[2] and CTs in different censuses.

[1] In India the rural local governments are called ‘Panchayats’.

[2]The urban settlements in India are broadly divided into three categories namely STs, CTs and Out-growths(OGs). The STs in India are the urban settlements which are administratively declared urban areas by state law which include all manners of urban local bodies such as municipalities, town-panchayats, cantonment boards etc. Out-growths are viable urban units which emerge adjacent but outside the administered area of STs. OGs do not satisfy the criteria of ST.

Figure 1.2: Number of Urban Settlements from 1981 to 2011



Source: Census of India (1981,1991, 2001 and 2011)

The number of CTs in India has increased from 1362 to 3894 during the decade 2001-2011 and accounted for almost 30% of urbanization as evident from Census 2011. It is significant especially in the context that during the previous decades CTs did show a marginal growth trend including the decade preceding 2001-2011. How had been the distribution of the growth among India states? Table1.1 shows that six states like West Bengal, Kerala, Tamil Nadu, Uttar Pradesh, Maharashtra and Andhra Pradesh accounts for almost 60% of CTs in India. All these states show a huge absolute rise in the number of CTs in recent decade with West Bengal leading the list.

STATES	NUMBER OF CENSUS TOWNS IN 2011	NUMBER OF NEW CENSUS TOWNS BETWEEN 2001-2011	GROWTH RATE OF CENSUS TOWNS BETWEEN 2001-2011
WEST BENGAL	780	526	67.44
KERALA	461	346	75.05
TAMIL NADU	376	269	71.54
UTTAR PRADESH	267	206	77.15
MAHARASHTRA	278	171	61.51
ANDHRA PRADESH	228	137	60.09
JHARKHAND	188	107	56.91
ODISHA	116	86	74.13
GUJARAT	153	83	54.24
KARNATAKA	127	81	63.77
ASSAM	126	80	63.49
RAJASTHAN	112	76	67.86
PUNJAB	76	55	72.37
BIHAR	60	52	86.66
HARYANA	74	49	66.22
MADHYA PRADESH	112	46	41.07
UTTARAKHAND	41	29	70.73
JAMMU AND KASHMIR	36	27	75.00
CHHATTISGARH	14	10	71.42
OTHERS	269	162	60.22
INDIA	3894	2600	66.77

Table 1.1: Distribution and growth of Census Towns in Indian States

Source: Census of India (2011) and author's calculation

With the Indian average for the growth of CTs was 66.77% during 2001-2011, Table 1.1 shows that Bihar has shown the maximum growth rate in terms of growth of CTs followed by Uttar Pradesh, Jammu and Kashmir and Odisha. The states like West Bengal, Kerala, Tamil Nadu, Uttar Pradesh, Odisha, Rajasthan, Punjab, Bihar, Uttarakhand, Jammu and Kashmir, Chhattisgarh show higher than average growth rate of CTs in India. The impact of such upsurge in the reclassified based urbanization is yet to be assessed as this phenomenon is very much novel in the context of Indian urbanization. Hence the CTs have become the focus of my analysis. This thesis examines the surprising increase in the number of CTs from different aspects.

Starting with Kundu (2011a) a large number of papers in the literature sees such phenomenal increase in the number of CTs from different perspectives. While Kundu(2011a) holds that such increase in an over activism from the part of Registrar General of India, the papers like Guin and Das(2015) do not support such opinion. In the context of West Bengal with statistically they show that the most of the ‘would be CT’ of 2001 qualified as CT in 2011 all over the state. What explains such large increase in CTs? Does development of city/ST in the neighborhood of village help acceleration of CT dynamics? What role does the transport infrastructure play in CT dynamics? Are village specific amenities relevant in CT dynamics? This thesis analyses the role of city specific factors, village specific amenities and transport specific factors both theoretically and empirically.

The next section reviews the relevant literature.

1.2. Survey of Literature

The literature related to CTs focuses on four aspects related to it: a) the unprecedented increase in CTs during 2001-2011, b) spatial distribution of CTs, c) CTs role in socio-economic transformation d) role of transport infrastructure and village specific non-tradables in CT dynamics. As it was expected, the growth of CTs have lured the attention of economists, geographers, other social scientists and policymakers for possible explanations.

The literature on the unprecedented increase in the number of CTs devote much attention on whether there is an over-activism from the Census to exaggerate the data on CTs. Kundu (2011a) initiated a debate by stating that the phenomenal increase in the CTs seems to be an outcome of activism by the Census. Because of the enthusiasm of state directorates in identifying the urban centres, the Register General of India was under tremendous pressure to review the methodology of data collection for identifying the urban settlements. In the context of West Bengal, Guin and Das (2015) statistically show that there is no such Census activism as opined by Kundu (2011a). The most of the villages which were identified as 'would be CTs' in 2001 all over the state have qualified as CTs in 2011. They explain that since agriculture has become non-remunerative in post-reform period such growth is nothing but sectoral diversification as the small and marginal farmers are coming out of agriculture and joining non-farm activities. Again, the growth of the informal economy, small scale industry in villages is also responsible for the change in employment pattern which leads to growth of CTs. Kundu (2011b) shows that the metropolis and large cities like Delhi, Chandigarh, Kolkata, Hyderabad, Chennai, Mumbai have experienced the decline in the growth of population in the last decade. He attributes this fact to the decline in the in-migration in the large cities due to the formalization which makes these urban centers less attractive to the marginal section. The formalization and sanitization like removal of encroachments, slums, petty commercial establishments, squatter settlements in big cities and judicial intervention to remove undesirable urban growth make poor people to become more vulnerable in staying there.

The literature on the spatial distribution of the CTs find that the CTs spatially grows both around existing urban centres and away from it. Transport infrastructure plays a crucial role in this matter. Pradhan (2013) has shown that the spatial distribution of CTs vary significantly among the states. In some states CTs grew rapidly around existing cities (eg.West Bengal) where in some other states it grew far away from existing urban centres (eg.Kerala).Pradhan (2013) also shows that there is a positive association between the degree of urbanization of a district and the magnitude of transformation of villages to CTs in those districts.

Marjit and Kar (2015) shows a reform in the labour market in an open economy leads to expansion of the urban formal sector and contraction of the urban informal sector with fall in the wage in urban informal sector and rise in the same in the rural informal sector. This causes a reverse migration in the economy with fall in the average wage until there is a substantial growth of urban organized sector. Krugman and Elizondo (1996) with the example of Mexico draws attention to an interesting feature that the gigantic cities like Mexico City in the developing countries is an outcome of import substitution policy when the manufacturing output serves a small domestic market as a consequence of strong forward and backward linkage and consequent agglomeration economy. However, as the economy moves out from inward looking strategy though trade liberalization, the manufacturing sector disperses with the mitigation of backward and forward linkages in Mexico City to northern states closer to US border causing the dispersion of non-farm labour force in the economy. Zhu (2017) identifies the phenomenon of in situ urbanization in a wide range of areas in south eastern coastal provinces of China, demonstrating that such phenomenon has been one of the major characteristics of China's urbanization process after 1970s after liberalization in line with Krugman and Elizondo (1996). Denis, Mukhopadhyay and Zérah (2012) refer to several field examples where political factors play a role in the governance boundary between the urban and the rural. They cite the case of Tamil Nadu, where in June 2004, 566 town panchayats (small urban local bodies) were reclassified as rural panchayats due to the resistance to urban taxation[3]. Bhagat (2005) presents different elements of this cost-benefit analysis in favor of rural settlements such as lower levels of taxation, cheaper electricity and absence of urban bylaws and especially

[3] See Sen (2018) for a review of political economy issues related to rural-urban migration.

access to public schemes, in particular Mahatma Gandhi National Rural Employment Guarantee Scheme(MGNREGS), which is supposed to provide guaranteed unskilled employment of 100 days to each rural household, and Indira Awas Yojana(IAY), which provides subsidies for house construction to targeted poor households.

The pioneering chapter by Krugman (1991) on economic geography, argues that lowering of transport cost accelerates the centripetal forces that attracts both labor and capital to the city. However, Helpman (1998) points out that the rising cost of non-tradable commodities in the city like price of housing, clean environment, congestion-free traffic can disperse the centripetal forces mentioned by Krugman (1991) and if transport cost is very high, an existing agglomeration grows in its population size. While in the former, a lower transport cost due to improved infrastructure, promotes growth of an existing agglomeration with higher welfare of its residents at the cost of the smaller agglomerations at its neighborhood, in the later, a smaller agglomeration grows in terms of population with falling welfare level of its existing residents. Chandra and Thompson (2000) in the context of US shows that the highways built between 1969 and 1993raised the income of the rural counties through which they pass and reduced the income of the adjacent counties. Baum –Snow et al.(2020) in a recent chapter show with Chinese data that investing in local transport infrastructure to promote the growth of hinterland often has a self-defeating impact of losing economic activities and specialization in agriculture in those areas.

In Indian context, Sharma (2013) points out that the improved transport infrastructure plays an important role in the birth of the CTs near the existing urban centers as workers rather than migrating to the cities prefer to commute to jobs. Ghani et al.(2012) found that district level infrastructure is partly facilitating the relocation of organized manufacturing to rural locations while the unorganized manufacturing is migrating to urban locations.

Such movement seems to be partially explained by the development of national level highways especially the construction of Golden Quadrilateral. However, there is a very limited impact of Golden Quadrilateral upgrades on unorganized manufacturing outside the nodal districts where the cities are located. Aggarwal (2018) takes a village-centric view and shows that expansion of rural roads and transport infrastructure results in greater market integration, reduced price of non-local goods, wider variety of consumption basket in rural areas. It also leads to greater participation of local teenagers in the expanded labor market. Mukhopadhyay et al.(2016) with an investigation in certain CTs in northern India shows that increased connectivity and growing rural income are the main driving forces for the growth of small scale non-tradable services which are the main sources of non-farm employment in these settlements. Van Dujine and Nijman (2019) based on their fieldwork in West Bengal and Bihar show that a sizable portion of urban growth has gone unrecorded in official statistics due to technical reasons. There are cases where the boundaries of existing agglomerations could be redefined as a new urban settlement. However, they also notice that in these states there has been a shift in the employment structure away from agriculture causing in situ urbanization in a dispersed manner. They identify the absence sufficient employment opportunities in existing urban settlements or major cities as one of the reasons behind this dispersed pattern of urbanization. Mathur et al (2021) also confirm this trend by use of National Accounts Statistics, National Sample Survey and Annual Survey of Industries data made available by Government of India. However, none of these chapters discuss the role of transport infrastructure in birth of the new CTs as we do in the present chapter.

Balakrishnan (2013) with two examples of Bangalore-Mysore highway and Pune-Nasik highway demonstrates that the urbanization along highways has been the emerging pattern of urbanization in developing countries. Based on NSSO 55th round(1999-2000), 66th

round (2009-2010),68th round(2011-2012)data, Mahajan and Nagraj (2017) argues that the road construction projects undertaken in India during 2000-2012, both highways and rural roads, expanded rural construction demand and employment.

1.3. Outline of the Chapters

The thesis contains three core chapters. This section provides a brief description of the chapters in the thesis.

Chapter 2 constructs a unified theoretical framework which accommodates some of the arguments forwarded in the literature for explaining the birth of the CTs. It uses the Harris-Todaro model of rural-urban migration, but unlike their chapter it is nested in urban economics literature as in Brueckner (2011).It also attempts to empirically check some of the hypotheses of the theoretical model by using data from the state of West Bengal during 2001-2011. The model shows that the factors like rise in the formal wage, the fall in cost of commuting to the nearby large urban area, the fall in the density of the population in the nearby urban area(due to formalization/sanitization) helps formation of the CTs. The CTs are more likely to be developed near urban centres with lower extent of urban sprawl. As the theory is tested empirically by using data from the state of West Bengal during 2001-2011 where the growth rate of census towns had been one of the highest in India, it turns out that the higher formal sector income in the nearby urban centres with lower extent of urban sprawl is the major factor explaining the birth of Census Towns.

Chapter 3 evaluates the role of transport infrastructure in this phenomenon by using the data from state of West Bengal, which has experienced the birth of the largest number of such towns. The theoretical arguments of the chapter assess the opposing role played by ‘force of agglomeration’ as proposed by Krugman (1991) and ‘force of dispersion’ proposed by Helpman (1998) and Rossi-Hansberg (2005) owing to the improved transport infrastructure in connection with CT dynamics .The results of the empirical exercise of the paper show that the existence state/national highways in the neighborhood increases the probability of a village, designated as a ‘would be CT’ in Census, 2001, of getting converted into a CT in Census, 2011. The closer the location of the highway, more intensive is the positive effect. The rail infrastructure did not play a significant role in the process. Interestingly, the paper finds that although in general the density of local road network complements highways in formation of cities, in the districts bordering Kolkata the complementarity relation works in the opposite way. As it evaluates the role of Golden Quadrangle (GQ) project, the highway construction project undertaken in India during this time to connect the four major metropolitan cities of India, the paper finds that it had a limited impact compared to national/state highways in birth of the CTs.

Chapter 4 uses principal component analysis and regression of them on the dependent variable to find the relative importance principal components which are the blend of all the control variables used so far. Principal Component analysis is a very useful multivariate technique which we use here to analyse the relative importance of all the variables in the birth of CTs during 2001-2011.The procedure used is to reduce the dimension of the dataset by extracting few principal components from the set of the original variables. The varimax rotation of them then leads to the choice of one original variable which has the highest correlation with the extracted principal components. This way we can identify those variables which are most crucial in explaining the CT dynamics. Finally, principal component regression tells us about the impact and significance of the chosen principal components in birth of CTs. To check whether the explanatory factors have varied significance in CT birth, the dataset of West Bengal for ‘would be CTs’ identified to be converted to CT in 2011 is bifurcated into 1) the ‘would be CTs’ in the districts North 24

Parganas, South 24 Parganas and Haora, the districts bordering Kolkata and rest of the districts to carry on the analysis.

1.4. Results

In this section, we summarize the results derived in the three core chapters of the thesis.

Chapter 2 applies Harris-Todaro model with urban economic features embedded in it to explain the birth of CTs. It also checks the theoretical arguments empirically using Census data of West Bengal. The theoretical model developed in the chapter allows movement of a homogeneous labour force among four sectors of the economy: rural farm sector, rural non-farm sector, urban informal sector and urban formal sector. The model assumes that the rural non-firm sector absorbs the residual labor force which fail to find employment in the three other sectors. The urban informal sector absorbs the urban labour force which fail to find employment in the urban formal sector. The labour in the urban formal sector enjoys an institutionally fixed wage rate. The wage rate in all other sectors is market determined. The rural non-farm sector and the urban informal sector are assumed to have only self-employed people with negligible amount of locally available capital used in the production process. The urban formal sector also uses global capital as input of production. The urban area has a fixed boundary and population density. We solve for the equilibrium of the model and develop the testable hypotheses stated below. First, a rise in the formal wage rate in the city lowers rural farm employment and raises the rural non-farm employment[4] and thereby increases the probability of developing CTs. In the short run, a rise in the formal wage although reduces the employment in urban formal sector, has an uncertain effect on the wage expected in the urban area. If it rises attracting labour to the city; the city with its defined boundary and density of population cannot

[4] The result differs from Marjit and Kar(2015) which identifies the fall in the urban formal wage through labour market reform as the reason for expansion of rural non-farm sector.

accommodate labours migrating from the rural area; however, the wage rate in the rural area rises and the farm sector is forced to shed-off labour who finds job in the rural non-farm sector causing non-farm employment to expand and helping a village to transform to a CT. But, if it falls then reverse migration occurs causing excess supply of labour in rural sector. If the rural farm sector with limited absorption capacity in the short run absorbs more labour compared to rural farm sector, then the village ceases to transform to CT. If the opposite occurs CT dynamics accelerate. Second, a lowering of transport cost to the city keeps rural farm employment unchanged but increases rural non-farm employment and thereby increases probability of creation of CTs.The existing literature on urban economics tells us that as the distance from the existing urban centre rises, transport cost for a commuter to a job located at the urban centre also rises. Thus,cities with low transport cost attracts large number of migrants to the city. But if the city is neither allowed to expand nor allowed to hold a higher density of population, the migration cannot take place. In such a situation, the number of commuters rises who live outside the city. This helps reclassification of the village nearby to the city into a CT. Third, smaller cities and the cities with lower density of population are more likely to have higher non-farm employment in the neighboring agricultural area and therefore have higher chance of creation of CTs in their neighborhood. A fall in the population density in the city causes fall in the participation in the urban informal sector who find job in the rural non-farm sector as the rural farm sector has a limited absorption capacity in the short run. The neighborhood village has a greater chance to be transformed into a CT. Last, an expansion in the boundary of the city reduces the chance of a neighboring village being transformed into a CT. Given the size of its formal sector, expansion of the city leads to an expansion of urban informal sector. The informal wage rate remaining unchanged this happens as labour relocates from the rural non-farm sector to urban informal sector, which reduces the chance of a village transforming in a CT. The empirical part of the chapter, using Census village/town data for the districts of West Bengal, India between Census years 2001 and 2011,verifies the relative importance of the factors identified in theoretical propositions derived in the chapter in formation of the CTs. It uses Logit regression for its purpose. It turns out that the higher formal sector income in the nearby urban centres with lower extent of urban sprawl is the major factor explaining the birth of CT. ‘Formalization of cities’ is not a significant factor explaining the birth of CTs.

Chapter 3 analyzes both the forces of agglomeration and dispersion that work because of development of transport infrastructure like highways, rail head and local roads. It looks at interaction of each of the highways and rail infrastructure with local roads. In the analysis it not only juxtaposes the transport infrastructure variables, also controls for nearness to the city and local amenities at the villages. Second, it finds that the state and national highways located near the city increases the probability of a village turning into a CT. The closer the distance, the higher is the chance of a successful conversion. Contrary to the existing literature, in case of West Bengal, the chapter finds that although local roads have a positive impact, do not significant influence in emergence of CTs except in the cases where it complements the highways. However, the nature of complementarity is different at the districts bordering the city of Kolkata compared to what we generally observe in the state. While generally it supports the forces of dispersion from the existing cities, in the neighborhood of Kolkata it supports the forces of agglomeration. Third, the GQ project in West Bengal has a weaker role compared to the state/national highways in turning the prospective villages into CTs.Fourth, commuting is in general is not an important factor in formation of CTs in West Bengal. Fifth, in case of West Bengal, with its uneven pattern of development centered around its capital city of Kolkata, all other things remaining the same the villages had a higher chance of getting converted in a CT in the districts bordering Kolkata. The results are new in the literature and important for policy making.

The fourth chapter juxtaposes all the factors used in second chapter and third chapter together and attempts to reduce the dimensionality of the explanatory factors by use of Principal Component Analysis (PCA). The principal components are blend of all the control variables used in the previous two chapters. The varimax rotation of them identifies an original control variable, which has the highest correlation with the each of the extracted principal components designated as dominant variables. As we regress the dominant variables of the significant principal components on the dependent variable for finding out relative importance of them in conversion of ‘would be CTs’ to CTs, we also infer which of the original variables are the most important in explanation of the formation of the CTs in West Bengal. It appears from the analysis that the explanatory variables have varied importance in the districts bordering Kolkata (North24 Parganas, South 24 Parganas and Haora) and the other districts. The existence of railways within 5km radius of a village, high population density in nearby city/ST and availability of electricity in a village are the most important factors in CT dynamics in 2011 all over West Bengal. However, the city specific factor population density in the nearby city/ST which is a significant factor in CT dynamics in North 24 Parganas, South 24 Parganas and Haora in 2011does not figure out as a dominant factor in the districts not sharing border with Kolkata. The analysis also suggests, in an uneven spatial distribution the city highway within 5 km radius appears to be a significant factor in both categories of districts, the nearness from the village to nearest city/ST does matter in the districts other than the bordering districts in CT dynamics. The result is interesting as it provides us with new insight about the factors associated with formation of CTs in West Bengal. The results, in this more general approach to the problem, compared to the partial approaches taken in the existing literature, suggest that fall in expected formal wage in the neighboring city in formation of CTs, is overemphasized. The long-distance daily commute to the nearest city, may have an important role in formation of CTs in West Bengal, which remained uncaptured in the existing partial treatments of the problem.

1.5. Plan of the Thesis

The rest of the thesis is organized as follows. Chapter 2 analyzes the impact of city specific factors in the birth of CTs. Chapter 3 analyzes the role of transport specific factors as well as village specific non-tradables in birth of CTs. Chapter 4 takes into account all these factors to analyze which among these are most crucial to the birth of CTs. Chapter 5 concludes the thesis.

CHAPTER 2*

GROWTH OF CENSUS TOWNS: CITY SPECIFIC FACTORS

*This chapter is based on

Chakrabarti, S, Mukherjee, V. (2020). Birth of Census Towns in India; An Economic Analysis. South Asian Journal of Macroeconomics and Public Finance,9(2):139-166.

2.1. Introduction

In Indian Census the reclassification of villages in small towns (called Census Towns) has been startling during the decade 2001-2011 and accounted for almost 30% of urbanization, which is significantly larger than their growth rate in previous decades. Though reclassified as towns, they are governed as rural settlements. The 2011 census has witnessed an enormous growth of CTs from 1362 to 3894 becoming the second highest component of urbanization after natural increase in population. Kundu (2011b) shows that the metropolis and large cities like Delhi, Chandigarh, Kolkata, Hyderabad, Chennai, Mumbai have experienced the decline in the growth of population during the same period. He attributes this fact to the decline in the in- migration in the large cities due to the formalization which makes these urban centers less attractive to the marginal section. The formalization and sanitization like removal of encroachments, slums, petty commercial establishments, squatter settlements in big cities and judicial intervention to remove undesirable urban growth make poor people to become more vulnerable in staying there.In fact, the Indian pattern of urbanization is a deviation from the traditional notion of rural-urban migration. In India rural-urban migration, however, does not show an accelerating trend during last five decades. Sen (2018) asserts that in India unlike other counries migration started to decelerate when the urban population was well below a quarter of the total population. The principal puzzle is that more Indians do not migrate voluntarily in response to growing divergence in economic opportunities between urban and rural areas.Bhide(2013) points out that the poor migrants, who migrate for petty jobs to the urban centres are becoming more and more vulnerable due to denied access to essential services. In reality,migration decision in India is political,economic, as well as behavioural and the rural governmental schemes act as insurance for staying in the rural sector in addition to growth of non-farm activities and love for native place for rural mass.This refers to the fact that the process of urban transformation in India is not much attributed to movement of people from rural to urban areas, but more due to 'morphing of places' from rural to urban (Mukhopadhyay,2017).Samanta (2012) opines that slow process of municipalisation and underreporting of actual urban territorial dimension is the reason behind the emergence of large number of CTs in West Bengal. However, these papers lack proper theoretical basis to explain the birth of CTs by such enormous amount during 2001-2011.This chapter tries to fill the gap by constructing a theoretical model, which is an application of Harris-Todaro framework with features of urban economics in it. The chapter argues that an extremely congested city with a village adjacent, a rise in the formal wage and a consequent fall in employment in the formal sector has an ambiguous effect on urban expected wage. It may trigger migration when urban expected wage rises or reverse migration when urban expected wage falls. Both migration or reverse migration has a complex effect on labour market and an uncertain effect on CT dynamics. Similarly, a fall in transport cost may cause a rise in probability of the village adjacent to the city to become CT. A change in the population density in the city and area of the city will have different impacts on the CT birth. While the fall in the density of population owing to the' formalization and sanitization' of a city has uncertain effect on CT dynamics, an expansion of the area of a city reduces the chance of its adjacent village to become CT. The chapter also tries to corroborate the results empirically using Census data of West Bengal during this period.

In existing literature there are papers which focus the impact of economic reforms on various sectors in an economy as well as on urbanization indirectly or directly. Marjit and Kar (2015) shows in an open economy that a labour market reform leads to expansion of the urban formal sector with contraction of the urban informal sector with fall in the wage in urban informal sector and rise in the same in the rural informal sector. A reverse migration occurs as a result in the economy with fall in the average wage until there is a substantial growth of urban organized sector. Krugman and Elizondo (1996) argue that the gigantic cities like Mexico City in the developing countries is an outcome of import substitution policy when the manufacturing output serves a small domestic market as a consequence of strong forward and backward linkage and consequent agglomeration economy. However, as the economy liberalize, the manufacturing sector disperses to northern states closer to US border causing the dispersion of non-farm labour force in the economy as backward and forward linkages mitigate in Mexico City. The in situ urbanization in south eastern coastal provinces of China has been one of the major characteristics of China's urbanization process after 1970s after liberalization as identified by Zhu (2017) in line with Krugman and Elizondo (1996).

The present chapter builds a unified theoretical framework which applies Harris-Todaro framework with urban economic features embedded in it. It accommodates some of the arguments forwarded in the literature for explaining the birth of the CTs. In fact the birth of a CT may occur due to myriad of factors. These factors may be village specific, city-specific, transport specific. This chapter identifies some of the city specific factors and argues about their significance in CT dynamics. The framework is similar in spirit to Marjit and Kar (2015) as it uses the Harris-Todaro model of rural-urban migration[5], but unlike their chapter it is nested in urban economics literature as in Brueckner (2011). The theoretical model developed in the chapter allows movement of a homogeneous labour force among four sectors of the economy: rural farm sector, rural non-farm sector, urban informal sector and urban formal sector[6]. The model assumes that the rural non-farm sector is a residual sector absorbing the residual labor force which are not accommodated

[5] See Ray (1998) for a discussion on Harris-Todaro model.
[6] In contrast, Marjit and Kar (2015) considers the labour force as heterogeneous by including one additional sector namely urban service sector which exclusively employs skilled labour.

in the three other sectors. The urban informal sector absorbs the residual urban labour force which do not find employment in the urban formal sector. The labour in the urban formal sector are employed at institutionally fixed wage rate. The wage rate in all other sectors is market determined. The rural non-farm sector and the urban informal sector are assumed to have only self-employed people with negligible amount of locally available capital used in the production process. The urban formal sector also uses global capital as input of production. The urban area has a fixed boundary and population density. We solve for the equilibrium of the model and develop the testable hypotheses stated below. First, a rise in the formal wage rate in the city lowers rural farm employment and has ambiguous effect on expected wage rate. The expected wage rate rises if the formal sector employment has low elasticity of demand and therefore, has low impact on probability of finding employment in the formal sector. This attracts labour to the city; the city with its defined boundary and density of population cannot accommodate labours migrating from the rural area; however, the wage rate in the rural area rises and the farm sector is forced to shed-off labour who finds job in the rural non-farm sector causing non-farm employment to expand and helping a village to transform to a CT. The expected wage rate falls in the case of high elasticity of labour demand in the formal sector and it raises the uncertainty of finding employment in the formal sector. This starts reverse migration at a lower wage rate[7]. Since the farm sector absorbs more labour now though with a limited absorption capacity, the chance of a village turning into a CT falls. Second, a lowering of transport cost to the city keeps rural farm employment unchanged but increases rural non-farm employment and thereby increases probability of creation of CTs. The existing literature on urban economics tells us that as the distance from the existing urban centre rises, transport cost for a commuter to a job located at the urban centre also rises. Thus,cities

[7]Marjit and Kar(2015) captures similar effect consequent on the fall in the urban formal wage through labour market reform.

with low transport cost attracts large number of migrants to the city. But if the city is neither allowed to expand nor allowed to hold a higher density of population, the migration cannot take place. In such a situation, the number of commuters rises who live outside the city. This helps reclassification of the village nearby to the city into a CT. Third, smaller cities and the cities with lower density of population are more likely to have higher non-farm employment in the neighbouring agricultural area and therefore have higher chance of creation of CTs in their neighborhood. A fall in the population density at the city causes fall in the participation in the urban informal sector who find job in rural non-farm sector and the neighborhood village has a greater chance to be transformed into a CT. Last, an expansion in the boundary of the city reduces the chance of a neighboring village being transformed into a CT. Given the size of its formal sector, expansion of the city leads to an expansion of urban informal sector. The informal wage rate remaining unchanged this happens as labour relocates from the rural non-farm sector to urban informal sector, which reduces the chance of a village transforming in a CT. The theory also argues that the large cities and the cities with high cost of commuting may dilute or reverse the positive effect of rise in formal sector wage on transformation of a village into CT. These factors are shown to amplify the effect of uncertain job prospect, which is an alternative way of capturing the negative effect of lack of insurance on formation of urban settlements[8].

The empirical part of the chapter, using Census village/town data for the districts of West Bengal, India between Census years 2001 and 2011, verifies the relative importance of the factors identified in theoretical propositions derived in the chapter in formation of the CTs.It uses Logit regression for its purpose. It turns out that the higher formal sector income in the nearby urban centres with lower extent of urban sprawl is the major factor

[8]See Lagakos (2020) for a discussion.

explaining the birth of Census Towns.'Formalization of cities' is not a significant factor explaining the birth of CTs.

This chapter is organised as follows. The second section presents the theoretical framework. The third section checks the theoretical propositions empirically with the data of West Bengal from Census. Section 4 concludes the chapter.

2.2. Theoretical Framework

Let us consider a space which consists of a circular city with radius $\bar{x}$ surrounded by a village[9]. Only the non-farm jobs are in the city and we assume that all of them are concentrated at the centre of the city. The other parts of the city are inhabited by the urban households which commutes to the centre for their jobs. In the model we assume all the households are single individual households and are part of homogeneous labour force. The population density of the city is represented by μ . The city consists of two sectors of production: (a) urban formal sector; and(b) urban informal sector. The urban formal sector produces its output by using two factors of production: labour(L) and global capital (K).[10] It offers jobs to a fixed number of workers at an institutionally fixed wage$\bar{w}$. Due to fixed number of jobs available in the urbanformalsectorin the city, all workers whoseek job in the formal sector do not get it. The urban informal sector which include mainly street vendors of goods and personal services and casual labourers (Dasgupta (2003)) absorbs the residual labour force in the city at a market determined wage (w)lower than formal wage rate $\bar{w}$. Apart from labour the urban informal sector also uses small amount of local capital in its production process the price of which is determined locally.

[9]In reality a city may be of any shape and may be surrounded by many villages nearby. But for simplicity, the shape of the city is assumed to be circular to define a fixed radius of it.
[10] The role of global capital in affecting the sub-national economy of our consideration has not been considered in this chapter. However, the inflow and impact of global capital remains as our future research agenda.

The village consists of two sectors of production:(a) rural farm sector; and (b) rural non-farm sector. The rural farm sector uses land, a specific factor and variable factor labour to produce agricultural output. On the other hand, the rural non-farm sector uses labour and small amount local capital to produce a non-farm output. The labour can freely move between the rural farm sector(sector1), the rural non-farm sector (sector2) and the urban informal sector (sector3).Since the employment opportunity in the urban formal sector is limited, labour can enter the urban formal sector (sector 4) only with certain probability. We assume, the product market and all the factor markets are perfectly competitive both in the rural and urban area.

The demand for labour in the four sectors of the economy described above is denoted byL_1, L_2, L_3 and L_4 respectively of whichL_1, L_2, L_3 represent the employment in the rural farm sector, rural non-farm sector, urban informal sector respectively and L_4 represents the employment in urban formal sector of the economy.Since the amount of capital used inthe rural non-farm sector andthe urban informal sector is too small compared to capital used in the urban formal sector, for simplification, we assume zero amount of capital is used in these sectors.

The utility function of the representative urban household is given by $u(c,q)$ where $q > 0$ denotes the household expenditure on housing per square feetand$c > 0$ denotes the expenditure on all other commodities. The marginal utility from consumption of each good is positive and diminishing. The equilibrium of the spatial model requires that all households living in the city enjoy the same level of utility irrespective of their spatial location; otherwise they have incentive of moving from low utility region to high utility region and the spatial equilibrium is not achieved. In the spatial model discussed above, utilities can be spatially uniform only if the price per unit of housing floor space falls as distance increases. Since higher commuting cost means lower disposable income, the offsetting benefit is a lower price per square foot at a greater distance.

As defined earlier, a village is transformed to aCTwhen75% of its male main workforce works in non-farm sector and its population exceeds 5000 and the population density exceeds400/square kilometer. Let us assume that the size and density of the population living in a village fulfill the criteria of a CT but the labour market condition is not fulfilled. The percentage of its male workforce that get employed in the village itself depends on the labour market conditions prevailing in the village and the adjacent city. The present chapter focuses on this aspect of formation of a CT. For facilitating the analysis, we assume, all working members in the rural households are male. Therefore, in our case the criteria that is required to be fulfilled by the village to be converted in a CT is$L_2 \geq \frac{3}{4}(L_1 + L_2)$which canalternatively be written as,

$$\frac{L_2}{L_1} \geq 3. \tag{1}$$

The values ofL_1andL_2 get determined at the labour market.

If L is the size of the labour force available in the economy, the labour market clearance condition for the economy is written as:

$$L_1 + L_2 + L_3 = L - L_4. \tag{2}$$

The common wage rate $w$that prevails in rural farm and non-farm sector and the urban informal sector clears the market.The values of L_1andL_2 get determined from the general equilibrium of the urban and rural production structure.

Now we look at the determination of labour demand L_1, L_2, L_3 and L_4 in each of the four sectors of production in the economy.

Rural farm sector

Rural farm sector uses L_1 units of the variable factor labour and N units of specific factor land to produce X_1 units of agricultural output. The production function of this sector is given by $X_1 = F(L_1, N)$. In production, L_1 and N are complementary in nature and shows diminishing marginal productivity with respect to labour $\frac{\partial^2 F(L_1,N)}{\partial {L_1}^2} < 0$. The rentper unit of land that prevails in the village is R. ^{W} is wage per unit of labour. The rural farm sector is price taker at the agricultural product market. We assume the price of the agricultural product as P_1. The producers choose the employment to maximize profit given by:

$$\pi_1 = P_1 F(L, N) - wL - RN \quad (3)$$

The chosen employment level of $L_1 > 0$ satisfies the following first order condition for profit maximization:

$$P_1 \frac{\partial F(L_1,N)}{\partial L_1} = w. \quad (4)$$

Since, $\frac{\partial^2 F(L_1,N)}{\partial {L_1}^2} < 0$ the second order conditionis also satisfied at the optimum.

From (4) we solve

$$L_1 = F(P_1, w, R). \quad (5)$$

Since $\frac{\partial^2 F(L_1,N)}{\partial {L_1}^2} < 0$, from equation (5) we notice that the demand for labour is an increasing function of P_1 and decreasing function of both w and R.An increase in price of the commodity increases the marginal revenue of the farm and its scale of production. This in turn raises demand for labour in production of the commodity. On the other hand, due to increase in w,employment of labour becomes costlier, leads to fall in demandforlabour. With higher R less amount of land is put into farming with lower demand for labour in the rural farm sector.

Rural non-farm sector

Rural non-farm sector uses labour (L) and negligible amount of capital (assumed as zero)to produce output X_2. The production function of this sector is of standard neoclassical type, given by $X_2 = F(L_2)$with diminishing marginal productivity of labour. The rural non-farm production units are assumed to be perfectly competitive in product and factor markets. The market price of labour is w and P_2 is the price of commodity 2.This sector acts as a residual sector in rural area as it absorbs the labour force not employed in the rural farm sector.

Urban informal sector

Let us now derive the labour demand function of the urban informal sector. The urban informal sector uses labour and local capital to produce its output. Since the population living in the city forms the working force in the city, we can write the population density

(μ) of the city as $\mu = \frac{L_3+L_4}{\pi\bar{x}^2}$

where, $\pi\bar{x}^2$ is the area of the city. So, given μ , $\bar{x}$ and L_4, The size of the informal sector labour force

(L_3) is determined as:

$$L_3 = \mu\pi\bar{x}^2 - L_4 \quad (6)$$

Notice from equation (6) that the size of the informal labour force in the urban economy is positively related to the population density and radius of the city, inversely related to the size of the formal urban employment.

Urban formal sector

For the urban formal sector, the production function is given by $X_4 = F(L_4, K)$.The urban formal sector uses global capital (K) with labour (L_4) to produce output X_4. The production function also is standard neoclassical type with diminishing marginal productivity of each factor. We assume that product and factor market are perfectly competitive. The return to capital and labour in sector 4 is r as specified earlier and $\overline{w}$ respectively. The price of commodity in the sector is P_4 . The profit function of sector 4 is given by

$$\pi_4 = P_4 F(K, L_4) - \overline{w} L_4 - rK. \tag{7}$$

Maximizing the profit function with respect to labour size of producer in sector 4 we get

$$P_4 \frac{\partial F(L_4, K)}{\partial L_4} = \overline{w}. \tag{8}$$

The second order condition for maximization is satisfied as $\frac{\partial^2 \pi}{\partial {L_4}^2} = \frac{\partial^2 F(L_4, K)}{\partial {L_4}^2} < 0$.

From (8), the labour demand function in the urban formal sector is derived as:

$$L_4 = F(\overline{w}, r, P_4). \tag{9}$$

The labour demand function is increasing function of P_4 and decreasing function of formal wage and interest $\overline{w}, r$ in the formal sector respectively. An increase in P_4 increases the supply of the commodity which in turn raises the demand for labour. On the other hand, due to increase in $\overline{w}$ employment of labour becomes costlier and leads to fall in demand for labour. Since both the inputs are complementary in production, a rise in interest rate r also lowers the demand for labour in this sector.

Rural urban migration is a process of flow of labour from rural to urban sector. Rural urban migration takes place as long as expected urban wage at the boundary of the city exceeds the rural wage. Migration comes to a halt when the rural wage gets equated to expected urban wage at the boundary of the city. Let transport cost per mile be$t > 0$.Then at the equilibrium the following must hold:

$$w = \frac{L_4}{L_3+L_4}\bar{w} + \frac{L_4}{L_3+L_4}w - t\bar{x} - \varphi. \qquad (10)$$

The left-hand side of the above equation is the rural wage. The right-hand side is the expected urban wage net of cost of commuting, which is sum of the cost of transport from the village to edge of the city $\varphi \geq 0$ and the cost of commuting from the edge to the centre$t\bar{x}$.

Manipulating equation (10)we get,

$$w = \bar{w} - (t\bar{x} + \varphi)\left(\frac{L_3+L_4}{L_4}\right). \qquad (11)$$

The above equation determines the market wage as a function of urban formal wage, transport cost and the radial distance of the center of the city from the boundary. The market wage rate is decreasing function of transport cost and the radius of the city. However, since L_4 i.e. the formal sector employment is a decreasing function of formal wage rate (from equation (8) and (9)), we are not sure about the effect of a rise in the formal wage rate on the market wage rate.

Labour Market

Substituting L_1, L_3 and L_4 from (5),(6) and(9) respectively in the labour market clearing condition (2), we solve for the labour demand in rural non-farm sector as,

$$L_2 = L - L_1(P_1, w(\bar{w}, t, \bar{x}, \varphi), R) - L_3(\mu, \bar{x}, L_4(P_4, \bar{w}, r)) - L_4(P_4, \bar{w}, r). \qquad (12)$$

The above equation states that the labour demand in rural non-farm sector is function of labour demand insector1,sector3 and sector4. The labour demand of all these sectors are in turn functions of parameters like prices of the products of the sectors, factor prices as well as parameters specific to the city like population density and the radius of the city.

2.2.1. Results

Proposition1: A rise in urban formal wage rate leads to creation of a CT if and only if$[1 - \frac{t\bar{x}+\varphi}{\bar{w}}\frac{\mu\pi\bar{x}^2}{L_4}\epsilon] > 0$where $\epsilon = -\frac{\bar{w}}{L_4}\frac{\partial L_4}{\partial \bar{w}} > 0$ is theelasticity of labor demand at the formal sector.

Proof: See Appendix.

Since, with the rise in urban formal wage rate the employment in the formal sector falls, the effect on expected wage rate becomes uncertain. The higher wage in the urban formal sector, now, can be obtained only with a lower probability. The extent of fall in formal sector employment depends on the elasticity of labor demand at the formal sector $\epsilon > 0$. If the "fall in employment" effect is not too strong i.e. $[\frac{t\bar{x}+\varphi}{\bar{w}}\frac{\mu\pi\bar{x}^2}{L_4}\epsilon]$ takes a value less than 1,the expected wage rises.Consequently, at the wage rate prevailing at the urban informal sector and rural sector, migration starts from the rural area to the city causing shortage of labour in rural sector, pushing up the market wage rate. The new equilibrium wage rate that stops migration is higher than the initial wage rate. Since the cost of employing labor rises, the rural farm sector reduces the use of labour. The displaced labour gets reallocated at urban informal sector and the rural non-farm sector. Given the density of the city the increase in urban informal labour force exactly balances the fall in urban formal labour force. Therefore, the residual labour unable to enter either the urban informal sector or the rural farm sector, settles in rural non-farm sector and the ratio of non-farm to farm job in the rural sector rises. Hence a village that already satisfies the demographic conditions tends to satisfy the labour market condition as well to get converted in CT. The opposite happens, if the "fall in employment" effect is strong i.e. $[\frac{t\bar{x}+\varphi}{\bar{w}}\frac{\mu\pi\bar{x}^2}{L_4}\epsilon]$ takes a value greater than 1. In such a situation, the expected wage falls because of higher uncertainty of finding job at the urban formal sector, and the reverse migration starts. At the lower market wage rate, if farm sector absorbs more labour with the limited absorption capacity compared to rural non-farm sector in short-run, the village does not transform in a CT. Notice that the higher transport cost magnifies the effect of change in higher formal wage. In presence of either a high transport cost or a larger urban sprawl, a fall in employment even of relatively small magnitude may trigger a strong “fall in employment” effect to reduce the chance of a village being transformed in a CT. Equation (11) suggests that the “fall in employment” effect essentially amplify the uncertainty about finding formal job in the urban area which is inherent in rural-urban migration.

Proposition 2: A fall in the transport cost leads to transformation of a village that satisfies the demographic conditions towards a CT.

Proof: See Appendix.

At the wage rate prevailing at the urban formal sector, informal sector and the rural area, a fall in transport cost leads to a rise in net expected wage in the city which starts migration from rural area to the city. In response the common wage rate at the urban informal sector and the rural sector rises at the equilibrium and the rural farm sector shrinks. Given density of the city, the displaced labour cannot enter the urban informal sector. Therefore, the size of labour force in the rural non-farm sector rises. Hence a village that already satisfies the demographic conditions tends to satisfy the labor market condition as well to get converted in a CT.

At the urban equilibrium, all the households living in different locations of the city must enjoy the same utility level. Otherwise, a household moves from one part of the city to the other. This implies decline of housing price/square-feet as distance from the centre of the city rises. The declining housing price/square-feet compensates for the rising commuting cost from a more distant location, which is the way the utility level stays constant at every location of the city. Therefore, the declining housing price/square-feet mirrors the explanation given in terms of commuting/transport cost in the chapter. In absence of housing price data, in empirical exercise, we use the transport cost data for the empirical analysis below.

Proposition 3: More ‘formalization and sanitization’ in cities leads to transformation of a village to a CT.

Proof: **See Appendix.**

More ‘formalization and sanitization’ in cities like removing encroachments, slums, petty commercial establishments, squatter settlements and judicial intervention to remove undesirable urban growth results in fall in the population density of a city. Since the urban formal sector with minimum wage legislation has a fixed absorption capacity of labour, this in turn leads to a fall in the participation in the urban informal sector. The displaced labour reverts back, market wage falls, both farm and nonfarm sector now employs more labour If the rural non-farm sector employs more labour compared to rural farm sector which has limited absorption capacity in the short run the village transforms to CT. Thus, if population density falls in the city, there is a rise in the ratio of non-farm employment to farm employment in the village inducing the transformation of village to a CT.

Proposition 4: An expansion in the boundary of the city leads to fall in the tendency of a village to become a CT.

Proof: **See Appendix**.

An expansion of the boundary of the city or urban sprawl causes more people living in the city. Given the population density of the city and limited absorption capacity of the urban formal sector it leads to a rise in the urban informal labour force, which comes from rural non-farm sector. So, the chance of a village transforming into a CT falls.

2.3. Empirical Testing of the Hypotheses

We use the following regression equation for empirically testing the validity of the theory suggested above:

$$y_{ij=}\alpha + \beta x_{ij} + D_j + u_i \qquad (13)$$

where, the dependent variable y_{ij} is a binary variable: $y_{ij} = 1$ defines a village i in district j which was 'would be CT' in Census 2001 and was identified as CT in Census 2011 and $y_{ij} = 0$ denotes a village which was 'would be a CT' in Census 2001 and was not identified as CT in Census 2011. The vector x_{ij} represents thevillage-specific characteristics which help transforming village i into a CT. D_j represents district specific dummy which takes into account of the fixed factors associated with the district where the CT/village i is located. u_i represents the random error associated with regression which we assume to be independently normally distributed. The district specific fixed factors would usually stand for the historical or social factors which are specific to a district and may have contributed to the growth of CTs. The independent variables represented by the vector x_{ij} are:

DENS: population density of the city/ST nearest to a village;
AREA: area of the city/ST nearest to the village;
DISTN: nearest city/ST road distance from the village;
BANK: number of bank branches in nearest city/ST to the village.
DISTN has been used as a proxy variable of transport cost used in the theoretical model. BANK has been used as proxy variable of urban formal wage. Since wage in the formal

sector is credited through banks, the number of branches of banks has been used as proxy variable for formal wage in the urban sector. It is expected that the number of bank branches in a city/ST has an association with extent of formalization of employment in the nearest city/ST. Hence, we have used it as a proxy variable for formal wage. As explained in the theoretical model, we expect that the regression coefficients of DENS, AREA and DISTN to be negative. On the other hand, coefficient of the explanatory variable BANK can either be positive or negative depending on the strength of the "fall in employment" effect as explained in the discussion following proposition 1.The existence of a sufficiently strong "fall in employment" effect would imply a negative coefficient of BANK. For weak "fall in employment" effect, it is expected to be positive.

2.3.1. Data and Estimation Procedure

The data used to analyze the above empirical model is taken from CTs/Villages Directory of West Bengal for2001 and 2011 extracted from Census of India (2001 and 2011).During the period 2001-2011 there has been maximum increase in terms of the number of CTs for West Bengal among the states in India. Hence this state becomes the focus of empirical analysis for the theoretical model set above. It is not that all the villages in West Bengal, which were identified as 'would be CTs' in Census 2001, have a nearby city (with population exceeding 1lac). In the absence of such cities we have used those urban bodies which have the status of ST and we have taken their population density and area as explanatory variable for our analysis. But all STs are not large enough to trigger migration from nearby villages. For solving this problem, we looked at the distribution of bank branches at the city and STs of West Bengal and considered only those STs in which the number of bank branches is above the median (turns out as 15). Table 2.1 below describes the data,

Variable Name	Mean	Standard Deviation	Minimum Value	Maximum Value
Dependent Variable (=1, for villages transformed to CT) (=0, for villages not transformed to CT)	0.80	0.40	0	1
DENS(population/sq.km)	12618.62	6901.34	1884	24841
AREA(in square km)	56.11	62.92	5.85	185
DISTN(in km)	27.15	28.31	0	165
BANK	189	369	15	1007

Table 2.1: Descriptive Statistics (City specific factors)

Source: Census of India(2001 and 2011)

The descriptive statistics presented in table 2.1 shows the mean, standard deviation, maximum value and minimum value of all the explanatory variables. The dependent variable has mean of 0.80 which means that 80% of the villages which were 'would be' census town in 2001 got converted into CT in 2011.Population density of the nearest city/ST from a 'would be CTs in 2001' vary from 1884 per square kilometer to 24841 per square kilometer with the mean at 12618.6per square kilometer. The maximum is corresponding to the city of Kolkata. The area of such city/ST has mean of 56.11 square kilometer with standard deviation 62.92.The distance of such a city/ST from a 'would be CTs in 2001'has mean distance of 27.15 Kilometers with minimum distance of0 km to the longest distance is 165 km. The number of branches of the banks vary from1007 to 15 with the mean of 189 on an average for the nearest urban bodies from the 'would be CTs in 2001'. The maximum number of bank branches belongs to the city of Kolkata.

We use logit regression for binary dependent variable taking the values 1 and 0.If Pi is the probability associated with the occurrence of the event and(1- Pi) is the probability associated with the non-occurrence of the event, Pi /(1- Pi) is the odd ratio and log{Pi /(1-Pi)}is the log-odd ratio or logit function. The logit function is a function of one or more independent variables whose parameters are estimated. While running the regression we take log transformation of the explanatory variables DENS, AREA, BANK and DISTN to reduce the variability. Initially we run two specifications of the same logit regression to test the hypothesis. While in the first specification the fixed effects are not controlled, in the second specification we control for district specific fixed effects. Later we run a third specification by dropping DISTN from the set of explanatory variables for checking robustness of the results.

2.3.2. Results

The results of the empirical testing are presented in the table 2.2 below.

Independent Variables	Regression 1	Marginal effect	Regression 2	Marginal effect	Regression 3	Marginal Effect
DENS	.50*** (.23)	.07	-.06 (.38)	-.008	.11 (.38)	.02
AREA	.20 (.20)	.03	-.79*** (.41)	-.10	-.83*** (.41)	-.12
DISTN	.29*** (.09)	.004	.35*** (.11)	.04	-	-
BANK	.04 (.14)	.007	1.19*** (.29)	.15	1.08*** (.29)	.15
District Specific Fixed Effect	No	-	Yes	-	Yes	-
N	657	-	657	-	657	-
Pseudo R^2	.06	-	.17	-	.14	-

Table 2.2: Regression Results (City specific factors)

Dependent Variable: Transformation of a village which was “would be Census Town‟ of Census2001 to Census Towns in Census 2011 (yij)

Note: Robust standard errors in the parentheses.

$* p < 0.10, ** p < 0.05, *** p < 0.01$

Notice without fixed effect that the coefficient of DENS (the density of population at the nearest city/ST) is positive and significant at 1percent level. However, as the regression specification considers district fixed effects DENS is significant no longer and its coefficient becomes negative. The opposite is the case for AREA (area of the nearest city/ST) and BANK (the number of bank branches in the nearest city/ST). While the coefficient of AREA is negative and significant at 1 percent level in presence of fixed effects, the coefficient of BANK is positive and significant at 1 percent level. The explanatory variable DISTN (distance to the nearest city/ST) is significant at 1percent level in both the specifications. Notice that from the theory we expected the regression coefficients of DENS, AREA and DISTN to be negative. The fixed effect regression gets the signs of all the coefficients correct except DISTN. The result shows that 'formalization of cities' argument forwarded by Kundu (2011b) is not a significant factor explaining the birth of the CTs. The coefficient of BANK turns out to be significantly positive, showing the existence of weak "fall in employment" effect in data. In West Bengal a rise in formal sector wage rate raised the expected wage and the market wage rate, helping formation of CTs.

Table 2.2 also calculates the marginal effects of all the explanatory variables on the dependent variable. In presence of district specific fixed effects, 1 percent increase in the nearest city/ST area(AREA)reduces the probability of a village designated as a 'would be CT' in Census 2001 to be transformed into a CT by 0.1 percent. Similarly, 1percent increase in nearest city/ST road distance (DISTN) increases the chance of such a village tobe transformed into a CT by 0.04 percent. The corresponding escalation of probability for number of banks in the nearby city/ST (BANK) is 0.15percent.

What explains the anomalous sign of DISTN derived from the regressions? Notice that the DISTN has been used in the regression as a proxy for 'transport cost' in the theory. But DISTN may not be a good measure of transport cost specially when the transport cost depends on quality of road and transport services. With better road condition and improved quality of transport services a greater distance can be travelled at a lower cost. Since we do not control for these factors owing to lack of data, possibly we get an anomalous sign of DISTN in the regression. Also, if transport system improves to connect an 'would be CT' is more conveniently to the nearest city/ST, endogeneity problem may arise in the regression specification run above. However, because of lack of data we are not sure whether this has actually happened11.When we drop DISTN from the set of explanatory variables the coefficients of AREA and BANK maintains their sign and level of significance. The sign of DENS changes from negative to positive but remains insignificant. While the marginal effect of AREA becomes stronger, the marginal effect of BANK remains the same as before.

2.4. Conclusions

The dynamics of the growth of the Census Towns (CTs) in India in the recent period attracts the interest of social scientists as this sudden increase in the number of CTs is unprecedented in the context of urbanization in India. The present chapter tries to find the significant factors that explain the formation of CTs.

Although the astonishing growth of CTs in India has been in the limelight in the context of urbanization in recent times, there is dearth of literature addressing this issue. The chapter constructs a theoretical model which is nested in the urban economics literature. It exploits the rural-urban labour movement dynamics to develop some hypotheses. The model shows that the factors like the fall in cost of commuting to the nearby large urban area, the fall in the density of the population in the nearby urban area (due to formalization/sanitization) helps formation of the CTs. The effect of a rise in the formal wage rate is not certain, as it

[11] There is a possibility that as suggested by Ghani et al. (2012), because of the development of the Golden Quadrilateral road project in this period, some of the formal sector industries shifted their locations outside the big cities owing to better road connectivity. The local agglomeration created by this, created CTs further away from the urban centres. But this argument needs to be explored further and beyond the scope of the present chapter.

adds to uncertainty of obtaining a formal sector employment in urban area. The formation of a CT is facilitated if only if the expected wage rises consequent on a rise in the formal sector wage. CTs are more likely to be developed near urban centres with lower extent of urban sprawl. As the theory is tested empirically by using data from the state of West Bengal during 2001-2011 where the growth rate of census towns had been one of the highest in India, it turns out that the higher formal sector income in the nearby urban centres with lower extent of urban sprawl is the major factor explaining the birth of Census Towns. The finding is corroborated by the fact that annualized growth of urban wage was 4.9% during 1993-94 to 1999-2000, much higher compared to 2.4% during 1983-1993-94 (Bhalla and Das (2006))12. The results also show that 'formalization of cities' argument forwarded by Kundu (2011b) is not a significant factor explaining the birth of the CTs.

Both the theory and empirics developed in the present chapter suffers from some limitations. First, the theory precludes the use the local/global capital in the agricultural production and local capital (however small) in the rural non-farm sector/urban informal sector. An inflow of global capital in a capital scarce economy like India may lead expansion of urban formal sector. This may trigger migration but in an extremely congested city and the existence of large informal sector may forbid them to enter into the urban economy. The residual labour force then enters into rural nonfarm sector and the CT dynamics accelerate. A more detailed analysis about the role of capital will lead to a more complete analysis. Second, on the empirical side the treatment of 'transport cost' in this chapter is not adequate. The distance from the nearest urban centre may not be a good measure of transport cost since both the quality of roads and transport services matter. Third, the chapter only exploits the 'pull' factors from the urban centres as channel of

[12] Tripathi (2015) reports that urban net domestic product (NDP) has grown at higher rate during 1993-1994 to 2004-2005 period compared to previous periods. In particular, the growth rate of service sector was as high as 11.5% during 1993-94 to 1999-2000 and the growth of industry was as high as 7% during 1999-2000 to 2004-05.

explanation towards the birth of the Census Towns; but the changes in the villages that are 'would be Census Town' may also turn out to be important in explaining the birth of the Census Towns. All these remain as our future research agenda.

Appendix

Proof of Proposition 1. Differentiatingequation (5) with respect to $\bar{w}$ and using equation (11) we get:

$$\frac{\partial L_1}{\partial \bar{w}} = \frac{\partial L_1}{\partial w}\frac{\partial w}{\partial \bar{w}}. \quad \text{(A.1)}$$

From equation (11):

$$\frac{\partial w}{\partial \bar{w}} = 1 - \frac{t\bar{x}+\varphi}{\bar{w}}\frac{L_3+L_4}{L_4}\epsilon \text{(A.2)}$$

where, $\epsilon = -\frac{\bar{w}}{L_4}\frac{\partial L_4}{\partial \bar{w}} > 0$.

Using equation (6), (A.2) can be written as:

$$\frac{\partial w}{\partial \bar{w}} = 1 - \frac{t\bar{x}+\varphi}{\bar{w}}\frac{\mu\pi\bar{x}^2}{L_4}\epsilon.$$

Therefore, $\frac{\partial w}{\partial \bar{w}} >=< 0$ if and only if $1 - \frac{t\bar{x}+\varphi}{\bar{w}}\frac{\mu\pi\bar{x}^2}{L_4}\epsilon >=< 0$. Since, $\frac{\partial L_1}{\partial w} < 0$ from equation (4), from equation (A.1), $\frac{\partial L_1}{\partial \bar{w}} <=> 0$ if and only if $1 - \frac{t\bar{x}+\varphi}{\bar{w}}\frac{\mu\pi\bar{x}^2}{L_4}\epsilon >=< 0$.

Differentiating equation (12) with respect to wage $\bar{w}$ and using equation (6) and (A.1) we obtain:

$$\frac{\partial L_2}{\partial \bar{w}} = -\frac{\partial L_1}{\partial w}\frac{\partial w}{\partial \bar{w}} =. -\frac{\partial L_1}{\partial \bar{w}}.$$

Since$\frac{\partial(\frac{L_2}{L_1})}{\partial \bar{w}} = -\frac{1}{L_1}\frac{\partial L_1}{\partial \bar{w}}(1+\frac{L_2}{L_1})$, sign $(\frac{\partial(\frac{L_2}{L_1})}{\partial \bar{w}}) = -$ sign $(\frac{\partial L_1}{\partial \bar{w}})$.

The statement of the proposition follows from inequality (1).□

Proof of Proposition 2. Since a change in t and a change in β creates have identical effect on $(\frac{L_2}{L_1})$, without loss of generality we discuss the case of change in t.

Differentiating equation (12) with respect to $t$and using equation (11) in it we obtain

$$\frac{\partial L_2}{\partial t} = -\frac{\partial L_1}{\partial w}\frac{\partial w}{\partial t} \leq 0.$$

Since,$\frac{\partial w}{\partial t} = -\bar{x}(\frac{L_3+L_4}{L_4}) < 0$ (from equation (11))

$$\frac{\partial(\frac{L_2}{L_1})}{\partial t} = \frac{L_1\frac{\partial L_2}{\partial t} - L_2\frac{\partial L_1}{\partial t}}{L_1^2} = \frac{1}{L_1}(-\frac{\partial L_1}{\partial w}\frac{\partial w}{\partial t}) - \frac{L_2}{L_1}\frac{1}{L_1}(\frac{\partial L_1}{\partial w}\frac{\partial w}{\partial t}) = -\frac{1}{L_1}(\frac{\partial L_1}{\partial w}\frac{\partial w}{\partial t})(1+\frac{L_2}{L_1}) \leq 0.$$

The statement of the proposition follows from inequality (1).□

Proof of Proposition 3. Differentiating equation (12) with respect to μ we obtain

$$\frac{\partial L_2}{\partial \mu} = -\frac{\partial L_3}{\partial \mu} \leq 0.$$

Since,$\frac{\partial L_1}{\partial L_2} \leq 0$(From equation (2))

$$\frac{\partial (L_2/L_1)}{\partial \mu} = \frac{L_1 \frac{\partial L_2}{\partial \mu} - L_2 \frac{\partial L_1}{\partial \mu}}{{L_1}^2} = \frac{1}{L_1}\left(\frac{\partial L_2}{\partial \mu} - \frac{L_2}{L_1}\frac{\partial L_1}{\partial \mu}\right) = \frac{1}{L_1}\left(\frac{\partial L_2}{\partial \mu} - \frac{L_2}{L_1}\frac{\partial L_1}{\partial L_2}\frac{\partial L_2}{\partial \mu}\right) \leq 0.$$

The statement of the proposition follows from inequality (1). □

Proof of Proposition 4. Differentiating equation (12) with respect to $\overline{x}$ we obtain

$$\frac{\partial L_2}{\partial \bar{x}} = -\frac{\partial L_1}{\partial w}\frac{\partial w}{\partial \bar{x}} - \frac{\partial L_3}{\partial \bar{x}} \leq 0.$$

Since from equation (2)$\frac{\partial L_1}{\partial L_2} \leq 0$

$$\frac{\partial (L_2/L_1)}{\partial \bar{x}} = \frac{L_1 \frac{\partial L_2}{\partial \bar{x}} - L_2 \frac{\partial L_1}{\partial \bar{x}}}{{L_1}^2} = \frac{1}{L_1}\left(\frac{\partial L_2}{\partial \bar{x}} - \frac{L_2}{L_1}\frac{\partial L_1}{\partial \bar{x}}\right) = \frac{1}{L_1}\left(\frac{\partial L_2}{\partial \bar{x}} - \frac{L_2}{L_1}\frac{\partial L_1}{\partial L_2}\frac{\partial L_2}{\partial \bar{x}}\right) \leq 0.$$

The statement of the proposition follows from inequality (1). □

CHAPTER 3*

GROWTH OF CENSUS TOWNS: VILLAGE AND TRANSPORT SPECIFIC FACTORS

*This chapter is based on

Chakrabarti, S, Mukherjee, V (2022). Role of transport infrastructure in birth of Census Towns in West Bengal. Asia Pacific Journal of Regional Science DOI:10.1007/s1685-021-002244-5

3.1. Introduction

In this chapter we study the role of transport infrastructure and local non-tradables in CT birth. In Indian Census the growth of villages in small towns (called Census Towns) accounted for almost 30% of urbanization during 2001-11, which was significantly higher than the preceding decades. This chapter evaluates the role of transport infrastructure in this phenomenon by using the data from state of West Bengal. India’s pattern of urbanization inherited from the colonial period was biased towards large cities. But it has been showing a reverse trend in the decade spanning from 2001 to 2011owing to the growth of small or medium sized towns called ‘Census Towns’ (CT).These towns, which actually are reclassified from the villages by fulfilling the criteria that they have (1) a population of 5000 or more, (2) population density of at least 400 per square kilometer, (3) 75% of its male main workforce working in non-farm sector, and (4) administered by rural local governments, show an unprecedented numerical increase during the period 2001-2011. In fact, they contribute to almost 30% of total urbanization in India during the said period.

Between 2001 and 2011 the pattern of urbanization in different states of India has not been the same. Mathur et.al(2021) through their analysis of migration tables provided by the Census (2011)show that while in states like Bihar and Uttar Pradesh the urbanization was dominated by natural increase in population; in states like Maharashtra and Gujarat it was mainly by rural-urban migration. In states like West Bengal and Kerala, the CT growth was the dominant form of urbanization. All the above mentioned factors were balanced in the case of states like Haryana and Andhra Pradesh. The motivation of studying the case of West Bengal in the present chapter follows from the fact that it had the highest absolute number of new CTs born among all Indian states in this period.

West Bengal is a state located in Eastern part of India sharing its international border with Bangladesh. It also shares its border with Indian states of Odisha, Jharkhand, Bihar, Sikkim and Assam. Kolkata is the capital of the state, which is also the third largest city of India. According to Census (2011) it is the fourth most populous state of India with a population of 91,347,736. Around 4.92 percent of the population lives in Kolkata. In terms of area it is the thirteenth largest state in India with an area of 88,752 square kilometer. In 2011 it was divided into 19 districts including Kolkata, sixteen percent of which were more than fifty percent urbanized. The spatial distribution of the new CTs in the state according to Census (2011) is shown in the map of West Bengal below.

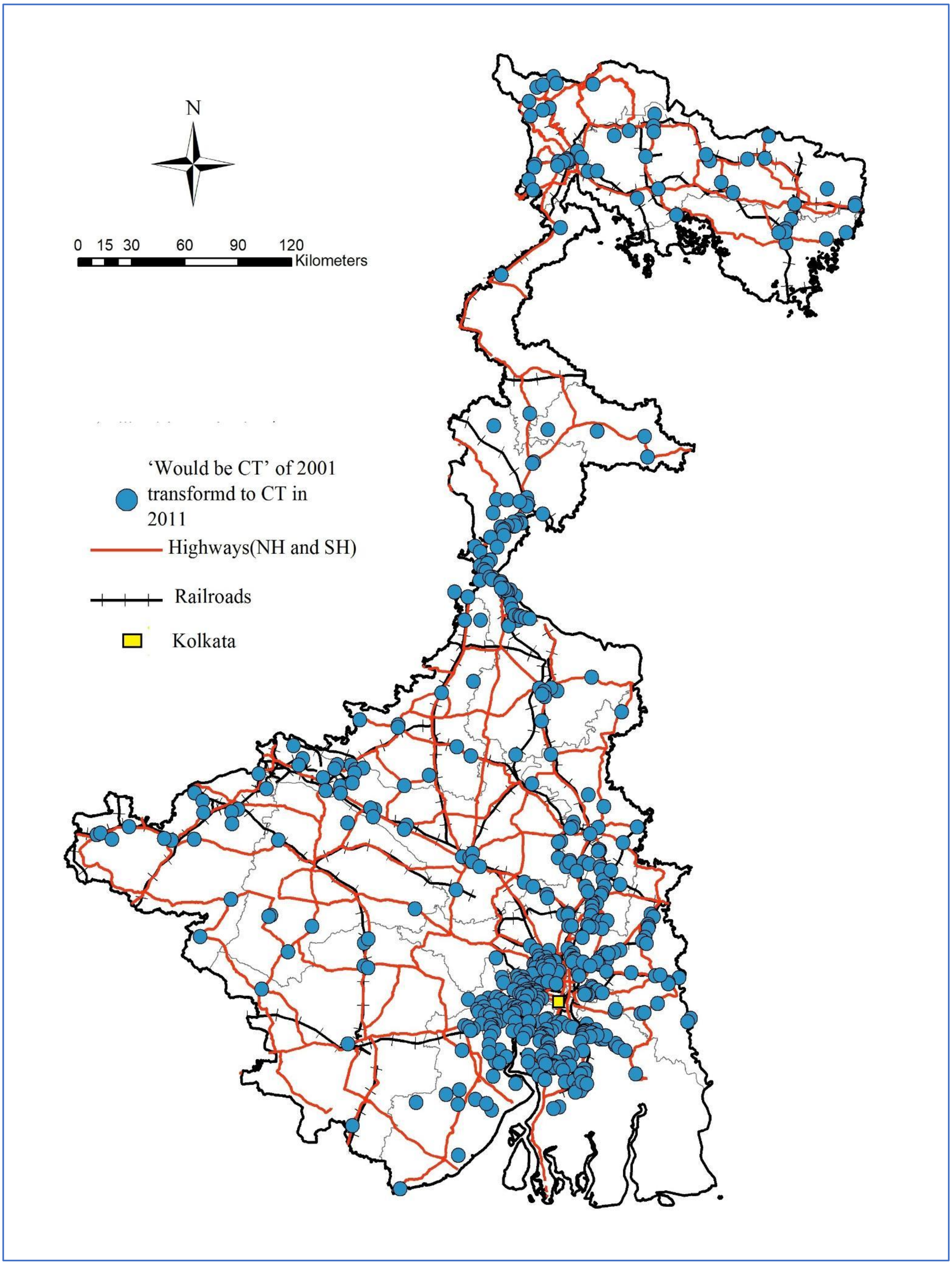
The literature of role of transport cost on the economy finds evidence both in favor and against agglomeration towards and dispersion from city or urban centre. With falling domestic transport cost economic production should have evenly spread across all the regions in a country. However, an opposite trend is observed where falling transport cost coincided with greater economic concentration within countries(WDR,2009).The pioneering paper by Krugman (1991) on economic geography explores how centripetal force accelerates with labor and capital are attracted towards the city as a result owing to the fall in transport cost. However, rising cost of non-tradable commodities in the city like price of housing, clean environment, congestion-free traffic can disperse the centripetal forces mentioned by Krugman (1991) as pointed out by Helpman (1998) and if transport cost is very high, an existing agglomeration grows in its population size. While in the former, a lower transport cost due to improved infrastructure, promotes growth of an existing agglomeration with higher welfare of its residents at the cost of the smaller agglomerations at its neighborhood, in the later, a smaller agglomeration grows in terms of population with falling welfare level of its existing residents. Chandra and Thompson (2000) in the context of US, shows the effect of the highways built between 1969 and

1993. While it raised the income of the rural counties through which they pass but the income of the adjacent counties was reduced as a result. Baum –Snow et al.(2020) show with Chinese data show the outcome of investing in local transport infrastructure. Instead of promoting the growth of hinterland often it has a self-defeating impact of losing economic activities and specialization in agriculture in those areas.

In Indian context, there are certain village centric views like Aggarwal (2018) that shows that expansion of rural roads and transport infrastructure results in greater market integration, reduced price of non-local goods,wider variety of consumption basket in rural areas. It also leads to greater participation of local teenagers in the expanded labor market. Mukhopadhyay et al.(2016) emphasizes on the role of connectivity along with growing rural income as the main driving forces for the growth of small scale non-tradable services which are the main sources of non-farm employment in these settlements with an investigation in certain CTs in northern India. Van Dujine and Nijman (2019) based on their fieldwork in West Bengal and Bihar show that a sizable portion of urban growth has gone unrecorded in official statistics due to technical reasons. There are cases where the boundaries of existing agglomerations could be redefined as a new urban settlement. However, they also notice that in these states there has been a shift in the employment structure away from agriculture causing in situ urbanization in a dispersed manner. They identify the absence sufficient employment opportunities in existing urban settlements or major cities as one of the reasons behind this dispersed pattern of urbanization. Mathur et al. (2021) also confirm this trend by use of National Accounts Statistics, National Sample Survey and Annual Survey of Industries data made available by Government of India. However, none of these chapters discuss the role of transport infrastructure in birth of the new CTs as we do in the present chapter.

The district level infrastructure partly facilitates the relocation of organized manufacturing industry to rural locations while the unorganized manufacturing shows tendency to migrate to urban locations as found by Ghani et al.(2012).Such movement seems to be partially explained by the development of national level highways especially the construction of Golden Quadrangle, a highway project undertaken by Government of India that was implemented in the study period. However, there is a very limited impact of Golden Quadrangle on unorganized manufacturing outside the nodal districts where the more than one highways meet.Sharma (2013) claims that commuting to the nearest city is an important reason for observed expansion of non-farm employment in the villages. Balakrishnan (2013) with two examples of Bangalore-Mysore highway and Pune-Nasik highway demonstrates that the urbanization along highways has been the emerging pattern of urbanization in developing countries. Based on NSSO 55thround(1999-2000) 66th round (2009-2010),68th round(2011-2012) data, Mahajan and Nagraj (2017) argues that the road construction projects undertaken in India during 2000-2012, both highways and rural roads, expanded rural construction demand and employment.

Figure 3.1: The spatial distribution of CTs in Census 2011 that had been classified as 'would be CTs' in Census 2001



There were 659 villages from 18 districts (excluding Kolkata) considered as ‘would be CTs’ in Census (2001) as they were likely to fulfil all the criteria of a CT in the next census. Eighty percent of these villages were transformed into CTs in Census (2011).The emergence of these CTs does not rest much on population growth as most of them already achieved a population size of 5000 in Census (2001). This chapter mainly shows how the economic forces working through transport infrastructure helped them to grow their non-agricultural sector employment such that they could become CTs. The map shows that 46% of these new CTs were born in the districts of North and South Twenty Four Parganas and Haora, which share their border with Kolkata. There are sixteen National Highways of length 3565 km. pass through West Bengal. Only four of them connects the city of Kolkata. Similarly, there are fifteen state highways of length 4505 km[13] , which are spread across the state with no direct connection to the city of Kolkata. The length of railways in West Bengal in 2011 was 3937 km[14]. The local roads are however not shown in the map. The chapter investigates whether the existence state/national highways, railways in the neighborhood increases the probability of a village, designated as a ‘would be CT’ in Census (2001)of getting converted into a CT in Census (2011). It also studies the role the density of local roads play in the process.

This chapter contributes to the literature in a number of ways. First, it analyzes both the forces of agglomeration and dispersion that work because of development of transport infrastructure like highways, rail head and local roads. It looks at interaction of each of the highways and rail infrastructure with local roads. In the analysis it not only juxtaposes the transport infrastructure variables, also controls for nearness to the city and local amenities at the villages. Second, it finds that the state and national highways located near the city increases the probability of a village turning into a CT. The closer the distance, the higher

[13]See wbtrafficpolice.com accessed on 28.09.2021.
[14]See https://www.statista.com/ accessed on 28.09.2021.

is the chance of a successful conversion. Contrary to the existing literature, in case of West Bengal, the chapter finds that although local roads have a positive impact, do not significant influence in emergence of CTs except in the cases where it complements the highways. However, the nature of complementarity is different at the districts bordering the city of Kolkata compared to what we generally observe in the state. While generally it supports the forces of dispersion from the existing cities, in the neighborhood of Kolkata it supports the forces of agglomeration. Third, the GQ project in West Bengal has a weaker role compared to the state/national highways in turning the prospective villages into CTs. Fourth, commuting is in general is not an important factor in formation of CTs in West Bengal. Fifth, in case of West Bengal, with its uneven pattern of development centered around its capital city of Kolkata, all other things remaining the same the villages had a higher chance of getting converted in a CT in the districts bordering Kolkata. The results are new in the literature and important for policy making.

The plan of the chapter is as follows. The next section discusses the theoretical possibilities of conversion of a village into a CT due to improvement of transport connectivity and due to increased amenities at the villages. Section 3 describes the empirical strategy of the chapter with data, estimation procedure and the results discussed in different subsections. Section 4 concludes.

3.2. The Theoretical Possibilities

In this section we describe the theoretical ways the development of transport infrastructure and non-traded service sector can influence the criteria, (1) a population of 5000 or more, (2) population density of at least 400 per square kilometer, (3) 75% of its male main workforce working in non-farm sector, which may turn the villages in West Bengal into a CT.

3.2.1. Improvement of Transport Infrastructure

In West Bengal the improvement of transport infrastructure at a village can occur in three different ways: (1) development of a highway that connects cities may pass through vicinity of the village; (2) improvement of rail-connectivity of the village to the cities; (iii) improvement of local road network near the village.

We will discuss the theoretical implications of each of them below.

(1) Development of a highway in the neighborhood of a village:

The development of a highway would lower the transport cost between the village and the nearest city. The theory proposed by papers like Janelle (1968), Krugman (1991) suggest that this would trigger the forces of agglomeration to attract labour and capital from the village to the city. Therefore, the chance of the village, getting converted in a CT diminishes as it loses both its population and non-farm production units to the city. The non-farm products are carried from the city to the village at lower price that now specializes in farm production. However, in a framework of continuum of cities and villages along a highway, Rossi-Hansberg (2005) argues, it is perfectly possible that in response to the lower transport costs the industry disperses geographically and new CTs develop specializing in production of intermediate goods, which is a view opposite of Krugman (1991) as they argued that both the final good production and the intermediate good production would agglomerate in the existing city. Helpman (1998) also opposes Krugman (1991) view by pointing out that from lowering of the transport cost a force of dispersion would come into play to disperse the non-farm activities and labour force to the neighboring villages. This happens because of rise in prices of non-tradables like housing, clean-environment, congestion-free traffic etc. in the existing big cities. The force of dispersion increases the chance of a village, neighboring a city transforming into a CT. The closer is the village to the city, it seems that following the idea of gravity in trade

(Head and Mayer 2014),it has a better chance of getting converted in a CT[15]. The 'nearness' of the city also increases the possibility that labours commute daily from the village to the city for their work rather than staying put at the city.

(2) Improvement of rail-connectivity to the cities:

The consequences of rail connectivity are expected to be similar to the consequences of development of highways as described above, except for the crucial difference that exists between two alternative modes of transport, the rail and the road. The rail connectivity involves higher fixed cost and lower marginal cost both for transportation of passenger and freight as the one has to approach the nearest railway station to avail the rail facility (Brueckner 2011). However, the road transport facility comes at doorstep at a higher marginal cost. Therefore, for a shorter distance the road transport seems to be a better option for transportation and for a longer distance, it is the railway. Therefore, the agglomeration and the gravity like forces discussed above are likely to be triggered more with railway connectivity if the existing city is located at a longer distance. As the nearness to the city increases, the highway connectivity seems to matter more.

(3) Improvement of local road network:

The local road network may act as a complement either to the highway connectivity or to the rail connectivity in the situation where the highway does not pass exactly through the village or the rail station is not exactly located at the village. In such situations, connectivity to the highway or the rail station from the village may play a role in aggravating the forces of agglomeration at the city. However, the forces of dispersion from the large city can also work in the opposite direction converting a village to a CT. Since a large village has asymmetric distribution of population with adjoining villages, as the local road-network improves, the forces of agglomeration may work in the same way as

[15]See Proost and Thisse (2019) for a recent survey of the literature.

described by Krugman (1991), perhaps at a smaller scale, between the adjoining small villages and the large village, which helps conversion of an already large village into a CT by attracting non-farm activity into it.

3.2.2. Development of non-tradable service sector:

Development of non-tradable services like availability of electricity services, banks and financial services, education services like schools and colleges etc. offers a better quality of life to village residents, creates more non-farm jobs and may attract more population in it. However, there exists a 'chicken and egg' problem in this process, because we are not sure whether a large population attracts better services or better services attract larger population. Although the causality cannot be ascertained, they are expected to be positively correlated with each other.

3.3. Empirics

For finding out whether connectivity to city/local connectivity explains the formation of CTs, we use the available data to run the following regression specification:

$$y_{ij} = \alpha + \beta T_{ij} + {}^{\gamma} x_{ij} + \varphi KOL_{ik} + D_j + u_{ij},$$

where the dependent variable $y_{ij}$is a binary variable that represents the CT status of the ith village in the jth district. For a CT, it takes a value of 1. Otherwise, it takes a value of 0. T_{ij} represents the set of explanatory variables related to transport infrastructure i.e. connectivity to city/local connectivity of village i, which are the main variables of interest of the present study. x_{ij} represents the set of variables that indicate the development of non-tradable service sector at the ith village in the jth district. The district specific fixed factors of district j, which are shared by all the villages located in district j, are captured through the dummy variable D_j. For checking whether proximity of Kolkata, because of uneven development of West Bengal centering around its capital city, increases the probability of a village converted to a CT, we introduce another dummy variable KOL_{ik}. It takes value of 1, if a village i belongs to a district k bordering the district of Kolkata. For all other villages it takes value of zero[16].The unobserved village specific factors are captured through u_{ij}, which we assume to be independently identically distributed across the villages.

In accordance with the theory, the set of variables included in T_{ij} are:

HIGHWAY5: A dummy variable that takes value of 1, if a highway passes through a neighborhood of 5 km radius around the center of village$i$ in district j;

RAIL 5: A dummy variable that takes value of 1, if there is at least one railway station within5 km radius neighborhood around the center of village i in district j;

NEARNESS: Reciprocal of the nearest city/ST[17] distance from the center of village i in district j.

ROAD: The length of rural roads per 1000 square km. area in district j. We assume uniform distribution of rural roads across all villages of the district.

For robustness check, we replace HIGHWAY 5 and RAIL 5, with HIGHWAY 10 and RAIL 10 which are defined accordingly. Since, the construction of the Golden Quadrilateral (GQ) changed the transport infrastructure in India during the study period, we also use a variable GQ, defined as a dummy variable that takes value of 1, if the GQ passes through the a neighborhood of 10 km radius around the center of village i in district j. We also consider interaction between the variables like (HIGHWAY 5*NEARNESS), (RAIL 5*NEARNESS), (HIGHWAY 5*ROAD) for our purpose.

[16]We thank one of the reviewers for attracting our attention to this issue.
[17]Statutory Town.

In the regression equation,the location of highways/railways are exogenous to the villages as they are constructed to connect the cities and it is coincidence that a highway/railway passes through the neighborhood of a village. The same is not applicable for local roads. However,we proxy this variable with district level density of local roads to make it exogenous to a village. The theory described earlier does not predict a definite sign for coefficients of HIGHWAY 5, RAIL 5. The negative significant sign of these variables suggest that the agglomeration effect of lower transport cost dominates its dispersion effect to attract labor and production units to city/ST, reducing the chance of a village to turn into a CT. The positive significant sign suggests the opposite. A positive significant sign of ROAD, would imply local agglomeration forces around the village dominates the agglomeration of the city/ST. Nearness of the city/ST would strengthen the force of agglomeration/dispersion originated at the city/ST. The lowering of the transport cost along with nearness would reinforce these forces. However, compared to RAIL 5, the effect of HIGHWAY 5 is expected to be more prominent if nearness to the city/ST increases.

The set of explanatory variables included in x_{ij} are:

BANK: A dummy variable that takes value of 1, if at least one branch of a commercial bank is present in village $i$at district j;

POWER: Represents percentage of electrified villages in district$j$, where village i is located.This indicates the probability of availability of power in village i in district j.

Since these variables are likely to be correlated with other factors, which we have not controlled for, the regression analysis does not establish any causality with respect to these variables. However, as the improved amenities at the villages strengthen village-centric agglomeration effect, both these variables are expected to have positive regression coefficients.

Because of uneven development of West Bengal centering around its capital cityof Kolkata, all other things remaining the same the location of a village in a district bordering Kolkata, may benefit the forces of agglomeration of the metropolitan city to get converted to a CT. Therefore the coefficient of theKOL_{ik} dummy in the regression equation is expected to have a positive sign.

3.3.1. Data and Estimation Procedure

The data used for the empirical study is taken from CTs/Villages Directory of West Bengal for2001 and 2011 extracted from Census of India (2001 and 2011) and also from State Statistical Handbook of West Bengal various years. Table 3.1 below describes the data.

Variable Name	Mean	Standard Deviation	Minimum Value	Maximum Value
Dependent Variable (1 for villages transformed to CT; 0 otherwise)	0.80	0.40	0	1
HIGHWAY 5 (1 if highway is within 5 km radius from the village center; 0, otherwise)	0.78	0.41	0	1
RAIL5 (1 if railhead is within 5 km radius from the village center; 0, otherwise)	0.38	0.48	0	1
NEARNESS (reciprocal of the distance from nearest city/ST from the village)	0.11	0.18	0.01	2
ROAD (rural road (km) in the district per 1000sq km)	11.46	9.5	3.09	30.77
HIGHWAY10 (1 if highways is within 10 km radius from the village center; 0 otherwise)	0.92	0.52	0	1
RAIL 10 (1 if railhead is within 10 km radius from the village center; 0 otherwise)	0.57	0.69	0	1
GQ (1 if Golden Quadrangle is within 10 km radius from the village center; 0 otherwise)	0.09	0.28	0	1
BANK (1,if at least one commercial banks in the village; 0 otherwise)	0.51	0.50	0	1
POWER(percentage of electrified village in the district 2001)	93.7	11.86	53.20	100
KOL (1 if the village is located in a district bordering Kolkata, 0 otherwise)	0.46	0.49	0	1

Table 3.1: Descriptive Statistics (Village and transport specific factors)

Source: Census of India (2001 and 2011) and State Statistical Handbook of West Bengal (various years).

Table 3.1 shows that 80% of the villages which were 'would be' census town in 2001 got converted into CT in 2011. Among the transport cost related explanatory variables of this change, HIGHWAY5 has mean of 0.78 implying that in 2007-2008, a highway passed through 5 km neighborhood of 78 percent of the villages considered in this study. Notice that HIGHWAY10 has mean of 0.92,which implies that if 10km radius is considered, around the same time, 92 percent of villages had a highway in their neighborhood. The highway can either be a national highway or a state highway. The highways constructed under the Golden Quadrangle (GQ) project by the middle of the decade, passed through the 10km radius of only 9 percent of the sampled villages. The data shows, around 2007-08, 38 percent of the villages had a railway station within 5 km radius. As the radius was extended to 10 km, 57 percent villages had a rail station within it. For the NEARNESS variable, for the sampled villages the mean is 0.11, with maximum of 2 and minimum of 0.01. Notice that, as the distance of a village from the nearest city/ST increases, the value of NEARNESS variable falls. In the case of the variable ROAD, the village level data was unavailable. Therefore, we have proxied it with the data on the roads maintained by the local administrative bodies like Gram Panchayats, Panchayat Samitis and Zilla Parishads aggregated at the district level. The data has been normalized per 1000 square km area of the district. The average length of local roads per 1000 sq km in the districts of West Bengal by 2007-08 was 11.46 km with a minimum of 3.09 km in the district of Darjeeling and maximum of 30.77 km in the district of South 24 Parganas. The assumption, here, is that the road allocation is uniformly distributed among all villages in a district.

For the non-tradable service sector related explanatory variables, it turned out that by 2007-08, the time when the Census operation took place, 50 percent of villages included in our study had at least one commercial bank branch located at the village. Since we do not have electrification data at the village level, we have proxied it by the district level data. On average, 93.70 percent of villages were electrified across all districts in West Bengal in

2001 with minimum of 53 percent and maximum of 100 percent. We interpret this data as probability that a village in a particular district receives the electricity service. Since, by 2007-08 almost all the villages received electricity services, the 2001 data also may be considered as indicator of average quality of electricity services in the villages as the newly connected villages experience unstable services in the initial years of connectivity.

There are three districts in West Bengal that share their border with the district of Kolkata. They are Haora, North and South Twenty Parganas. Of the 659 villages in our sample, 46% belonged to these districts.

We use probit regression as the dependent variable is of binary nature, taking the values 1, if a village identified as 'would be CT' in Census (2001) gets converted to a CT in Census (2011). Let P_i be the probability at which a village is converted to a CT. We allow the corresponding probability distribution to be associated with a cumulative normal distribution, Y = $\phi(x\beta + u) \in (0,1)$ so that $x\beta + u = \phi^{-1}(\mathrm{Y})$. Notice,

$$\mathrm{Y}' = x\beta + u.$$

Since the dependent variable takes the value 0 and 1, we assume, Y' takes the value 0 and 1. The above function $\mathrm{Y}' = x\beta + u$ is called the probit function whose parameters are to be estimated.

In our regression strategy, first, we regress the dependent variable with respect to the 'connectivity to city/local connectivity' variables and then with the 'non-tradable sector' variables like BANK and POWER. In the final specification, both types of explanatory variables are combined. In each specification we run two versions, one with district specific fixed effect (DSFE) and the other, without district specific fixed effect. The KOL_{ik} dummy is included in every specification.In each specification, robust standard error has been calculated to control for possible heteroscedasticity.

In regression set 1, in the connectivity variables we consider only the highway and the rail connectivity within 5 km radius, the local road network and their interactions. We also control for the role of NEARNESS. Since some parts of existing national highways are also part of the GQ project, the HIGHWAY and GQ variables show strong correlation with each other. Therefore, we run a separate set of regressions (regression set 2) exclusively with GQ as connectivity variable, which evaluates the role of GQ in converting the villages into CT. Regression set 3, reruns regression set 2 described above, considering 10 km radius for the highway/rail connectivity variables instead of 5 km radius considered earlier. This is done for robustness check. We also calculate the marginal effects for each set of regressions.

3.3.2. Results

The results of the first set of regression are presented in the table 3.2 below.

Explanatory Variables	PROBIT1	PROBIT2	PROBIT3	PROBIT 4	PROBIT 5	PROBIT 6	PROBIT 7	PROBIT 8
HIGHWAY5	1.10*** (.14)	1.23*** (.17)	1.41*** (.18)	1.43*** (.19)			1.44*** (.22)	1.45*** (.24)
RAIL5	-.04 (.14)	-.08 (.17)					-.07 (.18)	-.12 (.26)
NEARNESS	-.50 (.72)	-.44 (.69)					-.11 (.89)	-.17 (.91)
ROAD			.01* (.01)	.01* (.01)			.03* (.01)	.03* (.01)
HIGHWAY5*NEARNESS	-.22 (.86)	-.26 (.88)				-	-.17 (.44)	-.60 (.97)
RAIL5* NEARNESS	-.01 (.01)	-.01 (.01)					-.01 (.01)	-.01 (.01)
HIGHWAY5*ROAD			.01** (.01)	.01** (.01)			.01* (.01)	.01* (.01)
BANK					1.24*** (.18)	1.28*** (.19)	1.30** (.17)	1.33** (.19)
POWER (LOG TRANSFORMED)					1.12*** (.49)	1.27*** (.96)	1.22*** (.36)	1.23*** (.47)
KOL	.15* (.09)	.18* (.09)	.14* (.04)	.17* (.05)	.12 (.03)	.13 (.04)	.18* (.05)	.18* (.06)
DSFE	NO	YES	NO	YES	NO	YES	NO	YES
N	653	653	653	653	551	551	551	551
Pseudo R^2	.10	.11	.04	.06	.03	.05	.21	.26

Table 3.2: Regression Results (Set 1) (Village and transport specific factors)

Note: Robust standard errors in the parentheses. .

Dependent Variable: Transformation of a village which was "would be Census Town" in Census (2001) to a Census Towns in Census (2011)

$* p < 0.10, ** p < 0.05, *** p < 0.01$

For the first set, notice that the coefficient of variable HIGHWAY 5 is positive and significant at 1% level in all the specifications, where it is included. It means that the presence of a highway within 5 km radius of a village, declared as a 'would be CT' in Census, 2001, increases its chance of turning into a CT in Census, 2011. Going by the theory, this implies that in our case the forces of dispersion as anticipated by Helpman (1998), Rossi-Hansberg (2005) acting through HIGHWAY 5, had been more dominant than the centripetal forces towards the city as proposed by Krugman (1991). However, the presence of a rail station within 5 km radius, turns out to have an opposite but insignificant effect. Notice that as the distance of a village from the nearest city/ST increases, the value of NEARNESS variable falls. The negative sign of coefficient of NEARNESS in Table 3.2 and its interaction with HIGHWAY 5 indicate the negative effect of NEARNESS on conversion of a village into a CT. The negative sign shows that the centripetal force of agglomeration towards the city as suggested by Head and Mayer (2014) counters the dispersion force of enhanced possibility of commuting to the city through the highway, while staying put at the village. However, both these coefficients turn out to be insignificant. The interaction term between RAIL5 and NEARNESS has also negative and insignificant coefficient. The density of local roads has a positive effect on conversion of a 'would be CT' to a CT, showing existence of the dispersion force from the nearest ST/city and the local forces of agglomeration at work. But, the effect is not significant. Interestingly, the interaction of ROAD with HIGHWAY 5 has positive significant coefficient at 5% level. This implies that the existence of the dense network of local roads complements the positive role played by a highway in the formation of a CT, which is expected. The existence of local amenities like BANK and POWER is significantly associated with formation of CTs[18].The agglomeration force of Kolkata has a positive impact in formation of CTs in bordering districts, but at an insignificant level.

The second set of regressions replaces HIGHWAY5 with GQ and run similar specifications as in set 1. The results of the second set of regression are presented in the table 3.3 below.

Explanatory Variables	PROBIT 1	PROBIT 2	PROBIT 3	PROBIT4	PROBIT5	PROBIT 6
GQ	.39* (.11)	.47* (.13)	.38* (.09)	.46* (.11)	.45* (.12)	.50* (.15)
RAIL5	.07 (.16)	.11 (.12)			.06 (.15)	.07 (.16)
NEARNESS	-.22 (.32)	-.36 (.37)			-.26 (.19)	-.39 (.27)
ROAD			.01* (.01)	.01* (.01)	.01* (.01)	.01* (.01)
GQ*NEARNESS	-.16 (.32)	-.19 (.37)			-.19 (.29)	-.22 (.33)
RAIL*NEARNESS5	-.01 (.01)	-.01 (.01)			-.01 (.01)	-.01 (.01)
GQ*ROAD			.01* (.01)	.01* (.01)	-.01 (.01)	-.01 (.01)
BANK					.82* (.15)	1.12* (.22)
POWER (LOG TRANSFORMED)					.66* (.33)	1.06* (.45)
KOL	.11* (.04)	.13* (.06)	.13* (.06)	.15* (.07)	.15* (.08)	.17* (.09)
DSFE	NO	YES	NO	YES	NO	YES
N	653	653	653	653	551	551
Pseudo R^2	.03	.04	.02	.04	.11	.12

Table 3.3: Regression Results (Set 2) (Village and transport specific factors)

Note: Robust standard errors in the parentheses.
Dependent Variable: Transformation of a village which was “would be Census Town” inCensus(2001) to a Census Towns in Census (2011)
$* p < 0.10, ** p < 0.05, *** p < 0.01$

The results show that the construction of highways under the Golden Quadrangle project had a positive impact on the ‘would be CT’ villages located in the neighborhood to get converted into a CT. However, the effect is significant only at 10% level. Notice from

[18]One of the reviewers suggests that this may indicate to the underlying process of “step migration” from village to large cities as proposed by Ravenstein (1885). However, testing this hypothesis is beyond the scope of the present chapter due to non-availability of data.

Table 3.1 that only 9 percent of the sampled villages in our study had GQ highways in their 10 km neighborhood, which explains the weak explanatory power of GQ in formation of CTs. Interestingly, in the case of GQ, it appears that neither its interaction with NEARNESS nor ROAD are significant in explaining the formation of CTs. The other results is similar to the one, we found in set 2 regressions, except the fact that the local amenities now has insignificant impact on formation of CTs.

The third set of regressions replaces HIGHWAY5 and RAIL5 with HIGHWAY10 and RAIL10 and run similar specifications as in set 1. This checks the robustness of the results we found in set 1 regressions. The results of the third set of regression are presented in the table 3.4 below.

Explanatory Variable	PROBIT1	PROBIT 2	PROBIT3	PROBIT4	PROBIT 5	PROBIT 6
HIGHWAY10	1.01*** (.22)	1.04*** (.26)	1.09*** (.29)	1.11*** (.32)	1.21*** (.41)	1.22*** (.43)
RAIL10	-.22 (.14)	-.28 (.15)			-.29 (.15)	-.31 (.17)
NEARNESS	-.37 (.33)	-.38 (.35)			-.27 (.19)	-.38 (.25)
ROAD			.01* (.01)	.01* (.01)	.01* (.01)	.02* (.01)
HIGHWAY10*NEARNESS	-.43 (.89)	-.44 (.91)			-.36 (.97)	-.50 (.40)
RAIL10*NEARNESS	-.01 (.01)	-.01 (.01)			-.01 (.01)	-.01 (.01)
HIGHWAY10*ROAD			.01* (.01)	.01* (.01)	.01* (.01)	.01* (.01)
BANK					.89*** (.17)	1.11*** (.22)
POWER (LOG TRANSFORMED)					.57*** (.38)	.96*** (.50)
KOL	.14* (.05)	.17* (.06)	.12* (.05)	.17* (.07)	.16* (.07)	.18* (.08)
DSFE	NO	YES	NO	YES	NO	YES
N	653	653	653	653	551	551
Pseudo R^2	.06	.08	.05	.06	.17	.19

Table 3.4: Regression Results (Set 3) (Village and transport specific factors)

Note: Robust standard errors in the parentheses.
Dependent Variable: Transformation of a village which was "would be Census Town" in Census (2001) to a Census Towns in Census (2011)
$* p < 0.10, ** p < 0.05, *** p < 0.01$

The results are qualitatively similar as the set 1 results. The only difference is that the coefficients of HIGHWAY10 are smaller than the coefficients of HIGHWAY5. Although Table 3.1 suggests the greater radius of 10 km places almost 92 percent of the 'would be CT' villages in the neighborhood of a highway, which a significant jump over 78 percent in the case of 5 km radius, the effect of highway as a dispersion force becomes weaker with the increased distance from a village.

Tables 3.5, 3.6 and 3.7 calculate the marginal effects corresponding to set 3.2, 3.3and 3.4 regressions respectively.

Explanatory Variables	PROBIT 1	PROBIT 2	PROBIT 3	PROBIT 4	PROBIT 5	PROBIT 6	PROBIT 7	PROBIT 8
HIGHWAY5	.25	.28	.40	.42			.34	.39
RAIL5	-.01	-.02					-.01	-.01
NEARNESS	-.14	-.15					-.05	-.05
ROAD			.01	.01			.01	.01
HIGHWAY5*NEARNESS	-.05	-.07					-.06	-.07
RAIL5*NEARNESS	-.01	-.01					-.01	-.01
HIGHWAY5*ROAD			.01	.01			.01	.01
BANK					.33	.38	.31	.33
POWER (LOG TRANSFORMED)					.31	.32	.32	.34
KOL	.02	.03	.02	.03	.02	.02	.04	.06
DSFE	NO	YES	NO	YES	NO	YES	NO	YES

Table 3.5: Marginal Effects (Set 1) (Village and transport specific factors)

Explanatory Variable	PROBIT 1	PROBIT 2	PROBIT 3	PROBIT 4	PROBIT 5	PROBIT 6
GQ	.10	.15	.16	.19	.16	.19
RAIL5	.02	.02			.01	.01
NEARNESS	-.12	-.14			-.12	-.16
ROAD			.01	.01	.01	-.01
GQ*NEARNESS	-.03	-.05			-.06	-.12
RAIL*NEARNESS5	-.01	-.01			-.01	-.01
GQ*ROAD			.01	.01	- .01	-.01
BANK					.25	.32
POWER (LOG TRANSFORMED)					.10	.13
KOL	.02	.03	.03	.05	.03	.05
DSFE	NO	YES	NO	YES	NO	YES

Table 3.6: Marginal Effects (Set 2) (Village and transport specific factors)

Explanatory Variables	PROBIT 1	PROBIT 2	PROBIT 3	PROBIT 4	PROBIT 5	PROBIT 6
HIGHWAY10	.20	.24	.30	.33	.33	.35
RAIL10	-.02	-.02			-.01	-.01
NEARNESS	-.15	-.15			-.07	-.05
ROAD			.01	.01	.01	.01
HIGHWAY10*NEARNESS	-.17	-.18			-.19	-.20
RAIL10*NEARNESS	-.01	-.01			-.01	-.01
HIGHWAY10*ROAD			.01	.01	.01	.01
BANK					.27	.30
POWER (LOG TRANSFORMED)					.28	.30
KOL	.02	.03	.02	.03	.03	.04
DSFE	NO	YES	NO	YES	NO	YES

Table 3.7: Marginal Effects (Set 3) (Village and transport specific factors)

These tables show that while the location of a highway within 5 km radius of a ‘would be CT’ village increases its chance of being converted into a CT by 39 percent; its location within 10 km radius of a such a village reduces the chance of the village being converted into a CT by 4 percent. In contrast, the location of GQ within 10 km of such a ‘would be CT’ village increases its chance of being converted into a CT only by 19 percent. Location of at least one branch of a commercial bank in such a village increases its probability of getting converted into a CT by 30 to 33 percent. The corresponding number for 1 percent rise in chance of electrification is estimated as 13 to 34 percent. The location of a village in the bordering districts of Kolkata raises its chance of being converted to a CT by 4% to 6%.

Because of uneven development of West Bengal centering around its capital city of Kolkata, we also check whether the generalized conclusions drawn above holds for transformation to CTs of the villages located at the districts bordering Kolkata too. There are 295 such villages in our sample, as reported in Table 3.1, which is 46% of our entire sample of villages.Table 3.8 below shows the results of the regression when HIGHWAY 5 is included as the transport infrastructure variable.

Explanatory Variables	PROBIT1	PROBIT2	PROBIT3	PROBIT 4	PROBIT5	PROBIT 6	PROBIT7	PROBIT 8
HIGHWAY5	.91** (.23)	.96*** (.25)	1.19*** (.34)	1.33*** (.39)			1.24*** (.22)	1.45*** (.24)
RAIL5	.12 (.24)	.18 (.25)					.19 (.26)	.27 (.29)
NEARNESS	-.25 (.86)	-.44 (.69)					-.15 (.69)	-.17 (.91)
ROAD			.02* (.01)	.03* (.01)			.02* (.01)	.03* (.01)
HIGHWAY5*NEARNESS	-.34 (.86)	-.36 (.88)				-	-.17 (.44)	-.46 (.97)
RAIL5* NEARNESS	-.50 (.93)	-.54 (.98)					-.11 (.41)	-.12 (.41)
HIGHWAY5*ROAD			-.03** (.01)	-.04** (.01)			-.01* (.01)	-.01* (.01)
BANK					1.44*** (.22)	1.48*** (.24)	1.57** (.17)	1.63** (.19)
POWER (LOG TRANSFORMED)					1.26* (.88)	1.27*** (.96)	1.44*** (.36)	1.53*** (.47)
DSFE	NO	YES	NO	YES	NO	YES	NO	YES
N	295	295	295	295	171	171	171	171
Pseudo R^2	.04	.10	.03	.08	.05	.06	.19	.24

Table 3.8: Regression Results for Districts Bordering Kolkata

Note: Robust standard errors in the parentheses.
Dependent Variable: Transformation of a village which was “would be Census Town” in Census (2001) to a Census Towns in Census (2011)
$* p < 0.10, ** p < 0.05, *** p < 0.01$

The results are similar to the reported results of Table 3.2 above, with a major difference. For the villages located in the three districts bordering Kolkata the sign of the interaction term between HIGHWAY5 and ROAD has changed its sign from positive to negative and the effect is significant. The result implies, the local roads, although still plays a positive role in transforming villages into CTs, for the villages in these districts which are located within 5 km. radius of a state /national highway it strengthens the forces of agglomeration towards the nearest ST/city rather than strengthening the forces of dispersion as in the previous case. The results with other transport infrastructure variables like GQ and HIGHWAY10 are similar in spirit and are not reported here.

3.4. Conclusion

A dispersed pattern of urbanization in the form of sub-urbanization, peri-urbanization or urban sprawl have been a significant trend in different parts of the World over the last two decades. Accommodating highways and automobile expansion with enhanced ease of mobility due to improved commuting technologies is suspected to be the one of the reasons behind it (World Cities Report 2016). However, apart from the highways, the transport infrastructure also includes alternatives like railways and local roads. This chapter, in the context of growth of Census Towns in India during 2001-2010 period, juxtaposes these alternative forms of transport infrastructure in a statistical framework and evaluates their role in conversion of the villages, which was recorded as a 'would be Census Town' in Census, 2001, into a Census Town in Census, 2011. It uses the data from the state of West Bengal, which saw the birth of the highest number of Census Towns, for its purpose. The criteria for declaration of a village into a Census Town in India suggest that the agglomeration at the local level should trigger the process of conversion. However, the existing economic theory does not definitely answer which type of transport infrastructure acts as a trigger. The chapter finds some suggestive empirical results regarding this. It finds that in West Bengal the existence state/national highways in the neighborhood increases the probability of a village, designated as a 'would be Census Town', being converted in a Census Town. It appears that the highways promote the dispersion of non-farm economic activities from existing cities to the newly formed CTs due to the factors like growing congestion, pollution and higher housing prices at the cities. The closer the location of the highway, more intensive is the force of dispersion. The rail infrastructure did not play a significant role in the process. Interestingly, the chapter finds that the density of local road network in a district in general complements the forces of dispersion due to highways converting 'would be CTs' in CTs, except in the districts bordering the capital city of West Bengal, Kolkata. Due to uneven development of urban system in West Bengal surrounding the city of Kolkata, in these districts, the local roads in fact opposes the dispersing influence of the highways in formation of CTs, decelerating the concentration of non-farm activities at the 'would be CTs'. As the chapter evaluates the role of Golden Quadrangle (GQ) project, the highway construction project undertaken in India during the study period of 2001-2011 to connect the four major metropolitan cities of India, it finds that it had a limited impact compared to national/state highways in birth of the Census Towns. The chapter also finds a positive association between amenities available at the village in its conversion to a Census Town.

The results are new in the literature and important for policy making. As Baum-Snow et al (2020) mentions, about 20% of World Bank's lending supports development of transport infrastructure, more than that for poverty alleviation programs, it is important to know the expected impact of alternative projects like development of existing state/national highways, GQ project or local roads on spatial activities. Our results make an important contribution in this area. It appears from the results the impact of highways in urbanization process in West Bengal is quite opposite of what Baum-Snow et al (2020) observes in China. Instead of facilitating agglomeration, it promotes dispersion of non-farm activities away from the existing cities. This may have happened due to lack of infrastructure development in the existing cities which failed to solve the problems of congestion, pollution and high housing-prices at the cities. As theoretically it may lead to fall in welfare, the results of the chapter suggest that in West Bengal perhaps more investment in developing the infrastructure of existing urban centers other than Kolkata spread across the state could have been welfare improving along with the investment in highway projects.

Is there any limitation of the reported results? The results show the way the transport infrastructure has affected the transformation of a village to a Census Town. However, it does not control for the economic policies that may have utilized the transport infrastructure to trigger the change. In Indian context, the obvious candidate of such a policy would have been the economic reform undertaken in 1991. But, in a recent chapter Tripathi (2019) shows that economic reform has no effect on urbanization in India. The local level development policies could have an influence on the villages helping them to transform into Census Towns. However, the state level policies should have equal effect on the districts and the study controls for the district specific fixed effects. The chapter does not explore the exact channels through which transport infrastructure works. This remains as our future research agenda.

CHAPTER 4

GROWTH OF CENSUS TOWNS: PRINCIPAL COMPONENT ANALYSIS

4.1. Introduction

In Indian Census the reclassification of villages in small towns (called Census Towns (CTs)) happens if a village satisfies the following criteria: (1) it has a population of 5000 or more; (2) its population density is at least 400 per square kilometer; and (3) 75% of its male main workforce working in non-farm sector. The CTs are administered by rural local governments[19]. The number of CTs in India has increased from 1362 to 3894 during the decade of 2001-2011 and accounted for almost 30% of urbanization as evident from Census (2011).Denis, Mukhopadhyay and Zerah (2012) calls it 'subaltern urbanization'. This chapter focuses on the determinants of this particular kind of urbanization.

There are three different kinds of theoretical argument that attempt to explain the dynamics of formation of the CTs. The first is related to the impact of developments in the large city in the neighborhood. The factors like fall in formal sector employment, the rise in congestion, house-rent and pollution may incentivize the existing population living in the large city to relocate in the villages bordering the city. It is also possible that the rural population, which looks for opportunities to relocate in the large city for better livelihood, for the same reasons mentioned above are dissuaded in doing so. Some may resort to commuting rather than living within the city limit. The papers like Kundu (2011b), Sharma (2013) spell out such possibilities. The second is related to the development at the village-level. The development of local infrastructure like schools, health facilities, stable electricity connection, development of banking facilities at the villages, generates forces of agglomeration at the village level. They not only facilitate relocation from neighboring villages, also from the large city located nearby. The papers like Aggarwal (2018), Mukhopadhyay et al.(2016) take this view. Third, the development of transport infrastructure connecting the villages to the neighboring large city may play a role in the

[19] In India the rural local governments are called 'Panchayats'. The three tier Panchayat system consists of 'Gram Panchayat' at the bottom, 'Panchayat Samiti' at the middle and 'ZillaParisad' at the top.

formation of CTs. The reduced transport cost may either decelerate the formation of the CTs by strengthening the forces of agglomeration towards the existing cities, or it may accelerate the same by strengthening the forces of dispersion away from the existing cities.The effect of transport infrastructure in the formation of CTs is discussed by papers like Ghani et al.(2012), Chakrabarti and Mukherjee (2022).

This chapter attempts to find out which of the factors mentioned above explain the birth of CTs in West Bengal, an Eastern state of India, during 2001-2011. We work on West Bengal data, since West Bengal is the state which has experienced maximum increase in terms of number of CTs during 2001 and 2011, as shown in Table 1.1 in chapter 1.Itaccounts for two-third of the urbanization in the state during the period.

The table 1.1 shows that all the major states have experienced a jump in the number of CTs between 2001 and 2011 with West Bengal leading the list. In West Bengal, out of 780 CTs 526 have born during 2001-2011. In earlier papers Chakrabarti and Mukherjee (2020, 2022) explored the role of neighboring city, development of village specific factors and transport infrastructure in birth of CTs in West Bengal. Chakrabarti and Mukherjee (2020) explains the birth of CTs around existing cities by considering city specific factors like its formal sector wage, population density, area and transport cost from the neighborhood village to the city where the jobs are located. They find that high formal sector wage along with a low urban sprawl is conducive for the birth of Census Towns in the neighborhood of a city. Chakrabarti and Mukherjee (2022), on the other hand, finds that the existence state/national highways in the neighborhood increases the probability of a village, designated as a ‘would be Census Town’, being converted in a Census Town. The rail infrastructure did not play a significant role in the process. Interestingly, the paper finds that except at the districts bordering Kolkata, the capital city of West Bengal, density of local road network in a district complements the highways in explaining the formation of the CTs. This suggests that in these districts the transport infrastructure creates the forces of dispersion away from the existing cities. At the districts bordering Kolkata, on the contrary, the local roads oppose the dispersing influence of the highways in formation of CTs, and decreases the concentration of non-farm activities at the ‘would be CTs’. The paper did not find significant impact of Golden Quadrangle (GQ) project, implemented during the study period for connecting the four major metropolitan cities of India, in birth of the Census Towns in West Bengal. They also find the village specific factors play a positive significant role in conversion of a village to a Census Town.

Since the city-specific, village-specific and the transport infrastructure related variables are correlated with each other as one causes the other, we cannot use them as explanatory variables in a single regression framework. However, from the policy perspective it is important to know their relative contribution in formation of Census Towns. The present chapter attempts to solve this problem. It uses of Principal Component Analysis (PCA)[20] to reduce the dimensionality of the explanatory variables. The principal components are blend of all the control variables used in Chakrabarti and Mukherjee (2020, 2022) and are orthogonal to each other. The varimax rotation of these variables identifies control variables, which have the highest correlation with the each of the extracted principal components.We identify the principal components with the variable having the highest correlation with them and use them in the regression analysis to find out how they explain the conversion of villages in Census Towns in West Bengal. The chapter finds, in similar spirit as Chakrabarti and Mukherjee (2022), the explanatory factors play out differently in the districts bordering Kolkata, the capital city of West Bengal, and the other districts. The districts bordering Kolkata are North 24 Parganas, South 24 Parganas and Haora. While the presence of highways within 5km. radius of a village plays an important role in

[20] See papers like Mirko (2006), Ming and Lian(2015), Nugrahadi et al (2020), for applications of PCA in different context.

creation of CTs for both types of districts, in the districts bordering Kolkata density of population in the nearby city/Statutory Town (ST) plays a significant role. In the districts not bordering Kolkata the CTs are created away from the nearby STs and cities. It appears, among the city specific factors, the importance of density that we find in this chapter is a new finding. It was not significant when Chakrabarti and Mukherjee (2020) analyzed the importance of city specific factors in formation of CTs in West Bengal. Similarly, when Chakrabarti and Mukherjee (2022) analyzed the transport infrastructure specific factors, nearness did not appear as a significant variable. Therefore, this is also a new finding of the chapter. We obtain the new results as we take all the three types of variables in a single framework and eliminate correlation between them. The results suggest that the forces of dispersion created from the congestion at the existing cities/STs are important in explaining the birth of CTs in West Bengal both at the districts around Kolkata and the other districts. The highways help the dispersion. In the districts outside Kolkata, commuting to the nearest city/ST is not important for formation of CTs. It highlights the process the local agglomeration in and around the villages converted in CTs. However, in the districts bordering Kolkata, it seems the density of population in existing cities/STs plays an important role in dispersion process.

The plan of the chapter is as follows. The second section describes the methodology and the data and derives the results. The section following concludes the paper.

4.2. The Principal Component Analysis

The Principal Component Analysis (PCA) is a technique that reduces the dimension of correlated variables into new variables, called principal components (PC) which are uncorrelated with each other and describe the most of the information in the full dataset to explain its common variation.

The control variables used in the literature for explaining birth of CTs are mainly of three different types: (1)variables related to transport infrastructure; (2)variables related to village-specific infrastructure; (3)variables related to the nearest city/statutory towns.

An improvement of transport infrastructure at a village can occur in three different ways: (i) development of a highway that connects cities may pass through the village-neighborhood; (ii) improvement of rail-connectivity of the village to the cities; (iii) improvement of local road network near the village. The improvement of transport infrastructure reduces the cost of travelling to the city, which may have both positive and negative influence on a village in terms of its conversion to a CT. On the one hand, it facilitates migration from village to city and reduces its chance of being converted to a CT; on the other, it shelters the firms and workers who relocate from the city for avoiding the congestion and increases its chance of being converted to a CT.The increased commuting of non-farm workers, due to ease of commuting, to the nearest city/ST also help the conversion of a village to a CT. The set of variables related to transport infrastructure are:

HIGHWAY 5: A dummy variable that takes value of 1, if a highway passes through a neighborhood of 5 km radius around the center of village i in district j;

RAIL 5: A dummy variable that takes value of 1, if there is at least one railway station within 5 km radius neighborhood around the center of village i in district j;

NEARNESS: Reciprocal of the nearest city/ST distance from the center of village i in district j.

ROAD: The length of rural roads per 1000 square km. area in district j. We assume uniform distribution of rural roads across all villages of the district.

The development of non-tradable services like availability of electricity services, rural banks, other financial services etc. offers a better quality of life to village residents, creates more non-farm jobs and therefore, attracts more population in it. The set of variables related to local development are:

RBANK: A dummy variable that takes value of 1, if at least one branch of a commercial bank is present in village i at district j;

POWER: Represents percentage of electrified villages in district j, where village i is located. This indicates the probability of availability of power in village i in district j.

Now let us describe the variables related to the developments at the nearest city/statutory towns. First, in the short run a rise in the formal wage although reduces the employment in urban formal sector, has an uncertain effect in the expected wage in the urban sector, and consequently on the CT dynamics. As the wage expected in the urban area rises, labour starts migrating to the city; the city with its defined boundary and density of population cannot accommodate the migrants from the rural area, causing them to revert back to the village and absorbed in rural non-farm sector. However, the wage rate in the rural area rises and the farm sector is forced to shed-off labour. They find job in the rural non-farm sector causing non-farm employment to expand and helping a village to transform to a CT. On the contrary, if the expected wage in the city falls, reverse migration starts leading to fall in rural wage. Then the farm sector with limited absorption capacity accommodates more labour compared to rural non-farm sector and the village ceases to transform to CT. Since the wage in the formal sector is credited through banks, the number of branches of commercial banks has been used as proxy variable for formal wage in the urban sector. Second, a fall in the population density at the city causes a fall in the participation in the urban informal sector. These labour find job in rural non-farm sector since the rural farm sector with limited absorption capacity does not employ them. Therefore, the villages near the city has a greater chance to be transformed into a CT. Last, an expansion in the boundary of the city reduces the chance of a neighboring village being transformed into a CT. This happens as given the size of its formal sector, expansion of the city leads to an expansion of urban informal sector. The labour relocates from the rural non-farm sector to urban informal sector, which reduces the chance of the neighboring village transforming in a CT. The city specific variables used in analysis are:

DENS: Population density in the nearest city/ ST; a proxy variable for 'formalization and sanitization' in the city/ST; a lower value of DENS implies more 'formalization and sanitization';

AREA: Area of the nearest city/ST;

UBANK: Number of commercial bank branches in the nearest city/ST, a proxy variable for formal wage in the nearest city.

The empirical exercise consists of two parts. The first part uses PCA to reduce the number of variables described above into few principal components (PCs) which are the linear combination of original variables containing most of the information of original variables capturing majority of the variation in the dataset. The analysis helps us to extract those PCs which have highest Eigen values. The varimax rotation of them tells us which variables have highest association with the chosen PCs. Then, for finding out relative significance of the variables which have highest association with chosen PCs(dominant variables) in explaining the formation of CTs, we run the following regression specification:

$$y_{ij} = \alpha + \beta x_{ij} + D_j + u_{ij} \quad (1)$$

In equation (1) the dependent variable y_{ij}represents the status of a village in Census 2001 which was identified as 'would be CT'. It takes a value of 1 on the successful conversion of the village in Census 2011. Otherwise, it takes a value of 0.x_{ij} represents the set of dominant variables that indicate the dominant variable chosen from significant PCs at the ith village in the jth district. The district specific fixed factors of district j, which are shared by all the villages located in district j, are captured through the dummy variable D_j. The unobserved village specific factors are captured through u_{ij}, which we assume to be independently identically distributed across the villages.

4.2.1. The Data

The data is taken from the CTs/Villages Directory of West Bengal for2001 and 2011 extracted from Census of India (2001 and 2011)) and also from State Statistical Handbook of West Bengal various years. Table 4.1 below describes the data,

Variable Name	Mean	Standard Deviation	Minimum Value	Maximum Value
Dependent Variable (=1, for villages transformed to CT) (=0, for villages not transformed to CT)	0.80	0.40	0	1
Transport Related Variables				
HIGHWAY5 (=1, neighborhood of highways within 5 km radius from the village centre; 0, otherwise)	0.78	0.41	0	1
RAIL5 (=1, neighborhood of railheads within 5 km radius from the village centre; 0, otherwise)	0.38	0.48	0	1
NEARNESS (reciprocal of the distance from nearest city/ST from the village)	0.11	0.18	0.01	2
ROAD (the length of rural road in the district 2007-2008 per 1000 sq.km)	11.46	9.50	3.09	30.77
Variables Related to Local Non-Traded Services				
RBANK (=1,if 1 commercial banks in the village2007- 2008; 0 otherwise)	0.51	0.50	0	1
POWER (percentage of electrified village in the district 2001)	93.7	11.86	53.7	100
City/ST Specific Variables				
DENS(population/sq.km) Population Density of the nearest city/ST	12618.62	6901.34	1884	24841
AREA(in square km) Area of the nearest city/ST	56.11	62.92	5.85	185
UBANK Number of bank branches of the nearest city/ST	189	369	15	1007

Table 4.1: Descriptive Statistics (All factors)

Source: Census of India (2001 and 2011) and State Statistical Handbook of West Bengal (various years)

The descriptive statistics presented in table shows that 80% of the villages which were 'would be' census town in 2001 got converted into CT in 2011. Among the set of explanatory variables related to connectivity to city/local connectivity of village i, the dummy variable HIGHWAY5 has mean of 0.78 implying 78 percent of such villages were located in the 5km radius neighborhood of either nearest national highway or state highway. Similarly, the dummy variable RAIL5 having the mean of 0.38 implies that 38 percent of the 'would be CTs' villages in the Census 2001 were located in the 5 km radius neighborhood of the nearest rail station. For the NEARNESS variable, for the sampled villages the mean is 0.11, with maximum of 2 and minimum of 0.01. Notice that, as the distance of a village from the nearest city/ST increases, the value of NEARNESS variable falls. The minimum distance that we have found in our data was 0.5 km (the reciprocal of 2) and the maximum distance was 100 km (the reciprocal of 0.01).The average distance was 9.09km (the reciprocal of 0.11). In the case of the variable ROAD, we could not find data at the village level. Therefore, we have proxied it with the data on the roads maintained by the local administrative bodies like Gram Panchayats, Panchayat Samitis and Zilla Parishads aggregated at the district level. The data has been normalized per 1000 square km area of the district. The average length of local roads per 1000 sq km in the districts of West Bengal by 2007-08 was 11.46 km with a minimum of 3.09 km in the district of Darjeeling and maximum of 30.77 km in the district of South 24 Parganas. The assumption, here, is that the road allocation is uniformly distributed among all villages in a district.

Among the non-tradable services RBANK is taken at village level but in the absence of proper village level data, the data on POWER is taken at the district level. RBANK is a binary variable with mean of 0.51 which implies that 50 percent of 'would be CTs' villages have had at least one commercial branch in 2007-2008 before the Census operation of 2011. On an average 93.70 percent of villages were electrified across all districts in West Bengal in 2001 with a minimum of 53 percent and a maximum of 100 percent.

It is not that all the villages in West Bengal, which were identified as ‘would be CTs’ in Census 2001,had a nearby city with population exceeding 1lac. In the absence of such cities we have used those urban bodies, which have the status of Statutory Towns (STs) and we have taken their population density and area as explanatory variable for our analysis. But, all STs are not large enough to trigger migration/commuting from nearby villages. For solving this problem, we looked at the distribution of bank branches at the city and STs of West Bengal and considered only those STs in which the number of bank branches is above the median (turns out as 15).

Among the city specific attributes, population density of the nearest city/ST from a ‘would be CTs in 2001’ vary from 1884 per square kilometer to 24841 per square kilometer with the mean at 12618.6per square kilometer. The maximum is corresponding to the city of Kolkata. The area of such city/ST has mean of 56.11 square kilometer with standard deviation 62.92.The number of branches of the banks in the nearest urban bodies from the ‘would be CTs in 2001’, which has been considered as a proxy for wage at the nearest urban locality, vary from 15 to 1007with the mean of 189. The maximum number of bank branches belongs to the city of Kolkata. We take log transformation of the variables POWER, DENS, AREA and UBANK while doing the empirical exercise.

We also run separate regressions for the districts bordering Kolkata and the other districts of West Bengal. The districts bordering Kolkata are North 24 Parganas, South 24 Parganas and Haora. Of the 551 villages in our sample, which were ‘would be CTs in 2001’, 171 belonged to these districts.

4.2.2. The Principal Components

We perform the PCA with the variables described above. First, we calculate Eigen values and Eigen vector of each Principal Components. While the Eigen values represent the variances of the dataset, the Eigen vectors are the coefficients of the original variables in each principal component representing the correlation between a variable and the principal component. A PC qualifies for incorporation in the analysis if it has its Eigen value greater than one. Then we perform the orthogonal varimax rotation of the original Eigen vector matrix corresponding to Eigen values.The objective is to determine the association between the variables and corresponding principal components clearly which the original Eigen vector matrix fails to show in some cases. The rotated component vectors after varimax rotation represent clearly the correlation between the original variables and the chosen Principal Component.This method helps us to identify those variables with the highest load(dominant variables) in each PC.

4.2.3. The Regression

The regression specification (1) since has binary dependent variable we apply Probit regression technique. We allow the corresponding probability distribution to be associated with a cumulative normal distribution, $\mathrm{Y} = \phi(x\beta + u) \in (0,1)$ so that $x\beta + u = \phi^{-1}(\mathrm{Y})$. Notice,

$$\mathrm{Y}' = x\beta + u\ .$$

Since the dependent variable takes the value 0 and 1, we assume, Y' takes the value 0 and 1. The above function $\mathrm{Y}' = x\beta + u$ is called the Probit function whose parameters are estimated.

4.2.4. The Results

First we report the results as we use data from all the districts of West Bengal. The Eigen values of the principal components and corresponding rotated varimax table of Eigen vector matrix are shown in the following tables

Component	Eigen Value	Proportion	Cumulative
PC1	2.30	0.25	0.25
PC2	1.50	0.21	0.46
PC3	1.17	0.13	0.59
PC4	1.05	0.11	0.70
PC5	0.89	0.10	0.80
PC6	0.85	0.09	0.89
PC7	0.77	0.08	0.97
PC8	0.33	0.02	0.99
PC9	0.11	0.01	1.00

Table 4.2: Principal Components and their Eigen Values: All Districts

Variable	PC1	PC2	PC3	PC4
HIGHWAY5	-0.19	0.01	0.51	0.33
RAIL5	0.04	-0.04	0.71	-0.03
NEARNESS	0.03	-0.06	0.35	-0.58
ROAD	0.60	-0.06	0.05	-0.09
BANK	0.15	0.42	0.28	-0.13
POWER (LOG TRANSFORMED)	0.06	-0.02	0.16	0.70
DENS (LOG TRANSFORMED)	-0.08	0.74	-0.05	0.02
AREA (LOG TRANSFORMED)	0.54	-0.30	-0.02	0.12
U.BANK (LOG TRANSFORMED)	0.51	0.40	-0.06	0.10
N	551	551	551	551

Table 4.3: Principal Component Table: All Districts (Rotated Component Matrix with Varimax Rotation)

Table 4.2 shows the number of principal components to be extracted based on Eigen values. From the table we choose first four PCs whose Eigen values are greater than one explaining 70 percent common variation in data. The second column of this table shows each PC's individual contribution in explaining the data. The principal components are ordered according to their ability to explain the variation in the data in decreasing order. We observe that the first principal component individually explains 25 percent in the variation in the data, the second, third and fourth individually explain 21 percent, 13 percent and 11 percent respectively.

In order to identify the mostly associated control variable with a particular PC, the varimax orthogonal rotation for the first four PCs is carried out. The results are shown in table 4.3. The varimax orthogonal rotation represents the correlation between a variable and a principal component. We have chosen that variable from a principal component, which has the highest association with the principal component. The dominant variables in the four principal components that we have chosen are as following: ROAD for PC1, DENS for PC2, RAIL5 for PC3 and POWER for PC4. The associations indicate that transport specific rural road network and railheads within 5 km from a village has been the dominant variables in PC1and PC3. City specific population density and village non-tradable rural electrification also find their place in terms of dominance in PC2 and PC4 respectively.Keeping their dominant role in explaining the PCs in mind, henceforth, in our analysis we will identify PC1 by ROAD, PC2 by DENS, PC3 by RAIL5 and PC4 by POWER. These variables are regressed on the dependent variable as in (1). The results obtained are reported in Table 4.4 below.

Explanatory Variables	PROBIT1	MARGINAL EFFECT	PROBIT2	MARGINAL EFFECT
ROAD	0.01 (0.01)	0.01	0.01 (0.01)	0.01
DENS	0.36*** (0.07)	0.11	0.49*** (0.13)	0.16
RAIL5	0.10 (0.12)	0.02	0.11 (0.12)	0.04
POWER	0.92*** (0.41)	0.41	1.01*** (0.52)	0.45
District Fixed Effect	No		Yes	
N	551		551	
Pseudo R^2	.02		.03	

Table 4.4: The Regression Results: All Districts

Dependent Variable: Transformation of a village which was “would be Census Town” of Census2001 to Census Towns in Census 2011
Note: Robust standard errors in the parentheses.
$* p < 0.10, ** p < 0.05, *** p < 0.01$

We run two different specifications of (1). The first is without the inclusion of the district specific fixed effect and the second is with inclusion of it. In both the specifications, the variables DENS and POWER turn out to be significant at 1% level. The result is interesting on the one hand because the partial approach taken by Chakrabarti and Mukherjee(2020) did not find significant impact of DENS on birth of Census Towns in West Bengal. On the other, Chakrabarti and Mukherjee (2022) found ROAD as a significant variable affecting the birth of CTs, which is no longer true in the present analysis. However, since from Chakrabarti and Mukherjee (2022) we know that because of uneven development the districts neighboring Kolkata show a different trend in the case of the transport-infrastructure and the village specific variables, we bifurcate the entire data set in two parts and repeat the same exercise with each of them as above. First, we report the results of the data set that contains data only on the villages in the districts bordering Kolkata. The districts bordering Kolkata are North 24 Parganas, South 24 Parganas and Haora. Of the 551 villages present in the entire dataset, which were 'would be CTs in 2001' in West Bengal, 171 belonged to these districts.

The Eigen values of the principal components of the above exercise and the corresponding varimax table of Eigen vectors are reported in tables 4.5 and 4.6 below.

Component	Eigen Value	Proportion	Cumulative
PC1	2.86	0.31	0.31
PC2	1.61	0.18	0.49
PC3	1.04	0.13	0.62
PC4	1.00	0.11	0.73
PC5	0.87	0.09	0.82
PC6	0.70	0.07	0.89
PC7	0.62	0.06	0.95
PC8	0.19	0.03	0.98
PC9	0.04	0.02	1.00

Table 4.5: Principal Components and their Eigen Values: The Districts Bordering Kolkata

Variable	PC1	PC2	PC3	PC4
HIGHWAY5	- 0.07	-0.01	0.11	0.83
RAIL5	0.04	-0.02	0.81	0.10
NEARNESS	- 0.19	-0.09	0.36	-0.23
ROAD	0.56	0.07	0.15	-0.17
BANK	0.09	0.50	0.32	0.05
POWER (LOG TRANSFORMED)	0.29	0.03	-0.19	0.44
DENS (LOG TRANSFORMED)	-0.11	0.71	-0.11	-0.01
AREA (LOG TRANSFORMED)	0.57	-0.28	-0.01	0.02
U.BANK (LOG TRANSFORMED)	0.44	0.37	-0.04	-0.07
N	171	171	171	171

Table 4.6: Principal Component Table: The Districts Bordering Kolkata (Rotated Component Matrix with Varimax Rotation)

Here as before four principal components have their Eigen values greater than 1, which are taken up for the analysis. These PCs explain 73 per cent of the common variation in the data. The dominant variables in the four principal components that we have chosen are as following: AREA for PC1, DENS for PC2, RAIL5 for PC3 and HIGHWAY5 for PC4. Keeping their dominant role in explaining the PCs in mind, henceforth, in our analysis we will identify PC1 by AREA, PC2 by DENS, PC3 by RAIL5 and PC4 by HIGHWAY5. As these variables are regressed on the dependent variable, the results obtained are reported in Table 4.7 below.

Explanatory Variables	PROBIT1	MARGINAL EFFECT	PROBIT2	MARGINAL EFFECT
AREA	0.05 (0.11)	0.01	0.24 (0.12)	0.05
DENS	0.60*** (0.18)	0.10	0.65*** (0.18)	0.15
HIGHWAY5	0.62*** (0.19)	0.15	0.47** (0.20)	0.10
RAIL5	0.17 (0.19)	0.04	0.24 (0.19)	0.05
DSFE	NO		YES	
N	171		171	
Pseudo R^2	0.18		0.21	

Table4.7: The Regression Results: The Districts Bordering Kolkata

Dependent Variable: Transformation of a village which was “would be Census Town” of Census2001 to Census Towns in Census 2011

Note: Robust standard errors in the parentheses.

$* p < 0.10, ** p < 0.05, *** p < 0.01$

The first specification of the regression is without the inclusion of the district specific fixed effect and the second is with inclusion of it. In both the specifications, the variables DENS and HIGHWAY5 turn out to be significant at 1% level. Notice that the role of density of the nearest city/ST, which we derived in the regression consisting of all the districts is preserved in this regression as well. However, in the districts bordering Kolkata it seems the existence of a highway within 5 km radius of a village plays a significantly positive role in its transformation to a CT. While the result confirms the finding of Chakrabarti and Mukherjee (2020), it is interesting note that POWER, the variable which turned out to be significant in overall regression, no longer plays a role here.

Next, we report the results of the data set that contains data on the villages in the districts not bordering Kolkata. The Eigen values of the principal components and the corresponding varimax table of Eigen vectors are reported in tables 4.8 and 4.9 below.

Component	Eigen Value	Proportion	Cumulative
PC1	1.81	0.22	0.22
PC2	1.44	0.17	0.39
PC3	1.25	0.13	0.52
PC4	1.08	0.12	0.64
PC5	0.98	0.10	0.74
PC6	0.78	0.09	0.83
PC7	0.77	0.08	0.91
PC8	0.50	0.06	0.97
PC9	0.35	0.03	1.00

Table 4.8: Principal Components and their Eigen Values: The Districts Not Bordering Kolkata

Variable	PC1	PC2	PC3	PC4
HIGHWAY5	0.05	0.03	0.66	0.13
RAIL5	- 0.18	0.35	0.47	0.01
NEARNESS	- 0.05	-0.15	0.13	0.73
ROAD	0.01	0.75	0.13	0.09
BANK	0.12	-0.17	0.50	0.22
POWER (LOG TRANSFORMED)	0.05	-0.35	0.10	-0.59
DENS (LOG TRANSFORMED)	-0.35	-0.29	0.16	-0.09
AREA (LOG TRANSFORMED)	0.65	0.11	-0.04	-0.04
U.BANK (LOG TRANSFORMED)	0.62	-0.14	0.12	-0.08
N	380	380	380	380

Table 4.9: Principal Component Table: The Districts Not Bordering Kolkata (Rotated Component Matrix with Varimax Rotation)

The four principal components having their Eigen values greater than 1 here explain 64 percent of common variation in the data. The dominant variables in these PCs are: AREA for PC1, ROAD for PC2, HIGHWAY5 for PC3 and NEARNESS for PC4. Keeping their dominant role in explaining the PCs in mind, our analysis identifies PC1 by AREA, PC2 by ROAD, PC3 by HIGHWAY5 and PC4 by NEARNESS. As these variables are regressed on the dependent variable, the results are reported in Table 4.10 below.

Explanatory Variables	PROBIT1	MARGINAL EFFECT	PROBIT2	MARGINAL EFFECT
AREA	0.05 (0.09)	0.02	-0.01 (0.12)	-0.01
ROAD	0.01* (0.03)	0.01	0.01* (0.04)	0.01
HIGHWAY5	1.15*** (0.20)	0.18	1.10*** (0.27)	0.11
NEARNESS	- 0.90*** (0.35)	-0.10	-1.01*** (0.40)	-0.15
DSFE	NO		YES	
N	380		380	
Pseudo R^2	0.21		0.25	

Table4.10: The Regression Results: The Districts Not Bordering Kolkata

Dependent Variable: Transformation of a village which was "would be Census Town" of Census2001 to Census Towns in Census 2011
Note: Robust standard errors in the parentheses.
$* p < 0.10, ** p < 0.05, *** p < 0.01$

Notice that the variables HIGHWAY5and NEARNRSS turn out to be significant at 1% level. While the HIGHWAY5 has a positive effect on formation of CTs as expected, NEARNESS has a negative effect. The negative sign of NERNESS implies that in the districts, which are not bordering Kolkata, the commuting is not important factor for birth of the CTs. At the districts not bordering Kolkata, it appears that only the transport infrastructure related variables play a significant role in explaining the emergence of CTs: there is no significant role played by either the village-infrastructure specific factors or the city specific factors.

4.3. Conclusions

The burgeon of CTs in India during 2001-2011 has been astounding and allures economists to analyze in deep the reasons behind it. The earlier literature pointed out the importance of city specific factors like its formal-sector wage and area, transport-infrastructure related factors like availability of highways near the villages and the local road network, the village-infrastructure related factors like availability of electricity and banks, in conversion of villages in CTs. However, since these variables have mutual dependence on each other, no study before takes up all these factors together in a single framework to study their relative importance in formation of the CTs. The present chapter takes it up in a dataset of West Bengal, which have seen the birth of maximum number of CTs among the states in India during 2001-2011. The analysis has been carried out using the Principal Component Analysis, which consolidates the set of nine explanatory variables in four uncorrelated principal components. We identify the principal components with the dominant variable correlated with them and subsequently use them in the regression analysis to find their role in explaining the formation of CTs. The results show that the factors play their roles differently in the districts bordering Kolkata, the capital city of West Bengal and the other districts of the state. While in both types of districts the availability of a highway within 5km radius of a village, which was a 'would be CT' in 2001, helped the village to get converted in a CT in 2011, the density of nearby city/ST played a significant role in the districts bordering Kolkata. The commuting was not important factor in the districts not bordering Kolkata. The results suggest that the forces of dispersion away from the existing cities/STs is important to understand subaltern urbanization in West Bengal. The improvement of the highway infrastructure is an important instrument in the process. The partial analysis that is present in the existing literature often emphasizes the role of local-infrastructure in the villages and city-specific developments like rise in urban wages and areal expansion of the cities, in explaining the emergence of CTs. But a more general framework adopted in the present study do not support these views. The chapter shows that the subaltern urbanization in all over West Bengal is a fall out of policy of improving highway infrastructure. Whether it has improved welfare of the state remains as a future research agenda.

CHAPTER 5

CONCLUSIONS

The census 2011 highlights enormous growth of CTs from 1362 to 3894 during 2001-2011 in India. This thesis investigates the reasons behind the sudden unprecedented increase in the number of CTs during the reference period. The process of urbanization in India is not much attributed to migration which remains fairly stable during last five decades. The CT is a village reclassified as town if it satisfies the following criteria namely 1) population of 5000 or more, 2) population density of 400 per square km and 3)75percent of male main workforce working in non-farm sector. However, a CT is administered by village administration. This is basically a functionally defined urban space as against ST which is administratively defined urban space and administered by urban administration. This reclassification based urbanization has become the second largest component of urbanization after natural increase in population during 2001-2011 superseding migration based urbanization. The majority of states in India has experienced increase in the number of CTs with West Bengal leading the list. This thesis tries to find out the reasons behind such burgeon of CTs addressing three research questions: first, the factors specific to urban centre surrounded by village(s) that transform village(s) to CT(s); second, the village specific attributes and transport specific factors that are responsible in transformation of a village to CT and third, which among the above factors are mostly responsible in CT dynamics. The present chapter concludes the thesis by summarizing the results. It also outlines the limitations of the study, discusses the policy recommendations and the agenda for the future research.

5.1. Findings

The second chapter of the thesis deals with how the factors pertaining to the existing urban centres surrounded by village(s) helps the transformation of those village(s) to CTs. The chapter applies Harris-Todaro model by incorporating urban economic features in it. The chapter also attempts to empirically check some of the hypotheses of the theoretical model by using census data from the state of West Bengal during 2001-2011. The theoretical model has the following hypotheses: first, a rise in the formal wage rate in the city lowers rural farm employment and has ambiguous effect on expected wage rate. The expected wage rate rises if the formal sector employment has low elasticity of demand and therefore, has low impact on probability of finding employment in the formal sector. This attracts labour to the city; the city with its defined boundary and density of population cannot accommodate labours migrating from the rural area; however, the wage rate in the rural area rises and the farm sector is forced to shed-off labour who finds job in the rural non-farm sector causing non-farm employment to expand and helping a village to transform to a CT. The expected wage rate falls in the case of high elasticity of labour demand in the formal sector and it raises the uncertainty of finding employment in the formal sector. This starts reverse migration at a lower wage rate. Since the farm sector absorbs more labour now though with a limited absorption capacity, the chance of a village turning into a CT falls. Second, a lowering of transport cost to the city keeps rural farm employment unchanged but increases rural non-farm employment and thereby increases probability of creation of the CTs.The existing literature on urban economics tells us that as the distance from the existing urban centre rises, transport cost for a commuter to a job located at the urban centre also rises.Thus, cities with low transport cost attracts large number of migrants to the city. But if the city is neither allowed to expand nor allowed to hold a higher density of population, the migration cannot take place. In such a situation, the number of commuters rises who live outside the city. This helps reclassification of the village nearby to the city into a CT. Third, smaller cities and the cities with lower density of population are more likely to have higher non-farm employment in the neighbouring agricultural area and therefore have higher chance of creation of CTs in their neighborhood. A fall in the population density at the city causes fall in the participation in the urban informal sector who find job in rural non-farm sector if the rural farm sector with limited absorption capacity does not accommodate the labour force and the neighborhood village has a greater chance to be transformed into a CT. Last, an expansion in the boundary of the city reduces the chance of a neighboring village being transformed into a CT. Given the size of its formal sector, expansion of the city leads to an expansion of urban informal sector. The informal wage rate remaining unchanged this happens as labour relocates from the rural non-farm sector to urban informal sector, which reduces the chance of a village transforming in a CT. The theory also argues that the large cities and the cities with high cost of commuting may dilute or reverse the positive effect of rise in formal sector wage on transformation of a village into CT.These factors are shown to amplify the effect of uncertain job prospect, which is an alternative way of capturing the negative effect of lack of insurance on formation of urban settlements.

The empirical part of the chapter, using Census village/town data for the districts of West Bengal, India between Census years 2001 and 2011 verifies the relative importance of the factors identified in theoretical propositions derived in the chapter in formation of the CTs. It uses Logit regression for its purpose. It turns out that the higher formal sector income in the nearby urban centres with lower extent of urban sprawl is the major factor explaining the birth of Census Towns. 'Formalization of cities' is not a significant factor explaining the birth of CTs.

The third chapter contributes to the literature in a number of ways. First, it analyzes both the forces of agglomeration and dispersion that work because of development of transport infrastructure like highways, rail head and local roads. It looks at interaction of each of the highways and rail infrastructure with local roads. In the analysis it not only juxtaposes the transport infrastructure variables, also controls for nearness to the city and local amenities at the villages. Second, it finds that the state and national highways located near the city increases the probability of a village turning into a CT. The closer the distance, the higher is the chance of a successful conversion. Contrary to the existing literature, in case of West Bengal, the chapter finds that although local roads have a positive impact, do not significant influence in emergence of CTs except in the cases where it complements the highways. However, the nature of complementarity is different at the districts bordering the city of Kolkata compared to what we generally observe in the state. While generally it supports the forces of dispersion from the existing cities, in the neighborhood of Kolkata it supports the forces of agglomeration. Third, the GQ project in West Bengal has a weaker role compared to the state/national highways in turning the prospective villages into CTs. Fourth, commuting is in general is not an important factor in formation of CTs in West Bengal. Fifth, in case of West Bengal, with its uneven pattern of development centered around its capital city of Kolkata, all other things remaining the same the villages had a higher chance of getting converted in a CT in the districts bordering Kolkata.

The fourth chapter juxtaposes all the factors used in the second chapter and the third chapter together and attempts to reduce the dimensionality of the explanatory factors by use of Principal Component Analysis (PCA). The principal components are blend of all the control variables used in the earlier two chapters. The varimax rotation of them identifies an original control variable which have the highest correlation with the each of the extracted principal components.The variables with highest correlation with the principal components are defined as dominant variables. The regression of the dominant variables on the dependent variable for finding out relative importance of them in the conversion of ‘would be CTs’ to CTs, we also infer which of the original variables are the most important in explanation of the formation of the CTs in West Bengal. From our analysis, it appears that the existence of railways within 5km radius of a village, high population density in nearby city and availability of electricity in a village are the most important factors in conversion of a village to a CT while considering 'would be CTs' of whole West Bengal .To find whether the explanatory variables have varied importance in CT dynamics we disaggregate the whole dataset into two sub datasets. In one sub dataset we take the 'would be CTs' of the districts sharing border with Kolkata. The districts are North 24 Parganas, South 24 Parganas and Haora. In other sub dataset we take the rest of the districts in West Bengal. While the highway within 5 km radius explains the birth of CT in both categories of districts, the population density in the nearby city/ST matter exclusively for the districts sharing border with Kolkata.The rural road network and nearness of the village from the city/ST appear to be crucial factors in CT dynamics in the districts not sharing border with Kolkata.The result is interesting as it provides us with new insight about the factors associated with formation of CTs in West Bengal. In contrast to Chakrabarti and Mukherjee (2022), the regression analysis of this chapter finds railways support 'force of dispersion' in birth of CTs in West Bengal. The population density of the nearest city/ST which remains responsible for birth of CTs in the neighborhood of Kolkata does not appear as dominant variable when the 'would be CTs' belong in the non-bordering districts of Kolkata.The results, in this more general approach to the problem, compared to the partial approaches taken in the existing literature, suggest that the fall in expected formal wage in the neighboring city in formation of CTs, is overemphasized. The long-distance daily commute to the nearest city may have an important role in formation of CTs in West Bengal too especially in the bordering districts of Kolkata, which remained uncaptured in the existing partial treatments of the problem.

5.2. Limitations

Both the theory and empirics in the thesis suffer from some limitations. The theory in chapter 2 precludes the use the local/global capital in the agricultural production and local capital (however small) in the rural non-farm sector/urban informal sector. An inflow of global capital in a capital scarce economy like India may lead expansion of urban formal sector. This may trigger migration but in an extremely congested city and the existence of large informal sector may forbid them to enter into the urban economy. The residual labour force then enters into rural nonfarm sector and the CT dynamics accelerate. A more detailed analysis about the role of capital will lead to a more complete analysis. Other major limitation of this thesis is the dearth of data. Throughout the analysis we have used secondary data from Census 2001 and Census 2011. In the absence of proper village level data, we have proxied it with district level data from state statistical handbook of West Bengal various years. A primary survey in different districts of West Bengal and the other states could make the thesis more complete.

5.3. Policy Recommendations

The thesis brings up several policy recommendations. The analysis in chapter 2 brings some important policy recommendations. In an extremely populous city/there is very little possibility of population expansion. In this situation the possibility of the surrounding villages to become CT rises. Thus if the infrastructure of the villages is improved the flow of migration towards the urban centre may be checked. The improved physical infrastructure may lead to more job creation that will check the movement of the people to urban centre in medium and long run and the pressure of population in the city will be reduced leading to more inclusive pattern of development. Secondly, if a CT is converted to ST the problem of lack of infrastructure may be overcome. Hence the conversion of CTs to STs is a necessary step to render people urban amenities.

The analysis in chapter 3 focuses on transport infrastructure and village amenities in CT dynamics. Whether transport infrastructure supports agglomeration to urban centre or dispersion to suburb is a major debate. Our analysis finds a mixed result.Improved transportation facilities not only ease out daily commuting but also attracts labour and capital out of the urban centre to avoid competition. Hence investment in transport infrastructure by the policymakers will be a great leap in favour of inclusive urbanization and balanced economic growth. Also the improvement of village amenities like banks, schools, electricity along with village road will help the same if properly managed.

5.4. Future Research Agenda

The theory developed in the second chapter analyzed CT dynamics in terms of Harris-Todaro framework nested in urban economics. However, the inflow of global capital and the role of local capital is not taken into account in the analysis. But global capital inflow is an inevitable process in the period of economic reforms. Also the local capital whose role remains trivial in the analysis may also play a complementary role to global capital which may affect CT dynamics. The future research can extend the theory by including the role of global and local capital in the model. Chapter 3 admits the crucial role played by transport infrastructure and village specific non-tradables in CT dynamics. But the policies of central government and state government which directly or indirectly effect these factors are not taken into account. We have taken only the GQ project by government of India in CT dynamics. But state level policies in the past and present are ignored throughout. Taking into account these policies may explore the political economy behind the CT growth during 2001-2011. This remains also a future research agendum. Also throughout the analysis we have used secondary data covering only West Bengal in empirical analysis. However, a more credible empirical analysis requires primary survey. A comprehensive and complete primary survey of a greater dimension with sophisticated statistical technique may explore certain new dimension in such astonishing growth of CTs. Certain things such as the role of environment, importance of village panchayat system, significance of urban rent may be analyzed, which are not captured in the present thesis.

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