METU JFA 2013/1
(30:1) *139-163*

DOI: 10.4305/METU.JFA.2013.1.8

THE IMPACT OF MANUFACTURING INDUSTRY DECENTRALIZATION ON JOBS-HOUSING RELATIONSHIP AND COMMUTING BEHAVIOR: THE CASE FOR THE SİNCAN AND OSTİM ORGANIZED INDUSTRIAL DISTRICTS (1)

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Received: 16.04.2012, **Final Text:** 27.03.2013

Keywords: Industrial decentralization; jobs-housing relationship; commuting; Sincan and Ostim Organized Industrial Districts.

1. Bu çalışma, 48/2012-02 kodlu "Firma Yer Değiştirme Sürecinin Çalışanların Konut Alanları Üzerine Etkisi Ankara İmalat Sanayi Örneği" isimli bilimsel araştırma projesinin sonuçlarından yararlanılarak üretilmiştir.

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INTRODUCTION

Since 1985, Ankara has witnessed a period of rapid economic and spatial change, with one of the most visible changes being an expansion of urban space. In this period, many industries relocated outside the city center to industrial sites near such sub-centers as Sincan and Batıkent, both of which have seen a significant growth of manufacturing firms and employment. With the expansion of the urban transport network and technical infrastructure, new development projects for higher and middle-income groups are springing up on the fringes of the city, attracting many residents to set up home in the peripheral areas.

Prior to 1985, there had been a high level of spatial matching of urban jobs and urban housing in the Ankara basin (ABB, 2006); however, this was followed by a period of rapid urban sprawl on a city scale in every direction, especially along the south-western corridor (Çayyolu-Ümitköy). As is common with urban sprawl, Ankara came to feature a lack of concentration, clustering and proximity, following a development pattern that was dispersed, fragmented and discontinuous (Yaşar, 2010). Only the western corridor saw compact and mixed-use development, including the Sincan and Batıkent subcenters.

Due to the widening of the income gap between classes, inner city problems and lifestyle changes, many high-income households are opting to live on the urban fringes where higher priced residences are located, while the jobs for the highly qualified remain in the central areas of the city (Yaşar, 2010; Şenyapılı, 2005; Erişen, 2003). The residential areas on the south-western corridor of Ankara include Ümitköy, Beysukent, Konutkent I and II, Koru and Yaşamkent. Besides the high-income groups, largely middle- and, to a limited extent, lower-middle income groups are also tending to move to the urban fringes, but along the western corridor, along with many manufacturing jobs for the less qualified in such areas as Sincan, Eryaman and Batıkent on the western corridor of Ankara.

Accordingly, the decentralization in manufacturing jobs coupled with residential development is benefitting middle- and lower-middle income households, while the higher income groups are moving further from their work locations; and consequently, there has been a shift in the spatial relationship between urban jobs and urban housing in Ankara.

During processes of suburbanization, housing and employment locations are mutually adjusted to enable people to live in close proximity to their workplaces. These adjustments might involve a change in residence or a change in work place (and sometimes both), in what is called the co-location hypothesis (Gordon & Richardson, 1991; Lewinson & Kumar, 1994). Furthermore, co-location travel behaviors depend on an adequate supply of affordable housing and land in suburban areas, so that locators (both firms and workers) can make changes in their places of residence and work (Lewinson & Kumar, 1994).

With the increasing suburbanization, the co-location of jobs and housing is having profound impacts on urban development that are commonly observed in Western cities, including decreased distances to work, shorter commuting times and decreased travel costs, as well as decreasing traffic jams and pollution (Gordon & Richardson, 1997; Levinson & Kumar, 1994; Gordon, et al., 1991). The co-location of jobs and housing in Western cities has been the subject of extensive research; although little is known about the extent and the effects of the co-location of jobs and housing in Turkey – where it is a relatively new phenomenon – and its impacts on job accessibility, commuter patterns and commuter behavior. In this regard, this study will make an analysis of the impacts of manufacturing decentralization on the jobs-housing relationship, commuting patterns and commuting behavior in Ankara.

LITERATURE REVIEW

Co-location Hypothesis

The findings of studies of US cities have shown that a paradox accompanies the process of suburbanization. Despite the congestion in many cities during peak hours, average commuting times remain stable (Gordon & Richardson, 1991), showing very little variation between metropolitan areas with different population densities (Gordon, et al., 1989; Levinson & Kumar, 1994). The co-location hypothesis suggests that firms and households re-adjust spatially from time to time in order to strike a balance in average commuting times and distances, by which it has become possible to avoid increased commuting times and worsening congestion (Gordon, et al., 1989, 1991). The core of this hypothesis assumes that a decentralization of employment reduces commuting times, and also addresses the behavior of individual workers facing workplace and/or residence relocations, under the assumptions of declining wages and housing price gradients (Dubin, 1991). Researches into the relationship between jobs and housing and suburbanization offer mixed results about commuting times and distance. While the findings of some studies suggest a decrease in commuting times and distances, others claim the opposite.

Studies using micro-level data continue to show that residencies in job-rich areas, and workplaces in housing rich areas are associated with shorter commutes (Lewinson, 1998; Ewing & Cervero, 2001), suggesting that suburbanization may not necessarily result in a substantial increase in

commuting times or distances provided that jobs and residences undergo simultaneous decentralization.

In an analysis of excess commuting in Tokyo, Merriman, et al. (1995) conclude that either the decentralization of jobs or the centralization of residents gives rise to reductions in commuting times. Dubin (1991) agrees that the decentralization of firms might reduce commuting times of workers, but notes that this varies according to the socio-economic characteristics of the commuters. An analysis of San Francisco yields similar results, with Cervero & Wu (1997) noting that polycentric growth has lowered commuting times, with trips to downtown San Francisco taking 30 percent longer than to the peripheral centers.

Some empirical evidence contradicts the co-location hypothesis. A study based on census data reveals that the average commuting times in the United States increased steadily from 21.7 minutes in 1980 to 22.4 minutes in 1990, and to 24.3 minutes in 2000 (Horner, 2004). Hamilton (1982) points to the fact that despite the movements of jobs towards residential areas, employment decentralization has not resulted in a reduction of average commute times, but conversely, a slight increase. Cervero & Wu (1998) analyze the relationship between employment decentralization and commuting distances and times in the San Francisco Bay area, where employment has grown rapidly since 1980. Between 1980 and 1990, this trend led to a substantial increase in average commute distances and times, contradicting the co-location hypothesis that employment decentralization results in shorter commuting times. Lewinson et al. (2003) made a re-examination of the rational locator hypothesis, comparing commuting time data in metropolitan areas with different geographic scales. They conclude that, in time, larger regions show little change in commuting times, while cities, starting with a much shorter average commute time, show a marked increase.

In another study based on data from 1980 and 1990, Cervero & Wu (1998) conclude that, contrary to the co-location hypothesis, employment decentralization cannot been associated with shorter average commuting distances or durations, unlike the existing decentralized urban spatial structure. Baccani (1997) also shows that the decentralization of employment failed to resolve the problem of commuting distances in Paris, as it has rather increased – a result, he notes, of the decentralization of population. Levinson (1997) concludes that changing the urban spatial structure has little effect on commuting durations. In his research on the Washington metropolitan area, he suggests that the increases in commuting times due to the suburbanization of residences are counteracted by the correlated process of suburbanizing jobs. Cervero and Landis (1992) distinguish between commuting times and distances when considering the effect of decentralization in San Francisco. They note that, generally, the suburbanization of jobs has led to no change in commuting distances, but has fostered a decrease in commuting times due to the wider use of the automobile.

Cervero (1996) finds little relationship between the variables of the jobs-housing balance and self-containment in the cities he studies. Some cities he found to be nearly perfectly balanced, however only a third of their workers reside locally, and even smaller shares of residents work locally. Moreover, restricted housing production and high housing prices in suburban areas obstructs the co-location of housing and jobs. Ewing (1997) and Naess (2006) report that most suburban dwellers in US

metropolitan areas and in the Copenhagen region resettle from the inner city to subcenters in suburban areas and travel longer total distances than inner-city residents. Furthermore, Kim (2008) finds that when both the population and employment are growing in subcenters in the Seattle metropolitan region, and when workers change their location, they prefer a commuting zone similar to their previous one in terms of travel time and distance. This behavior results in the average commuting time and distance being maintained at a stable level, contradicting the co-location hypothesis.

In practice, commuting times are not only determined by the jobs-housing balance, but are also influenced by other socio-economic and land-use variables. For example, in his study of the distant new town in Hong Kong, Lau (2010) finds that low-income workers that reside there not only lack freedom of choice in their mode of travel, but also experience a spatial mismatch between housing and jobs that results in increased commuting times. Furthermore, low-income workers are unwilling to look for remote jobs as the wages offered are too low to justify the commuting costs. As such, socio-economic and land-use variables, such as income, spatial mismatches between jobs and housing, and choice of mode of travel can be vital factors influencing commuting times.

A number of recent studies have focused on differences in commuting patterns between economic sectors. For example, using American housing survey data, Crane and Chatman (2003) found that decentralizations of service, wholesale and construction sector employment are associated with shorter commutes, while decentralizations in employment in the finance, insurance, real estate, manufacturing and government sectors are associated with longer commutes. This is a result of the substantial clustering of service, wholesale and construction sector employment in the suburbs. Similarly, Lee et al. (2006) suggest that the average commuting times in 12 of the largest metropolitan areas in the United States in the 1990s did not increase in parallel to the dramatic decentralization of employment, and indicated also that travel times were shortest in the retail sector, followed by services. In particular, the extent to which employment decentralization can affect the commuting patterns of workers depends largely on the type of decentralized employment. The relationship between various types of employment and housing in the suburbs is a precondition for the balance of jobs and housing.

In addition to these international studies, there have also been a number of studies focusing on commuting patterns in Turkey. Based on his 1980 study of people who had migrated to Ankara from İskilip, Ersoy (1991) shows the effects of the duration of stay in the city on the spatial relationship between housing and work places. While the first migrants, who settled in Ankara before 1950, tend to travel on average 2 km from their residences to their places of work, new immigrants tend to commute 3.5–4 km. Ersoy revealed also that nearly half of the workplaces and housing areas were within walking distance for the first immigrants, while only 25 percent of the new immigrants from İskilip are able to walk to work. The study also reveals that the average distance between the workplace and home increased significantly over time for all immigrants.

A study (Tekeli et al., 1991) on the historical development of industrial production in the Ankara Metropolitan Area shows that housing and workplace connectivity patterns of different segments of the workforce bear similarities and differences related to whether the industrial establishments have differentiated or undifferentiated levels of production in time.

The study revealed apparent variations in the distribution of housing and workplace connectivity patterns among blue-collar (apprentices, journeymen, craftsmen) and white-collar employees (engineers and technicians) in the industrial establishments with differentiated levels of production in time.

In a study of the İstanbul Metropolitan Area (Alkay, 2011), although the commuting times of most service-sector workers are longer than those in the retail sector, they are shorter than those of manufacturing sector workers. Another finding of the study is that the 31.5 percent of workers live and work in the same district in the İstanbul Metropolitan Area, although there are apparent differences among the workers of different sectors. For instance, the share of workers who live and work in the same district is 58 percent for the manufacturing sector, 45 percent for the services sector and 58 percent for the retail sector. Also, there is a significant difference in commuting times for workers who live and work in the same area (16.84) and workers who reside in different areas to their workplace (41.46).

Doğan's (2008) study of housing along the western development corridor in Ankara, including case studies of Etimesgut and Sincan, shows that the residents in these areas generally work in Sincan-Etimesgut or Kızılay-Bakanlıklar. Most households aim to reduce their commuting distance when choosing their location, but prefer housing at the fringe of the city due to the advantages of accessibility. Therefore, low commuting times and costs indicate that there is little trade-off between lower housing prices/rents and greater commuting times for most households. Households rather prefer to reduce their commuting costs by using public transport and the service buses provided by the employer, or by walking to work from their nearby dwellings. On the whole, households whose income levels are better than others, especially professionals and those working in the service sector, use their private cars for commuting.

Günay's study (2007) of İstanbul notes that the average duration of trips within the urban fringe (65 minutes) are higher than in the urban core (30 minutes). Trip durations are rather long for all vehicles within the urban fringe when categorized according to vehicle modes, with travel times particularly high for public transport, at 81 minutes. It should be noted that average trip distances within the urban fringe (24.2 km) are considerably higher than in the urban core (7.1 km).

This paper investigates the different effects of co-location that arise between manufacturing firms and their employee base in peripheral areas, depending on occupational status and distance from the city center, by making a comparison of decentralized employment within two industrial sites.

The Context of Ankara

Ankara, the capital city of Turkey, has an urban area of 61,000 ha. (ABB, 2006) and a population of 4,550,662 in 2011 (TUIK, 2011a). Since 1985, Ankara has undergone a spatial transformation together with rapid economic and spatial restructuring, and witnessed a 98 percent increase in population between 1985 and 2011. In addition, the urban area has increased by 97 percent in only 20 years, from 1985 to 2005, 39 percent of which was recorded in the seven years from 1998 to 2005 (ABB, 2006). The area covered by the city has increased faster than the increase in population, and, as such, density has decreased from 85 people per ha.

in 1985 to 67.5 in 2000 (Çalışkan, 2004; Yaşar, 2010). This development signaled also the advent of a newly established jobs-housing relationship and commuting behavior.

Since 1985, urban growth has been stimulated by low-density urban sprawl and a decentralization of manufacturing industry. Between 1985 and 2011, the population in the suburban area, including both the inner and outer peripheral areas, grew by 10.6 percent (from 1,186,017 to 1,312,842), while the city center experienced a somewhat stagnated population increase of 3.6 percent (from 1,065,411 to 1,104,518) (Tekeli et al., 1987; TUIK, 2011a). Within these years, significant population growth was experienced, with an 86.1 percent increase in outer core locations at 6–15 km from the city center, due especially to transformation projects.

The decentralization of population occurred together with employment decentralization, especially in the manufacturing sector, on the western corridor; and the spatial restructuring has been accompanied by an economic restructuring, with the economy becoming increasingly service-sector oriented. The manufacturing sector is the second largest sector in Ankara, accounting for 23.5 percent of employment (2005) (1) (ABB, 2006), and has gained momentum especially after 1985 (2). In the period from 1988–2007, employment has increased by 45 percent and the number of firms has increased by 57 percent (TOBB, 1988; 2007). In the central urban areas, employment in the finance, insurance, real estate and commercial services sectors has increased, causing manufacturing factories to move away from the city center to make space for the high-revenue yielding service sector. Additionally, new forms of production, the division of production processes and the spatial division of production (made possible through advances in communication and transportation technologies) have led to a radical change in the spatial distribution of industry. Both small- and large-scale production is widely considered to have a detrimental effect on cities in terms of pollution and decreasing drastically the "quality of life". Responding largely to environmental issues, both the central and municipal governments have been making an effort to decentralize manufacturing firms through planning decisions on industrial development that encourages them to move outside the main urban area.

As a consequence of the above, the decentralization of manufacturing firms from the inner city areas has come to shape the new industrial geography of Ankara. Urban regeneration decisions in existing inner city industrial areas have been especially effective, and these planning decisions have encouraged industrial firms to move out of the inner city areas (Kazıkiçi Bostanları and Siteler) to areas away from the center (Ostim, İvedik, Hurdacılar, Demirciler and Gersan Industrial Sites) and to the outer periphery of the city (Sincan Organized Industrial Zone) (ABB, 2006, 285). In parallel to this, new industrial sites were proposed in the planned areas on the western side of Ankara, especially on the İstanbul Road (Sincan, Ostim and İvedik), which attracted many of the manufacturing firms, most of which relocated to the industrial sites. Accordingly, in the 1974–1988 period, 12.3 percent of manufacturing firms chose to relocate (Görer, 1990), rising further to 20 percent in the 1988–2007 period; while the average decentralization distance for manufacturing firms more than doubled in the second era (from 6 km to 13.6 km) (Bostan, 2008; Bostan, et al., 2010).

The residential and industrial decentralization is also leading Ankara to experience changes in commuting patterns, particularly in long-distance commuting trips. From 1980–1990, there was a slight change in the average

2. Ankara may be classified as a services city, considering the fact that 69.2 percent of total employment was in the services sector in 2005. In second place is industry, providing 23.5 percent of the employment, follwed by agriculture with 7.3 percent (ABB,2006). Functions related to Ankara's status as a capital city enhance its services city character.

3. Employment in the manufacturing sector increased from 46,257 in 1988 to 85,198 in 2007. In the same period, the number of firms also increased from 1,273 to 2,976 (TOBB).

4. The findings of the same study also show that 13.6 percent of firms relocated to the inner core, 11.8 percent to the inner suburb, and only 1.6 percent outside of Ankara.

distance of trips to work, however in the 20 years between 1980 and 2000 this average changed from 6.1 to 10.22 km as a result of the decentralization of residential areas without establishing a jobs-housing balance (Çalışkan, 2004). Along the western corridor, while 40 percent of the population was living within 10 km of the city center in 1990, this figure had decreased to 30 percent by 2000. On the other hand, on the southwestern corridor, although 92 percent of the population was living within 10 km of the city center in 1990, this figure had decreased to 60 percent by 2000 (Sutcliffe, 2005). The effects of decentralization differ depending on the type of development along the corridors, which can be either sprawl or compact with mixed use. Thus, 51 percent of the workers living on the western corridor are employed on the same corridor, compared to a ratio of 6 percent for the southwestern corridor (Şenyapılı, et al., 2002).

The lengthening of commuting in Ankara would have a considerable impact on both the local and global environment, due especially to the increased use of motorized transport. In Ankara, the number of private cars increased by 4.9 times (from 202,095 to 983,405) in the period between 1992 and 2011 (TUİK, 2011b), and Ankara now boasts the highest number of private cars per person when compared to all other Turkish cities. In 2008, the number of cars per thousand people was 188 in Ankara, compared to 95 for Turkey as a whole, and 139 for İstanbul, and this figure had grown to 200 by 2009 (TUİK, 2008, 2009). In addition, the share of private cars among all motorized vehicles increased from 17–20 percent in 1990 to 28 percent by the end of 2000 (ABB, EGO Directorate General, 2008). For example, 73 percent of residents living along the southwestern corridor commute by private car (Şenyapılı, et al., 2002).

In Ankara, one of the main factors affecting the job-housing relationship and the commuting behavior in the city are the former and recent urban plans. The 1990 Urban Plan and those that followed have encouraged decentralization out of the main Ankara basin. Ankara is surrounded by topographical thresholds that form a geographical limit that forced the city to remain naturally compact and highly dense up to 1985. The initial proposal for development to promote suburbanization was made for Sincan and Batıkent on the western corridor in the 1990 Plan. Later, the 2015 Plan also proposed decentralization of the city in order to resolve the increasing problem of air pollution, and to address the increasing population. Ankara's 2023 Urban Master Plan (the most recent) has also proposed decentralization, but by developing far more urban land than is needed and lacking measures to control urban growth, this plan has led to a sprawl type of urban development (Yaşar, 2010), encouraging a high level of private car usage in the absence of an adequate mass public transport system.

In the present case, to prevent air pollution and dense development within the existing built up area, the 1990 and 2015 plans encouraged the construction of residential developments and industry outside the Ankara basin and led to low density urban sprawl with partial interventions and unplanned speculative fragmented developments – especially along the southwestern corridor (**Figure 1,2**). In particular, the 2023 master plan of the city, which was made on the assumption of a worst-case scenario in population growth, has also encouraged urban sprawl in Ankara (**Figure 3**). In addition, not only are the surrounding lands being over-consumed due to dispersal, but there is also an over-production of housing. This is a result of pressure from the real estate market and the profit-oriented

view of the local authority as the producers and coordinators of the plans, alongside other reasons, and has thus promoted urban sprawl (Yaşar, 2010). Nevertheless, along the western corridor there has been a rather balanced and mix-use development, with industrial zones in Ostim, İvedik and Sincan, and mass housing areas in Sincan, Etimesgut, Eryaman, Batıkent and their peripheries. Sincan, Etimesgut and Batıkent are planned subcenters on the metro and railway networks, and have done much to resolve the housing problem of the middle classes through the provision of cheaper properties. The type of compact and mixed-use development on the western corridor and the urban sprawl experienced along the other corridors leading out of the city (especially along the southwestern corridor) has affected the job-housing relationship and the commuting behavior of manufacturing workers differently.

Figure 1. 1990 Master Plan (Tekeli et al. 1987)

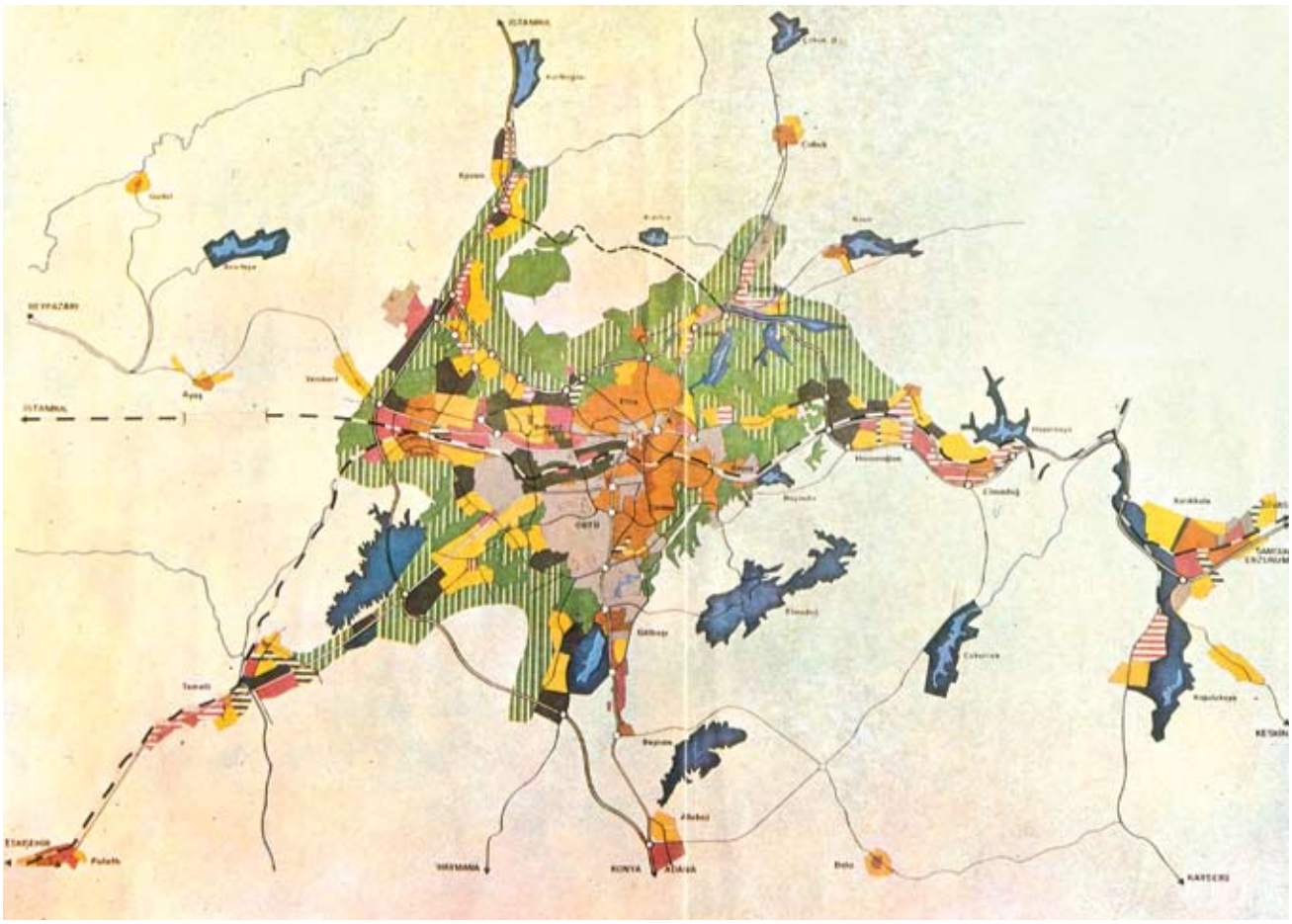

Figure 2. 2015 Master Plan (Tekeli et al. 1987)

The pattern of urban growth is one of the major factors influencing the changes in commuting in Ankara, with other reasons being high levels of motorization, a lack of public transport and transport infrastructure, weak traffic management and poorly developed municipal, fiscal and regulatory institutions. In particular, urban sprawl on the fringes of the city is seen as a key factor in the increase in long-distance commuting. Accordingly, the formation of subcenters featuring compact urban development with mixed land use (Sincan and Batıkent) should also play an important role in reducing long-distance suburb-to-center commuting. However, in Ankara, the current policies being put in place to address transport problems frequently focus on large and expensive transport infrastructures, which can be attributed in part to the lack of empirical studies. This study makes an empirical contribution to the field by analyzing the impacts of decentralization of manufacturing to the subcenters on the jobs-housing balance and commuting in Ankara.

STUDY AREA AND RESEARCH METHODOLOGY

In the empirical analysis, to analyze the relationship between jobs and housing and the commuting behaviors of those employed in manufacturing, Ankara is categorized into four main parts (**Figure 4**): The inner core (the area 0–6 km from the city center), the outer core (the area 6–15 km from the city center), the inner periphery (the area 15–25 km from the city center) and the outer periphery (the area 25–50 km from the city center). The inner core and outer core comprise the main urban

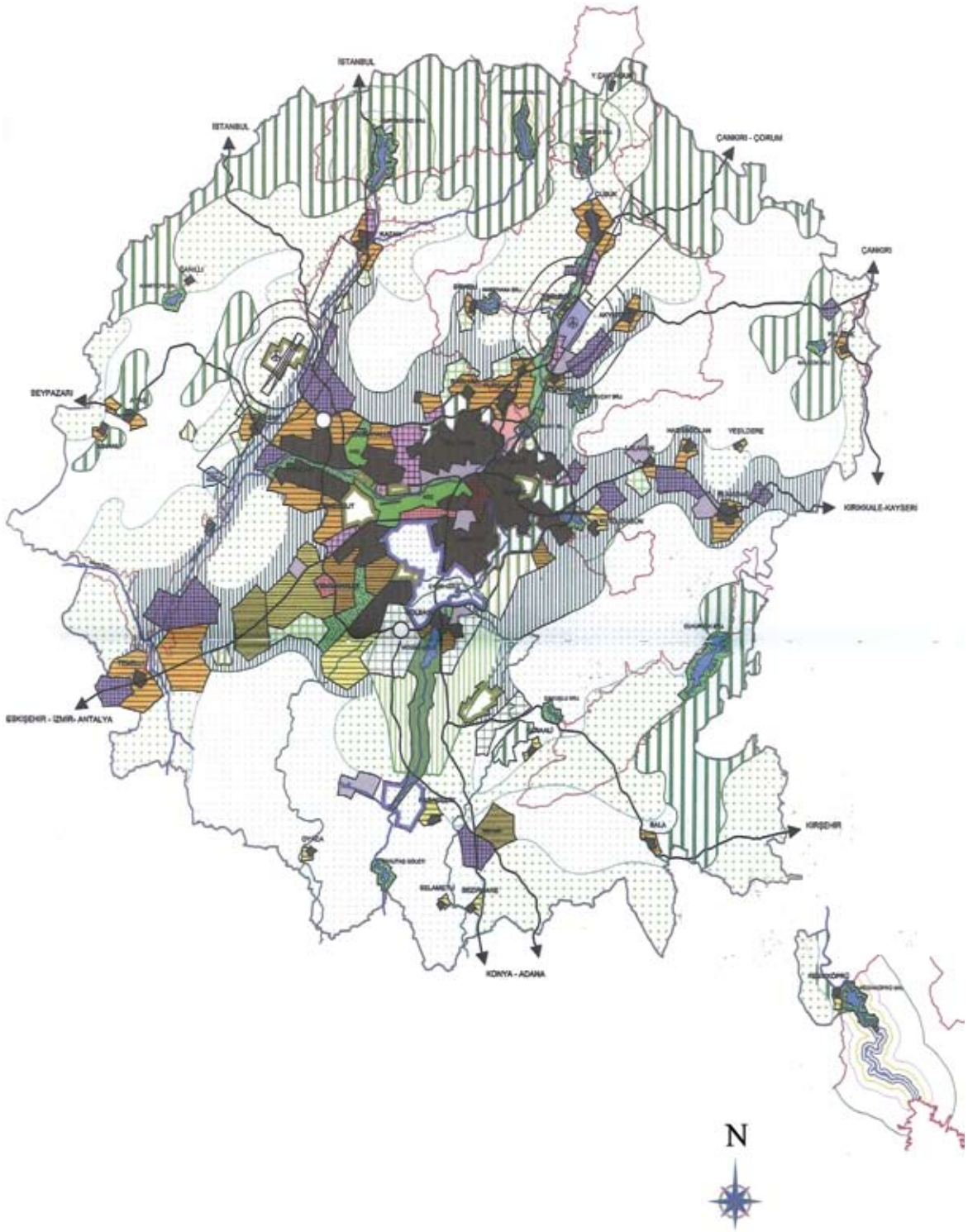

Figure 3. 2023 Regulatory Development Plan (ABB, 2006)

area of Ankara, characterized by high density, compact and mixed-use development within the main Ankara basin. On the other hand, the inner periphery has largely scattered low-density residential areas of high- and middle-income groups together with organized and unorganized industrial developments. The area between 25–50 km shows largely a sprawl type of development in its residential and industrial developments. After 50km,

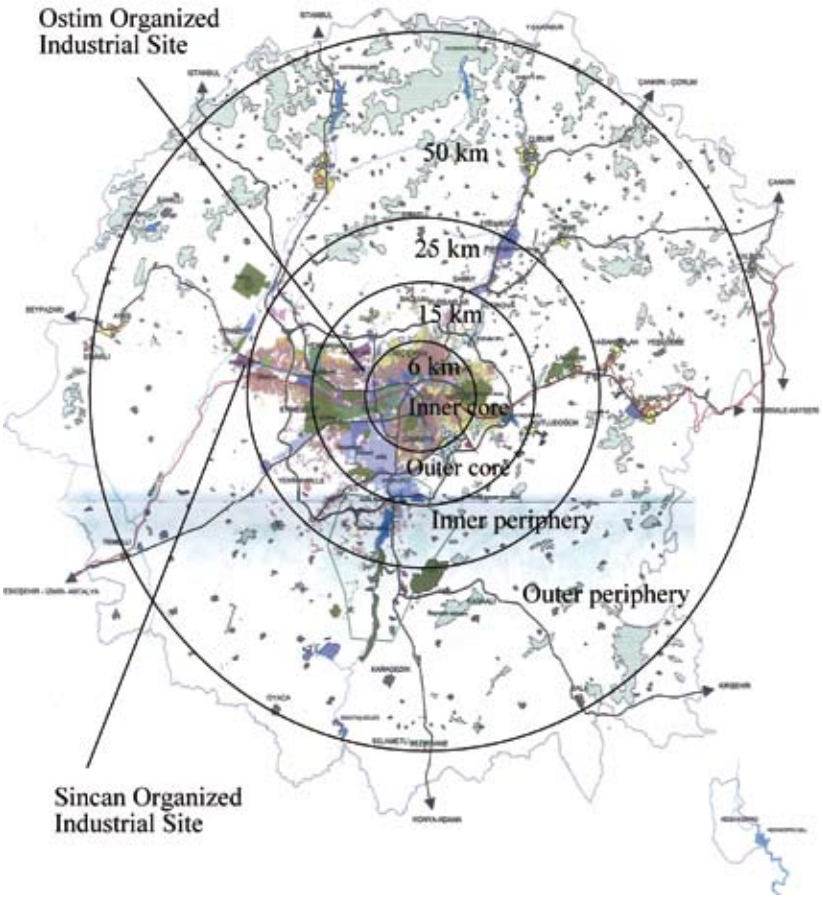

Figure 4. 6 km, 15 km, 25 km and 50 km Radii of the Ankara Metropolitan Area (base map ABB, 2006). Source: Ankara Metropolitan Municipality, (2006), 2023 Plan Report

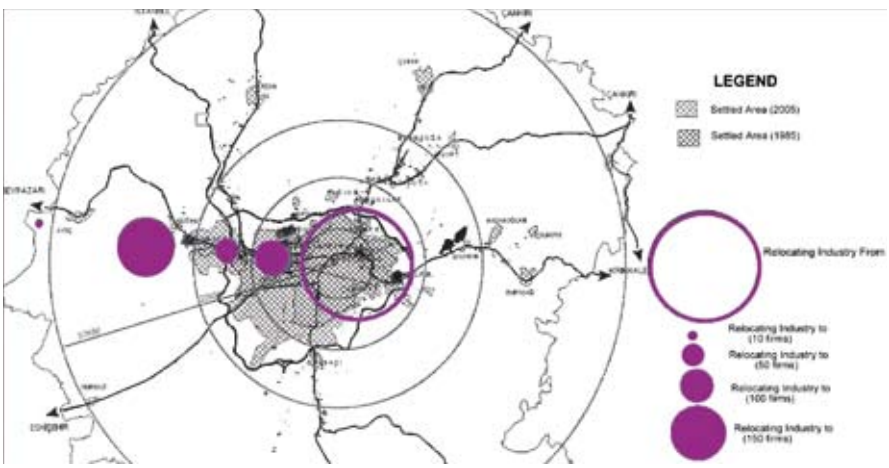

Figure 5. Firm Migration 1988–2007 in the Ankara Metropolitan Area (Bostan, 2008)

there are an insignificant number of decentralized manufacturing firms (1 percent), and so this study retains as its main area of focus the area within a 50 km radius of the city center.

Ankara has two important nodes, one in the outer core and one in the outer periphery, that are home to the largest share of firms (51.8 percent, 18.8 percent) and workforce (31.9 percent, 32.0 percent), (Bostan, 2008). Bostan (2008) also indicates that the largest share of firms that relocated did so to these two industrial nodes between 1988 and 2007, especially along the

western corridor (**Figure 5**). The findings of the study reveal that while 44.7 percent of the firms that chose to relocate moved to the outer core, many to Ostim, 27.0 percent relocated to the outer periphery, many to the 1st Sincan Organized Industrial District.

Responding to this fact, in this study, the decentralized firms, the employees of which were interviewed, were chosen from among the firms in the Ostim Organized Industrial District (OID) located on the outer core, and the firms in Sincan OID, located on the outer periphery on the western corridor. To evaluate especially the impact of distance on commuting patterns as well as housing market characteristics, a comparative study of the two nodes has been made.

The data used in this study is derived from an employee survey conducted in the Sincan and Ostim OIDs in May 2011 and December 2012, in which workers employed in these decentralized zones were selected randomly and interviewed. Among other questions, the respondents were asked to state the location of their homes and workplaces, as well as the locations of previous homes if they had moved. Using this data, the real distance between homes and jobs was measured to give a distance from the home district to the job district, utilizing a land-use map of Ankara.

A total of 650 questionnaires were distributed to 5 percent of workers in the decentralized firms, 475 to workers in the Sincan OID, and 175 to workers in the Ostim OID. The occupational status of the workers influences their incomes and represents their socio-economic level, and this occupational status, as a behavioral variable, is a relevant factor in determining where one is likely to work. Lastly, social factors influencing residential location may be better understood from occupation than from income alone (Miller & Çubukgil, 1982). In this respect, the laborers were interviewed on the basis of their status, defined as low, middle or high. Low-status workers included unskilled workers and foremen, middle-status workers include administrative employees and technicians, and high-status workers included managers and engineers. In this way, it has become possible to analyze the effects of the decentralization of manufacturing firms on the relationship between jobs and housing, and the commuting patterns on the basis of the workers' occupational status.

The first part of the empirical analysis provided an overall estimate of the spatial match or mismatch of manufacturing jobs and residential locations. Firstly, to define the location of the population within the different distance circles for the years of 1985 and 2011, the populations of the districts were obtained, and were spatially distributed according to the distance circles. Due to a lack of employment data for the same years, the data provided by Bostan et al. (2008) for 1988 and 2007 was used. In this way, both the spatial distribution of the population and their employment within the distance circles were obtained and evaluated.

Secondly, an index of dissimilarity was used to make an overall estimate of the spatial match or mismatch for the inner city and the main urban area. Recently, a dissimilarity index has also been used to measure the proximity of residents to their jobs, or the extent to which residential and employment locations differ across a metropolitan area. The dissimilarity index is used here as a spatial mismatch index (SMI) which, for a given metropolitan area, can be calculated as:

$$SMI_i^n = \frac{1}{2} \sum | pi/P - ei/E |$$

where E and P are respectively the total employees and total population of the metropolitan area under study; *ei* and *pi* are respectively the employment and population of the district; and n is the number of districts within that metropolitan area. Ranging between 0 (perfect balance) and 1 (perfect imbalance), the SMI value describes the extent to which people change their areas of residence (measured as districts in this paper based on data availability) closer to areas where their jobs are located. SMI values from the above equation are then multiplied by 100 to get larger numbers for easier interpretation and comparison, and to allow an interpretation of the index as a percentage of population that would have to move to where more jobs are located to yield a perfect balance.

RESULTS

Employment-Population Distribution: A General Survey

Ankara experienced decentralization of both habitation and manufacturing jobs between the two survey years (**Table 1**). In terms of residential location, 47.3 percent of the population lived in the inner core in 1985, falling to 24.3 percent in 2011. The inner periphery in particular experienced a substantial population increase, from 1.9 percent to 21.2 percent; while figures for the outer periphery rose from 0 to 7.7 percent. A total of 29 percent of the population lived in peripheral areas in 2011 (Tekeli et al.1987; TUIK 2011a).

On the other hand, in 1988, 32.6 percent of manufacturing jobs were located in the inner core, compared to only 11.6 percent in 2007. Between the inner and outer peripheries, the former experienced stagnant development, with a minor decrease from 21.7 percent to 20.0 percent, while the latter increased to 34.3 percent in the same period. More than half of all manufacturing jobs (54.3 percent) were to be found in the peripheral areas in 2007 (Bostan, 2008).

The speed of decentralization of manufacturing jobs in Ankara appears to be more rapid than that of residences in the 1985–2011 period (**Figure 6**). Some 71 percent of the population was to be found within the main urban area in 2011, and more than half of the manufacturing employment

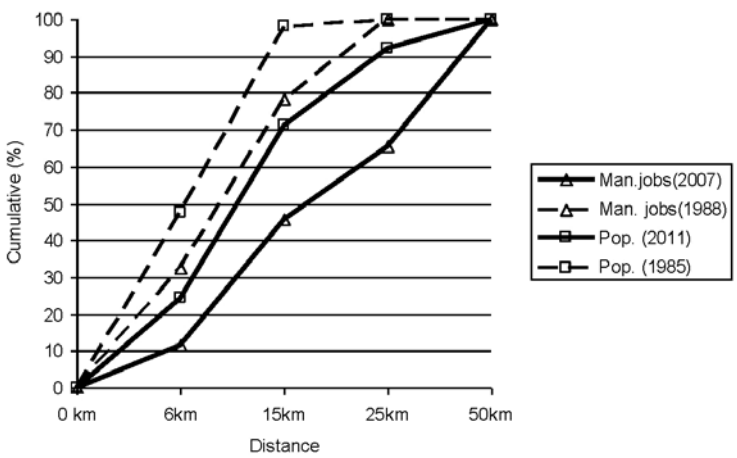

Figure 6. Spatial Distribution of Employment and Population (Pop=Population; Man. Jobs= Manufacturing Jobs)

was in the peripheral areas in 2007, meaning a shift of more jobs to the less populated areas and an increase in the spatial mismatch between manufacturing jobs and residential locations.

For an evaluation of the spatial matches for manufacturing sector employment and residential areas, a spatial mismatch index is calculated for the inner core and the main urban area for the 1985 and 2011. As employment data for these particular years is unavailable, manufacturing employment data for the years of 1988 and 2007 is used. The SMI value shows a clear increasing trend for the main urban area, while the inner core shows a slight decrease. For 1985, the SMI recorded a value of 7.4 and 9.0 respectively in the inner city area and the main urban area; but by 2011, the mismatch in the inner city area had decreased to 6.7, while increasing to 12.5 for the main urban area. In the inner area, a slight increase in population matched with the significant loss of manufacturing employment caused a reduction in the spatial imbalance, and the mismatch between employment and population became more pronounced in the main urban area. In order to make the residential distribution of population identical to the distribution of employment across districts in the inner city and the main urban area, the percentages of residents that would have to relocate would be respectively 6.7 and 12.5 in 2011 (**Table 1**).

The employment-population relationship is dynamic, as both population and employment are subject to change in terms of both size and location. Respective "Fixed-residence SMIs" for 1985 and 2011 were calculated in order to reveal the impacts of population and employment shifts on SMIs. In 1985, the fixed residence SMI increased from 7.4 to 18.0 in the inner city, based on 2007 employment distribution figures, while holding population distribution at its 1985 level. The main urban area observed a similar trend, but to a greater extent (from 9.0 to 26.0). This change indicates that the overall manufacturing employment growth was much higher in the districts with fewer residents.

By comparing the fixed-residence SMI values with the 2011 SMI values, we can estimate the impact of population shifts on the SMIs. Both the inner city and the main urban area witnessed a decrease in their SMIs (respectively from 6.7 to 4.0, and from 12.5 to 3.8), meaning that in 1985 the population shifted slightly towards the districts in the inner city, and to a large extent to the districts in the main urban area.

Coming to the present day, there has been an increasing spatial mismatch in the main urban area as a result of the residential and manufacturing employment shifts between 1985 and 2011. In contrast, the peripheral areas have become job-rich in the manufacturing sector, which means less commuting time and distance for the residents living in the periphery, and more opportunities to enhance the spatial matches between the residential and job location choices. To learn how the decentralization of manufacturing jobs to the western corridor affected the jobs-housing relationship of workers and their commuting behavior, the residential mobility and commuting patterns of the surveyed workers in terms of

	Inner core	Main Urban Area
1985	7.4	9.0
2011	6.7	12.5
Fixed 1985 population	18.0	26.0
Fixed 2011 population	4.0	3.8

Table 1. Spatial Mismatch Index for Ankara

time and distance are used as a measure of job accessibility, allowing an assessment of the spatial match in the employment-residence relationship.

Residential Mobility

Residential mobility is an important part of the jobs-housing balance. Both theoretical and empirical studies suggest that residential mobility intensity varies according to the commuting distance (Zax, 1991; Wissen & Bonnerman, 1991). In general, a longer commuting distance tends to make workers more willing to relocate.

As Sincan is located three times further from the city center than Ostim, the workers in Sincan are more likely to relocate. Since the decentralization of manufacturing, 28 percent of workers in the Sincan OID have changed their residential location, corresponding to 16 percent of workers in the Ostim OID.

With increasing distance, the cost of commuting increases, impacting mostly on low-income groups and leading to residential mobility. Both in Sincan and Ostim, most of the workers that made a residential relocation were in the low- or middle-class, accounting for 85 percent of the workers in the Sincan OID and 54 percent of those in the Ostim OID. Residential mobility results in reduced commuting times, especially for the low-income group, and one reason for this may be that those with low incomes need to save on transportation costs, and thus move to locations closer to their work to avoid long journeys (**Table 2**).

The results presented in **Tables 3** and **4** indicate that in the Sincan OID, low- and middle-status workers (low- and middle-income workers) who have changed their residential location tend to have shorter commuting distances and times within the fringes of the city, as a preference to engaging in long-distance commuting to the city center, when compared to the commuting times of both the workers who have not relocated to Sincan and all of the workers in the case of Ostim.

While the labor market in the Sincan suburb is dominated by manufacturing, which is one of the main sources of jobs for low-income workers, in parallel, the housing market is dominated by low-priced

Table 2. Average Commuting Distance (km) (One way)

LSW: Low status workers, MSW: Middle status workers, HSW: High status workers, TW: Total workers.

	LSW	MSW	HSW	TW
SİNCAN				
Previous home-work distances	16.05	18.29	22.71	**17.57**
Current home-work distances	5.63	10.43	18.51	**8.62**
OSTİM				
Previous home-work distances	18.83	10.17	11.53	**13.79**
Current home-work distances	14.84	13.88	14.02	**14.95**

Table 3. Average Commuting Time (Minutes) and Distance (km) (One way)

	Average Commuting Time				Average Commuting Distance			
	LSW	MSW	HSW	TW	LSW	MSW	HSW	TW
SİNCAN								
Employees who have relocated	**20.19**	**15.53**	**18.25**	**18.9**	**5.63**	**10.43**	**18.51**	**8.62**
Employees who have not relocated	25.18	26.53	25.96	25.69	8.85	13.60	18.97	11.78
OSTİM								
Employees who have relocated	**37.7**	**30.0**	**13.8**	**26.6**	**13.00**	**9.37**	**7.32**	**9.86**
Employees who have not relocated	37.6	30.1	26.2	32.1	14.84	13.88	14.02	14.95

	Sincan						Ostim					
Hour	Employees who have relocated		Employees who have not relocated		Total Employees		Employees who have relocated		Employees who have not relocated		Total Employees	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Less than 0.5	109	**83**	230	**67**	339	**71**	9	**31**	18	**12**	27	**15**
0.5–1	22	**17**	105	**30**	127	**27**	12	**41**	80	**55**	92	**53**
1.01–2	-	-	9	**3**	9	**2**	7	**24**	39	**27**	46	**26**
2.01–3	-	-	-	-	-	-	1	**4**	8	**5**	9	**5**
Above 3	-	-	-	-	-	-	-	-	**1**	**1**	**1**	**1**
Total	131	**100**	344	**100**	475	**100**	29	**100**	146	**100**	175	**100**

Table 4. Distribution of Commuting Trips According to Duration (One way)

housing. In 2012, Sincan had the lowest level of house prices for both rent and sale in the Ankara Metropolitan Area (Uğurlar & Eceral, 2012, 240), and this job and housing match is important for reducing commuting times and distances from the subcenter to the city center, especially for low- and middle-status workers in manufacturing. Of the 52 percent of workers who live in the Sincan subcenter, 79 percent are lower-status and 19 percent are middle-status. Only 2 percent of the higher-status workers reside in the Sincan area, attributable to the low match between the housing market and their housing preferences.

Depending on the distance from the city center and housing market characteristics, in the Ostim case, only 24 percent of workers live in the same neighborhood as their work (Batıkent subcenter) and 36 percent in the Yenimahalle District. This finding has been supported by a new study (2013) of the employees in Ostim in which only 32.1 percent of employees were found to have been living in the Yenimahalle District (Gazi University, 2013, 88). Travel distances and times could not decrease for the workers, especially for the low- and middle-status workers, due to the unaffordable housing market characteristics. In particular, low-status low-income groups are able to settle only in housing areas approximately 40–45 km from Ostim, such as Kayaş, Mamak, Pursaklar and Kazan. In contrast to the Sincan case, high-status workers with high-incomes travel less distances and spend less time travelling due to the local housing market characteristics in the Batıkent subcenter and its peripheries, which are matched to the higher-status workers' housing preferences together with widespread private car usage.

When the direction of residential mobility is considered, it can be seen that in the Sincan OID, 65 percent of the workers who have relocated have moved to same district in which they work (Sincan); corresponding to 41 percent in the Ostim OID (Ostim and Batıkent). As such, it can be argued that as the distance of the subcenter from the city center increases, more residential shifts to the job districts occur, in line with the co-location hypothesis.

An analysis of the reasons behind residential mobility reveals that "residing close to the job" is the main factor in residential relocations, both for Sincan and Ostim (**Table 5**), accounting for nearly 50 percent of the respondents in the Sincan case and 55 percent in the Ostim case. "To purchase one's own house" was the second most important reason for residential relocation for the workers in both Sincan and Ostim. The effect

Table 5. The Reasons for Residential Mobility

Reasons	Sincan	%	Ostim	%
Residing close to job	**66**	**50**	**16**	**55**
Purchase one's own house	33	25	5	17
Family reasons related	5	4	1	4
Housing driven factors (size, price, quality)	16	12	2	7
Better neighborhood environment	4	3	1	4
Other	8	6	4	13
Total	131	100	29	100

of other factors, including housing driven factors and better neighborhood environments on residential mobility were not significant in residential mobility for the Sincan and Ostim cases. This indicates that for both cases, especially for Sincan, housing decentralization has been a significant follower of employment decentralization along the western corridor.

Commuting Patterns

How the jobs-housing match plays out in the city affects people's lives. One major parameter of commuting is the distance workers must travel to work. As shown in **Table 6**, in the Sincan case 38 percent of workers travel a short distance (< 5 km, one way) to work, while people who travel a medium distance (5–20 km, one way) account for about 49 percent. Finally, nearly 13 percent of respondents have to commute fairly long distances (over 20 km, one way). Daily commuting times also indicate that the travelling times of most commuters (98 percent) are short, being less than one hour.

In the Ostim case, most respondents (60 percent) travel a medium distance from home to work, one-quarter (26 percent) travel a short distance, and 14 percent commute a long distance. Some 8 percent of workers travel more than 40km, while there was only one worker who travelled more than 40 km in the Sincan case.

Also in the Sincan case, the share of respondents whose residential locations are also on the western corridor is 87 percent, while the share of respondents for the Ostim case is 57 percent. Accordingly, the respondents living in Sincan commute shorter distances and for less time than those in the Ostim case. The findings show that the long-distance decentralization of firms to Sincan enhanced the home to work matches more than the short-distance decentralization of firms to Ostim.

Another central parameter of commuting is the amount of time workers spend travelling to work. The data presented in **Table 6** shows that the percentage of workers that commute for longer than two hours a day is not more than 6 percent in both cases. Shorter commuting times (less than 0.5 hours) are enjoyed by 71 percent of the workers in Sincan, and by 15 percent of the workers in Ostim, while the share of medium commuting times (1–2 hours) is more for the workers in Ostim (26 percent) than those

Table 6. Commuting Distance and Time

Commuting Distance (km)	Sincan	%	Ostim	%	Daily Commuting Time (hour)	Sincan	%	Ostim	%
< 5	178	38	45	26	< 0.5	339	71	27	15
5-10	79	17	27	15	0.5-1	127	27	92	53
10.1–20	153	32	78	45	1.01-2	9	2	46	26
20.1–40	64	13	11	6	2.01-3	-	-	9	5
40.1–60	1	-	14	8	>3	-	-	1	1
Total	475	100	175	100	Total	475	100	175	100

in Sincan (2 percent). The results also reveal that the time spent commuting is generally shorter for the manufacturing workers in Sincan than for those in Ostim.

Commuting time is a function of distance and speed, whereas travel speed depends largely on the mode of commuting. Public transport is not the preferred mode of commuting for many workers in Sincan (**Table 7**) due to the provision of free employee transportation (provided by employers), which remains the mode of choice for most people (77 percent), being faster and more comfortable on long journeys. The second most popular mode is the private car, accounting for 20 percent of the total, and preferred especially by higher status workers. In the Ostim case, workers prefer overwhelmingly to travel by private car (53 percent). This is followed by dolmuş (a semi-public transportation mode), used by 26 percent of the workers, and by free employee transportation services with 14 percent. Finally, public transport is used only to a limited extent (3 percent for bus, 3 percent for subway), and in neither case does walking constitute a significant share.

For each commuting variable, we adopt an index to measure the representation of commuter subgroups in each category. The index is calculated as a percentage ratio (the ratio between the percentage of a commuter subgroup to all commuters, and the percentage of commuters in a particular category for a given commuting variable). While a value of 1 means "proportional representation" or "full representation," a value larger or smaller than 1 refers respectively to "over representation" and "under representation".

As shown in **Table 8**, in the Sincan case, high-status, high-income commuters tend to travel a longer distance, while low-status, low-income commuters report a shorter travel distance. The middle-status respondents tend to travel both medium and longer distances to their place of work. The findings of the study support the prevalent notion that low-income commuters travel shorter distances than those with higher incomes. On the other hand, the daily travel times of the higher-income respondents tend to be of medium length based on the high level of private car usage, whereas low-status low-income respondents spend shorter times on commuting. Middle-status workers tend to spend medium and long periods of time commuting.

The Ostim case produces different results that contrast the prevalent notion that low status-low income commuters travel shorter distances than those with higher incomes. While low-status low-income respondents mostly commute long and medium distances, the high-status high-income respondents tend to commute shorter distances. In parallel to the distances,

Commuting Time (hour)	Sincan	%	Ostim	%
Bus	3	1	6	3
Subway	-	-	6	3
Dolmuş	12	2	44	26
Private car	94	20	91	53
Employee Transportation Services	365	77	24	14
Bicycle	-	-	-	-
Walk	1	0	1	1
Total	475	100	171	100

Table 7. Commuting Mode

	Sincan			Ostim		
	LSW	MSW	HSW	LSW	MSW	HSW
Travel distance						
Short	**1.38**	**0.66**	0.13	0.78	0.87	**1.40**
Medium	0.64	**1.33**	2	1.06	**1.07**	0.83
Long	0.26	1.33	**3.13**	**1.18**	0.84	0.93
Travel Time						
Short	**1.03**	0.92	0.93	0.75	0.93	**1.35**
Medium	0.71	1.25	**1.5**	1.19	**1.06**	0.69
Long	0.43	**2.77**	-	**1.62**	0.90	0.33

Table 8. Association between Worker Status and Commuting Distance and Time

travel times are longer for low-income groups and shorter for high-status respondents. The middle-status middle-income respondents show a pattern of commuting for long periods of time.

CONCLUSION

As of 1985, the spatial relationship between jobs and housing has been changed profoundly as a result of the accelerated industrial decentralization and increasing urban expansion in the periphery of Ankara, fueled by urban development and redevelopment, the pressures of the real estate market and the profit-oriented approach of the local authority. The period leading up to 1985 saw a spatial match between manufacturing jobs and urban housing within the main Ankara basin, but developments post-1985 led to the manufacturing jobs-housing relationship becoming increasingly imbalanced in space, especially in the main urban area.

The periphery of Ankara became job-rich in the manufacturing sector between 1985 and 2011 as a result of the decentralization, and so by moving to these areas, workers were able to decrease their commuting times or distances. This is consistent with the co-location hypothesis that states that firms and households periodically readjust their location to achieve more balanced commuting distances and times, and to reduce commuting costs. The average commuting distance decreased from 17.53 km to 8.62 km for the manufacturing workers who moved to Sincan, and the findings of the survey confirm that in Sincan (on the outer periphery) an increase in the spatial match for workers, especially those in the low- and middle-income range, has occurred. Shorter travel distances and times – consequences of a spatial match – were reported by many of the respondents in this study. As travel distances and commuting times are often used as a measure of job accessibility (Cervero & Day, 2008; Zhao et al., 2009), these results highlight the increasing job accessibility due to the co-location of manufacturing jobs and housing in Sincan, where compact, mixed-use and high-density development has occurred.

On the other hand, although Ostim is closer to the city center, average commuting distances have increased from 9.86 km to 14.95 km for workers who have relocated, which contradicts the co-location hypothesis. In addition, short travel distances and times are not recorded, especially for the low-status low-income workers, due to the unaffordable housing market characteristics. In contrast, the high-status high-income workers travel shorter distances for shorter durations due to the matching of housing area characteristics to the higher status workers' housing preferences, together with the high level of private car usage.

Generally, de-concentrations of urban land to peripheral areas promote the use of private cars (Naess & Sandberg, 1996; Bell, 1991), and lead to drops in the use of public transport, cycling and walking. In the Sincan case, public transport, including buses, remains limited, and has not improved sufficiently to take into account the required accessibility of peripheral residential areas. Instead, the shortfall in public transport has been compensated with company transportation services for low- and middle-status workers. Being free, faster and more comfortable than buses, company transport services remain as the preferred mode of travel for many workers. Secondly, private cars are used to a limited extent, especially by the high-status workers. In contrast to Western cases, the distanced decentralization of manufacturing firms to Sincan has not encouraged private car usage, with only a small percentage of journeys realized by private car. Although Ostim is closer to the city center, private car usage is widespread among the workers. In both cases, public transport is used to a limited extent, and there is very little use of non-motorized forms of transportation, including walking and bicycling, due to the undeveloped infrastructure for these modes (such as bicycle and pedestrian routes) and habit.

In the Sincan case, the status corresponding to the income of workers is an important variable that helps explain a worker's choice of a particular mode of transport, as the differences in the use of transport modes are obvious between higher- and lower-status workers. The findings related to the relationship between travel distances and status are largely consistent with the traditional theory that higher-status (higher-income) people tend to travel longer distances. In addition to the decrease in commuting distances and shortened travel times (an indicator of increased accessibility to jobs), 28 percent of the survey respondents had relocated to close to the Sincan OID, while 34 percent were already living there and were able to meet the growing demand for labor. With workers residing closer to the manufacturing jobs and the firms moving to locations closer to the workers' housing areas, a high level of spatial match has been achieved for most of the workers (62 percent). Without doubt, the co-location of jobs and housing also contributes to decreasing levels of congestion and urban environmental pollution, as well as decreasing travel distances and times for Sincan. On the other hand, in the Ostim case, residential relocations to be closer to the place of work have been more limited when compared to the Sincan case.

According to Cervero and Wu (1998), in rapidly growing regions it is difficult to reduce commuting times and distances due to the lag in housing production. However, even though the peripheral areas of Ankara (especially the western corridor where there is a dense, mixed-use growth pattern) experienced a significant shift of manufacturing employment after 1985, the average commuting time and distance are shorter for the workers in the Sincan case when compared to those in the further centralized Ostim area. This may have been achieved through the implementation of policies and the construction of infrastructure alongside residential developments to keep pace with growth. Workers and firms co-locate to avoid increased commuting times and worsening congestion, and this co-location hypothesis, which argues that a decentralization of employment reduces commuting times, was verified in the Sincan case, but refuted in the Ostim case. At the same time, this study has shown that the distance travelled to work does not necessarily increase as a result of distanced decentralization.

This study does have some limitations. Firstly, no survey was made of the employers, which could have revealed the role of companies in the co-location process. Secondly, the survey did not include questions about whether the respondents would consider changing their jobs to work in closer proximity to their residence, which would be important in assessing the labor market impacts of a growing employment-residence match along the western corridor based on distance and the housing market characteristics. These issues can be addressed in future studies. This paper represents a first and necessary step towards understanding the emerging jobs-housing balance and the findings related to the degree of employment-residence match; while the workers' commuting patterns and travel behaviors provide a foundation for future research in a different direction. Besides residential mobility strategies, including regulations to make housing transactions easier and faster, some affordable housing projects on the periphery of the city close to manufacturing employment and a developed network of mass public transportation could provide a cost-effective (in terms of both time and money) means of commuting, although urban transport policy has to date controversially encouraged private car ownership.

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SYMBOLS

$SMI_i^n = \frac{1}{2} \sum | pi / P - ei / E |$

Alındı: 16.04.2012, **Son Metin:** 27.03.2013

Anahtar Kelimeler: Sanayinin desantralizasyonu; iş-konut ilişkisi; iş yolculuğu; Sincan ve Ostim Organize Sanayi Bölgeleri

İMALAT SANAYİNİN YER DEĞİŞTİRMESİNİN İŞ-KONUT İLİŞKİSİ VE İŞ YOLCULUĞU ÜZERİNE ETKİLERİ: SİNCAN VE OSTİM ORGANİZE SANAYİ BÖLGELERİ ÖRNEĞİ

Ankara, hızlı bir şekilde ekonomik ve mekansal yeniden yapılanma sürecinden geçmekte, bu süreçte kentsel alanın hızla yayılması ve imalat sanayinin yer değiştirmesi ön plana çıkmaktadır. 1985'ten beri kentsel büyümenin batı koridoru dışında kent çeperinde hemen hemen her yöne doğru yaşanan düşük yoğunluklu kentsel saçaklanmaya bağlı olarak gerçekleştiği görülmektedir. Batıkent ve Sincan alt merkezlerinin yer aldığı kentin batı koridoru ise, yer değiştiren firmaların buraya yönelmeleri ve gerçekleşen yeni konut alanlarıyla yoğun ve karma kullanımlı olarak gelişmektedir. Bu çalışma kapsamında Sincan ve Ostim Organize Sanayi Bölgelerinde, yer değiştiren firmalar için 2011 ve 2012 yıllarında işgücü anketi yapılmıştır. Bu anketin sonuçlarına göre, Ostim örneğinden farklı olarak, kentin çeperinde yer alan Sincan alt merkezinde çalışanların statü, konut piyasası özellikleri ve şehir merkezinden uzaklık faktörlerine bağlı olarak uzun mesafeli iş yolculuklarının azaldığı görülmektedir. Bu çalışma aynı zamanda, imalat sanayi firmalarının yer değiştirmesinin orta ve özellikle de düşük statülü çalışanların konut yeri ve işyeri seçimlerinde iş-konut ilişkisinin daha iyi sağlanması için mekansal fırsatlar yarattığını ve konut hareketliliğini artırdığını ortaya koymaktadır. Toplu taşım

olanaklarındaki eksikliklere ve Sincan'ın kent merkezinden oldukça uzak olmasına rağmen alım gücüne uygun konut stoğunun bulunması, Sincan OSB'de çalışanların yeni iş-konut ilişkisinin mekansal olarak daha iyi sağlanmasına yol açmaktadır. Bu çalışma, aynı zamanda kent merkezinden uzun mesafeli olarak gerçekleşen imalat sanayi firmalarının yer değiştirmesinin zorunlu olarak uzun mesafeli iş yolculuklarını gerektirmediğini de ortaya koymaktadır.

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