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The Effect of Public Transit on Employment in Israel's Arab Society*

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Arnon Barak

Abstract

The Arab population is characterized by low employment rates, particularly among women, due to cultural characteristics and structural barriers. A common argument is that one of these barriers is the lack of transit access to places of employment, due to the low level of public transit service in the Arab localities.

This study examines that argument by looking at the reform in public transit that affected many Arab localities between 2010 and 2015 to varying degrees and at various times. In order to identify the reform's effect on employment, we use, for the first time in Israel, administrative data regarding trips on bus lines in the Arab localities, and distinguish between people who benefited from access to a private vehicle and those who did not, assuming that the employment decisions of the latter are more sensitive to the level of service.

The results of the study show that public transit has a weak effect on employment rates among the Arab population. In particular, we did not find that the reform led women to join the labor force. However, it did help some working women continue to work—educated women aged 30–50 with no access to a private vehicle, a group that comprises about 8 percent of all working-age Arab women (20-64). If 10 bus trips per day are added to the locality—similar to the average increase in recent years—the chance that such a woman will remain employed increases by about 0.5 percent. We also found that the improvement in service helps older men (aged 40–64) with no access to a private vehicle to integrate into the labor market, and that in this case, the effect is even slightly greater—about 0.7 percent. This group comprises about 8 percent of all Arab working-age men (20–64).

The findings of the study support the argument that in order to increase employment rates among the Arab population, other barriers must be removed, and public transit is, at the very most, a complementary factor in this regard. Improving public transit helps women and men who have overcome structural and cultural barriers and are on the verge of employment. Beyond that, it is reasonable to assume that the reform improved the quality of life in the Arab community in other ways. The number of passengers increased significantly, which shows that the population used public transit for various needs and benefited from its expansion, since it reduces the cost of travel in terms of time and money.

The study was conducted with limited available data, and relates only to the additional service between 2010 and 2015. Since it is not likely that the additional service is immediately fully reflected in employment, some of the ramifications of the improved service, which has expanded significantly in the years since then, may not be reflected in this study.

השפעת התחבורה הציבורית על התעסוקה בחברה הערבית

ארנון ברק

תקציר

האוכלוסייה הערבית, ובעיקר הנשים, מתאפיינת בשיעורי תעסוקה נמוכים בשל מאפיינים תרבותיים וחסמים מבניים. טענה רווחת היא שאחד החסמים הללו הוא היעדר גישה תחבורתית למקומות תעסוקה, בשל רמת השירות הנמוכה של התחבורה הציבורית ביישובים הערביים. עבודה זו בודקת את הטענה לעיל באמצעות בחינה של רפורמה בתחבורה הציבורית שנגעה ליישובים ערביים רבים בשנים 2010-2015 בעוצמות שונות ובזמנים שונים. כדי לזהות את השפעת הרפורמה על התעסוקה אנו משתמשים, לראשונה בישראל, בנתונים מִנהליים לגבי נסיעות של קווי אוטובוס ביישובים הערביים, ומבחינים בין אנשים שהייתה להם גישה לרכב פרטי לבין כאלו שלא הייתה להם גישה, מתוך הנחה שהחלטות התעסוקה של האחרונים רגישות יותר לרמת השירות.

תוצאות המחקר מלמדות על השפעה חלשה של התחבורה הציבורית על שיעורי התעסוקה באוכלוסייה הערבית. בפרט, לא מצאנו שהרפורמה הביאה להצטרפות של נשים לכוח העבודה. אולם היא סייעה לחלק מהנשים העובדות להמשיך לעבוד – נשים משכילות בנות 30–50 ללא גישה לרכב פרטי, קבוצה שמהווה כ- 8% מכלל הנשים הערביות בגילי העבודה (20–64); כאשר מוסיפים 10 נסיעות אוטובוס ביום ליישוב – בדומה לגידול הממוצע בשנים האחרונות – הסיכוי שאישה כזו תישאר מועסקת עולה בכ-0.5%. כמו כן מצאנו כי השיפור בשירות סייע לגברים מבוגרים (40–64) חסרי גישה לרכב פרטי להשתלב בשוק העבודה, וכי במקרה זה ההשפעה אף מעט גדולה יותר (כ-0.7%). קבוצה זו מהווה כ-8% מכלל הגברים הערבים בגילי העבודה (20–64).

ממצאי המחקר תומכים בטענה שכדי להעלות את שיעורי התעסוקה בחברה הערבית יש להסיר חסמים אחרים, והתחבורה הציבורית משמשת לכל היותר גורם משלים לעניין זה: שיפורה מסייע לנשים וגברים שהתגברו על החסמים המבניים והתרבותיים ונמצאים על סף תעסוקה. מעבר לכך, סביר להניח שהרפורמה שיפרה את איכות החיים בחברה הערבית מבחינות אחרות: מספר הנוסעים גדל משמעותית והדבר מעיד כי האוכלוסייה השתמשה בתחבורה הציבורית לצרכים שונים ונהנתה מהרחבתה, שכן זו הפחיתה את עלויות הנסיעה במונחי זמן וכסף.

המחקר נערך במגבלת הנתונים הזמינים ומתייחס לתוספות השירות בשנים 2010–2015 בלבד. מכיוון שאין זה סביר כי התוספות מייד מתבטאות בתעסוקה במלואן, ייתכן שחלק מההשלכות של שיפור השירות, שהלך והתרחב משמעותית בשנים שחלפו מאז, לא באו לידי ביטוי במחקר הנוכחי.

1. Introduction

Improvements in the quality of transportation, including an improved match between public transit and users' needs, potentially reduces the cost of traveling to work and expands the relevant opportunities and choices of employers and employees, particularly employees with low earning potential who cannot afford to purchase a private vehicle.[1] Consequently, public transit may contribute to achievement of an important socio-economic goal defined by the Israeli government, which is to increase employment rates in minority sectors, and specifically among Arab women.[2]

Improving the quality of public transit service may contribute to employment rates by resolving spatial mismatches between the locations of low-income earners and relevant employment opportunities. Kain (1968), the first to discuss this phenomenon, argued that the high unemployment rate of African-Americans in Chicago and Detroit was not the result of discrimination but mainly due to the distance between job-seekers' inner-city homes and the centers of employment that had relocated to the suburbs. Over time, it has become clearer that isolation from suitable employment opportunities is due to lack of accessibility and not necessarily due to geographic distance, because suitable transportation can frequently overcome the effects of distance (Tyndall, 2017).

This understanding prompted developments in the literature focusing on transit mismatch. Numerous studies have indeed shown that an increase in vehicle ownership rates among low-income individuals may overcome transit mismatches and improve these individual's position in the labor market (e.g., Baum, 2009; Gautier & Zenou, 2010). Others found that investment in roads has a similar effect (Duranton & Turner, 2012; Gibbons et al., 2016). With respect to Israel, Frish and Tsur (2010) used a gravitation model to examine how increased investments in infrastructure between 1993 and 2003 affected commuting and wages, and found that men's wages increased by 10%-14% in 2002-2004.

Several studies in the US found a positive association between public transit access and the probability of employment (Sanchez, 1999; Yi, 2006), especially for unskilled workers (Kawabata, 2002) and women (Ong & Houston, 2002) who are not vehicle owners. No evidence of such effect, however, was found in studies that examined whether proximity to high-quality public transit increases the probability that US welfare recipients will become employed (Cervero et al., 2002; Sanchez et al., 2004). All these studies share the limitation that, being based on cross-sectional data, they describe correlations rather than causal effects. The identification problem stems from the fact that in all these studies, the variable that represents public transit access depends on individuals' place of residence. Since this feature is clearly not the result of random selection, it is impossible to identify a causal relationship based on differences in the quality of public transit. To do so, we need longitudinal data, which make it

[1] Low-income individuals have a greater tendency to use public transportation (Suhoy & Sofer, 2019).
[2] Based on Employment Targets for 2010-2020 (Government Resolution 1994).

possible to track both individuals and changes in the quality of public transit, which are presumed to be exogenous to individual characteristics.

Holzer, et al. (2003) overcame this limitation using the difference in differences (DID) technique based on a natural experiment following the expansion of the heavy rail system in San Francisco. These researchers found that after the new train line was completed, companies adjacent to the new rail line hired more employees of Hispanic descent who lived in inner-city communities (a group that tends to use public transit). Nonetheless, even in this case, the presumption of exogeneity is questionable: It is reasonable to assume that firms that relocated in proximity to the new line chose to do so out of consideration for the accessibility by the potential labor force. A similar approach was adopted by Nielsen and Rotger (2015) who examined the behaviors of households rather than of firms. They found that the opening of a new train station in Copenhagen led to a change in commuting patterns and an increase in income among the population living in proximity to the station, due to improved access to remote places of employment that offered higher wages. Even in this case, however, concerns regarding exogeneity remain: We cannot rule out the possibility that the rail line was not planned randomly and that it was located where planners believed that demand for commuting existed.

Two recently published studies use original methods to overcome endogeneity concerns.[3] Mayer and Trevien (2017) adopted two different methods to identify the effect of the construction of a regional train in the Paris metropolitan region. One method was based on the fact that the train was planned to connect new airports and cities to the center of Paris. As a result, municipalities located between these points were connected to the line even though there was no specific intention to connect them. These municipalities were compared to other municipalities in the metropolitan area of Paris that were not connected to the new train line. The second method they used was to compare municipalities that were connected to the train network with municipalities that were originally planned to be connected but ultimately were not connected to the train network due to budgetary and technical constraints. The results of their study indicate that the construction of the train led to a 9% increase in employment in the municipalities adjacent to the new train stations.

In another study, Tyndall (2017) used the exogenous shock caused to the mobility of Brooklyn residents by Hurricane Sandy, which struck the city of New York in October 2012. The hurricane caused the prolonged closure of the train line connecting Brooklyn to Manhattan, significantly affecting the mobility of Brooklyn residents who worked in Manhattan. Tyndall found that this effect led to an increase in unemployment among residents of the neighborhoods

[3] These studies did not address the potential criticism that the coefficients obtained are biased because expectations of public transportation improvements themselves cause individuals to seek employment outside the home. This criticism is not disconcerting for two reasons: First, if such a bias exists, it is toward the zero, such that represents an underestimation of the effects of public transportation improvements. Second, expectations are relevant mainly in studies on the effects of infrastructure on real estate prices, whereas this factor is arguably not significant in the labor market.

adjacent to the train line, and specifically among population groups dependent on public transit: residents with no automobile ownership and Hispanic individuals. It should, however, be noted that this is a unique area in the US in which the rate of public transit use exceeds the rate of household car ownership.

Clearly, then, compelling evidence shows that improvements in public transit have a positive effect on employment rates and income. Most findings, however, are limited to the operation of trains in urban areas, and it is difficult to generalize from these findings to the effect of buses on the population in Arab localities in Israel, as this population lives in rural localities and does not usually use public transit. The current study examined the effect of public transit improvements in rural areas, focusing on the Arab population and specifically Arab women, whose employment rates are lower than other population groups.

Previous studies of the effect of public transit quality on Arab women's employment in Israel found no evidence of such association. Yashiv and Kasir (2012) reported no evidence of an effect of satisfaction with public transit, as measured by the Central Bureau of the Statistics (CBS) social survey of 2005. Malki (2011) similarly found no association between the year in which public transit became available in a locality and the rate at which the women in that locality joined the labor force. It is certainly possible that one reason for these results is that past improvements in public transit in the minorities sector were typically limited in scope. If public transit is to be effective and reliable, public transit network must be comprehensive, accessible, and afford access to many locations in its relevant area. That is to say, there is a minimal level of service below which people will not use public transit to travel to work and therefore improvements below this minimal level are not expected to have an impact on employment outcomes.

The current study examines the public transit reform implemented in 2010-2015, which involved numerous Arab localities, creating discernable improvements in public transit service levels that occurred at varying levels of intensity and times. To identify the effect of these changes on employment, we distinguish between individuals who had access to a private vehicle[4] and others, based on the assumption that the latter are more sensitive to public transit service quality. Moreover, the current study uses, for the first time in this context, administrative data on bus trips in Arab localities. The findings of the current study indicate that public transit has a weak effect on employment rates in the Arab population. Specifically, we found no evidence that the public transit reform prompted women to join the labor force, although the improvements apparently helped a share of the working women to maintain their employment status. We found that this effect was concentrated in educated women between the ages of 30 and 50 who had no access to a private vehicle. We also found that the improvement in service quality contributed to the integration into the labor force of men between the ages of 40 and 64 who had no access to a private vehicle.

[4]Individuals with access to cars are individuals who have a driver's license and a car is available for their use.

The remainder of this paper is organized as follows: Section 2 introduces background on employment in the Arab sector, specifically Arab women, and the public transit reform. Section 3 presents the methodology, Section 4 provides details on the dataset and present descriptive statistics. Section 5 presents the findings, including robustness tests and tests on additional outcome variables. Section 6 concludes.

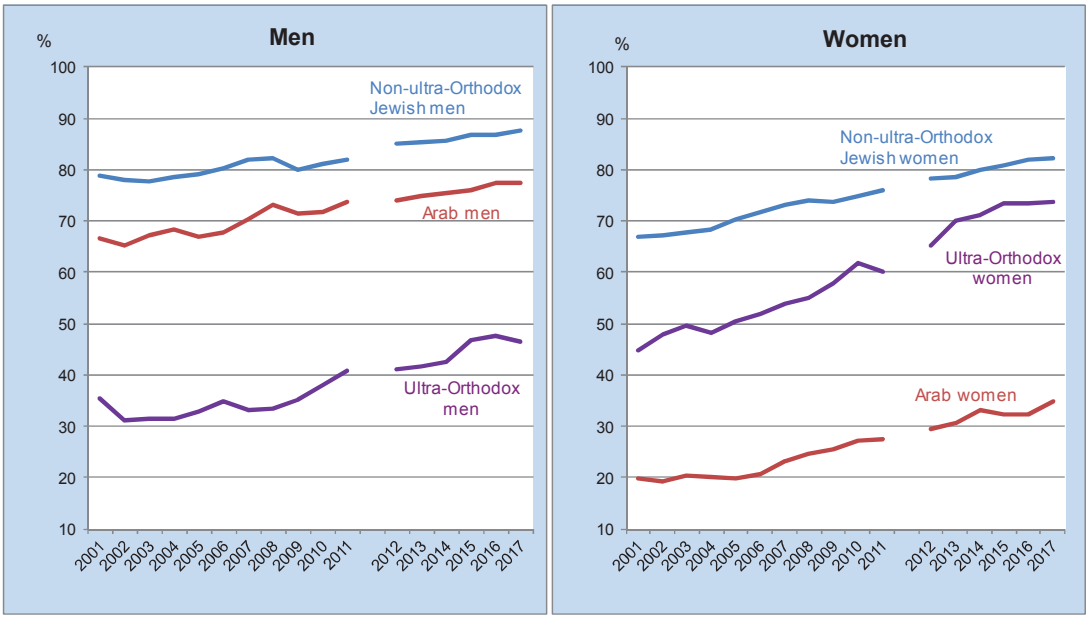
2. Background: Employment and Transportation in the Arab Population

2.1 Employment in the Arab Population

The Arab population's status in the labor market is a macro-economic issue that has numerous implications for Arab society and for the economy as a whole. In 2015, the Arab population[5] accounted for 21% of the total population of Israel, and according to Central Bureau of Statistics (CBS) estimates, no significant change is expected in this share in the next 50 years;[6] It therefore appears that this issue will remain an important one in the foreseeable future. Yashiv and Kasir (2013) explain that the Arab population's integration into the labor market is disconcerting due to the low participation rates (especially of women), the high unemployment rates among labor market participants, the concentration of workers in specific occupations and sectors, and their relatively low wage levels. Although Yashiv and Kasir use data only up to 2011, this description appears to apply to the current situation as well.

Figure 1

Employment rate for men and women in the prime working ages (25–64), by population group, 2001–17



SOURCE: Central Bureau of Statistics (Labor Force Survey). Between 2011 and 2012 there is a break in the series due to changes in the survey. Data are not concatenated.

[5] Including the Bedouin, Druze, and Circassian sectors.

[6] See CBS (2017) Press Release: "Projected Population of Israel until 2065."

In 2017, the employment rate of Arab women was a mere 35% - significantly lower than the employment rate of Jewish women. Although Arab women increased their employment rates considerably since the early 2000s, the difference between Arab and Jewish women did not decline (see Figure 1). The employment rate of Arab men in 2017 was 77.5%, significantly higher than the employment rate of Arab women, but lower than the employment rate of Jewish men (excluding the Haredi population). Similarly to Arab women, Arab men also increased employment rates in recent years, but the difference between their employment rates and the employment rates of Jewish men remained unchanged.

Several key obstacles to Arab women's participation in the labor market are typically mentioned: lack of appropriate training or education, limited command of the Hebrew language,[7] high fertility rate and shortage of children's daycare facilities, limited supply of jobs, cultural factors, and employers' discriminatory practices (Schlosser, 2006; Malki, 2011; Report of the Committee for Economic Social Change, 2011; Yashiv & Kasir, 2013). In addition to these myriad factors, it is also frequently argued that lack of access to public or private transportation hampers Arab women's participation in the labor market. This argument is based on the fact that Arab women who work tend to remain close to home: 60% are employed within their locality, a rate that exceeds all other population groups (see Table 1).[8] One possible reason is the low percentage of Arab women who have a driver's license and a high rate who are dissatisfied with the public transit in their area. Notably, private cars are the primary means of travel to work for Arab women, despite the low rate of driver's license holders among them. For Arab men, an important means of travel to work is employer-organized pools (23%). For women, this transportation solution is used much less frequently (a mere 7%).

[7] This barrier was studied by Lipshitz and Tahaoku (forthcoming): "The Arabic language as a barrier to employment of Arab women." See findings here (p. 22):
https://www.idc.ac.il/he/research/aiep/Documents/round-tables/12.7.3.pdf

[8] A similar picture also emerges from Labor Force Survey (2016). According to these figures, 66% of employed Arab women work in their locality, compared to 55% of employed Jewish women and less than 45% of employed men.

Table 1
Occupation and transportation characteristics, by population group and gender, 2016[a]

(percent)	Jews and others		Arabs	
	Men	Women	Men	Women
Employed people	82.3	78.4	76.1	28.5
of which: employed in their residential locality	35.2	50.8	38.3	60.2
of which: travel to work by private vehicle[b]	64.6	52.3	59.2	62.8
Not satisfied with public transportation[c]	28.7	30.0	43.1	49.6
Have a driver's license	88.1	74.0	86.8	54.7
of which: Drive often	85.3	80.4	80.2	73.8

[a] Population aged 20–64

[b] Includes commercial vehicle and motorcycle

[c] Those responding "Not so satisfied" and "Not at all satisfied"

SOURCE: Central Bureau of Statistics Social Survey.

In this study we focus on the transportation barrier issue, to explore whether improvements in public transit in Arab localities in recent years led to a rise in employment rates in the Arab population. For this purpose we use the fact that changes in the transportation system were implemented in numerous localities at varying degrees and times. The method we use to identify the effect is based on a distinction between individuals who have access to a private vehicle and those who have no such access, with the expectation that employment rates of individuals who have no such access will show greater sensitivity to public transit improvements. This method is designed to address potential endogeneity: Service improvements may be the result of demand that stems from employment rates that increased for other reasons, but this concern is less disconcerting in the case where the effect is focused in the group that has no access to a private vehicle.

2.2 Public transit in the Arab localities and the public transit reform

For many years, many Arab localities suffered from a lack of public transit service, and the Arab localities that did receive service, received a very low level of service. This appears to be the situation even as recently as in 2010, as indicated by Figure 2A, which presents the number of buses that stop in the vicinity of each of the 125 Arab localities[9] on a representative day in that year. At that time, 36 localities (28.8%) has no service at all; most of these localities were concentrated in the Negev, the Golan Heights, Yizreel Valley, and eastern Lower Galilee.[10] An additional 54 localities (43.2%) had an extremely poor level of service — fewer than 50 trips per day — and these localities also included Arab cities whose residents numbered over tens of

[9] According to the CBS definition which combines the localities Barta'a, Mu'awiya and Ein a Sahale into Basma; Bayada, Zalafa, Musmus, Musheirifa and Salem into Ma'ale Iron, and Jatt with Baqa Al-Gharbiyye.

[10] A locality that is an exception is Jise Az-Zarqa, which located on the Coastal Plain with a population of more than 10,000 at the time.

thousands (Baqa Al-Gharbiyye, Tire, Kafar Qasem, Qalansawe, Ar'ara). Between 50 and 200 buses a day passed through 28 of the remaining localities, and an additional 7 localities were the exception, with over 200 trips per day, apparently due to their proximity to major traffic axes in the north of Israel. A developed public transit system of over 500 bus trips per day including internal bus lines existed in only 2 of these 7 localities, which are two of the country's most populated Arab cities: Nazareth and Rahat. In Nazareth, that was the situation for many years, but in Rahat, bus service was initiated only in 2009, after a tender for public transit in the city was issued two years earlier — the first tender of its kind in an Arab locality.

The Rahat tender heralded the significant change that occurred in the past decade in government policy on the development of public transit in Arab society. A concrete manifestation of that change occurred in 2010, upon the adoption of Government Resolution 1539, which approved the five-year economic development plan for 13 of the largest Arab localities,[11] with a focus on four sectors in which significant disparities existed in comparison to all localities in Israel: employment, housing and real estate, personal security, and public transit.[12] Consequently, the level of public transit service in many Arab localities improved, in the form of the addition of new bus lines and expanded service in existing lines.[13]

Figure 2B presents the change in the number of buses passing in proximity to each locality in the period from 2010 to 2015. Excluding Nazareth, in which the public transit system is unique compared to the remaining Arab localities, the localities adjacent to Wadi Ara Road (Umm Al-Fahm, Ar'ara, Kafar Qara) benefited from the largest addition in service (over 200 daily trips), which was part of the overall changes made to bus lines in the Hadera-Netanya transportation cluster.[14] In that period, significant additions of over 100 daily trips were recorded in many of the major Arab localities, reflecting either the opening of intercity bus lines connecting these localities with major hubs[15] or the opening of internal bus lines.[16]

Table 2 summarizes the above changes in aggregate figures for each year. A dramatic improvement in the public transit system is evident already in 2010, when over 2,000 trips were added to all Arab localities in total: 10 new localities were connected to the system, and a

[11] Between 2003-2008, Daliyat Al-Karmel and Isifya were united into a single locality called Ir Carmel and therefore reference is sometimes made to 12 major Arab localities.
[12] https://www.gov.il/he/Departments/policies/2010_des1539
[13] In December 2015, another Government Resolution was adopted (922) concerning a new five-year plan for economic development of all minority populations. An annual budget of NIS 100 million was approved under this Resolution, for added services in the minorities sector with emphasis on improvements in public transportation. For additional information see Greenwald, D., Grossman, G., & Levi, A. (2018). https://www.hks.harvard.edu/centers/mrcbg/publications/awp/awp95
[14] These localities benefited from an improvement in the series of bus lines from Afula to Jerusalem, and especially to Tel Aviv, and from new bus lines from Umm Al-Fahm to Afula and Hadera.
[15] Examples of such connections are the new lines that opened from Daliyat Al-Karmel and Isifya to Haifa University; From Kafar Qasem to Petah Tikva and Rosh Ha'ayin; from Tire, Tayibe and Qalansawe to Netanya and Kfar Saba; and from Shfaram and Tamra to Carmiel.
[16] In those years, internal bus lines opened in the following major localities: Umm Al-Fahm, Baqa Al-Gharbiyye, Daliyat Al-Karmel and Isifya, Tire, Nazareth, and Sakhnin.

significant increase (an addition of at least 20 trips or an increase of at least 50%) was recorded in 43 localities. In 2011, the scope of service grew little, but service expanded significantly in the next four years, at the rate of 1,500 trips per year. In those years, a total of 13 localities were connected to the public transit system, and a significant increase was recorded in the scope of services in 30 localities each year. In total, from early 2010 to early 2016, the average number of trips per locality doubled,[17] and the number of trips per capita grew by 80%. For comparison, the number of trips per capita rose by only 30% in non-Arab localities in the same period.[18] In summary, it appears that throughout the entire period under review, many Arab localities experienced a large-scale improvement in public transit. The increase in the supply of trips in Arab localities between 2012 and 2016[19] was accompanied by a 45% rise in the number of passenger trips in those bus lines[20] (from 25.6 million to 37.3 million).

Table 2

The increase in the number of daily bus trips in Arab localities, by selected indiecs, 2010–16

(Number of daily trips at the beginning of the year, unless specified otherwise)

	2010	2011	2012	2013	2014	2015	2016
Total trips	8,203	10,240	10,588	11,635	13,478	14,873	16,781
Increase in total trips during the year	2,037	348	1,047	1,843	1,395	1,908	5,317
Number of localities without service	36	26	25	17	14	12	11
Number of localities with a notable change[a]	43	15	31	27	25	33	63
Average number of trips per locality	66	82	85	93	108	119	134
Number of trips per 1,000 people	7.2	8.9	9.0	9.8	11.0	11.9	13.2
Number of trips per 1,000 people in Jewish localities	19.9	20.9	21.8	22.2	23.4	24.0	25.9

[a] An increase of at least 20 trips or growth of at least 50 percent.

SOURCE: Adalya - Public Transportation Administration.

[17] The sharp rise in the number of trips in 2016 reflects the accelerated development of public transportation in the Arab localities following Government Resolution 922 (see ft. 10).

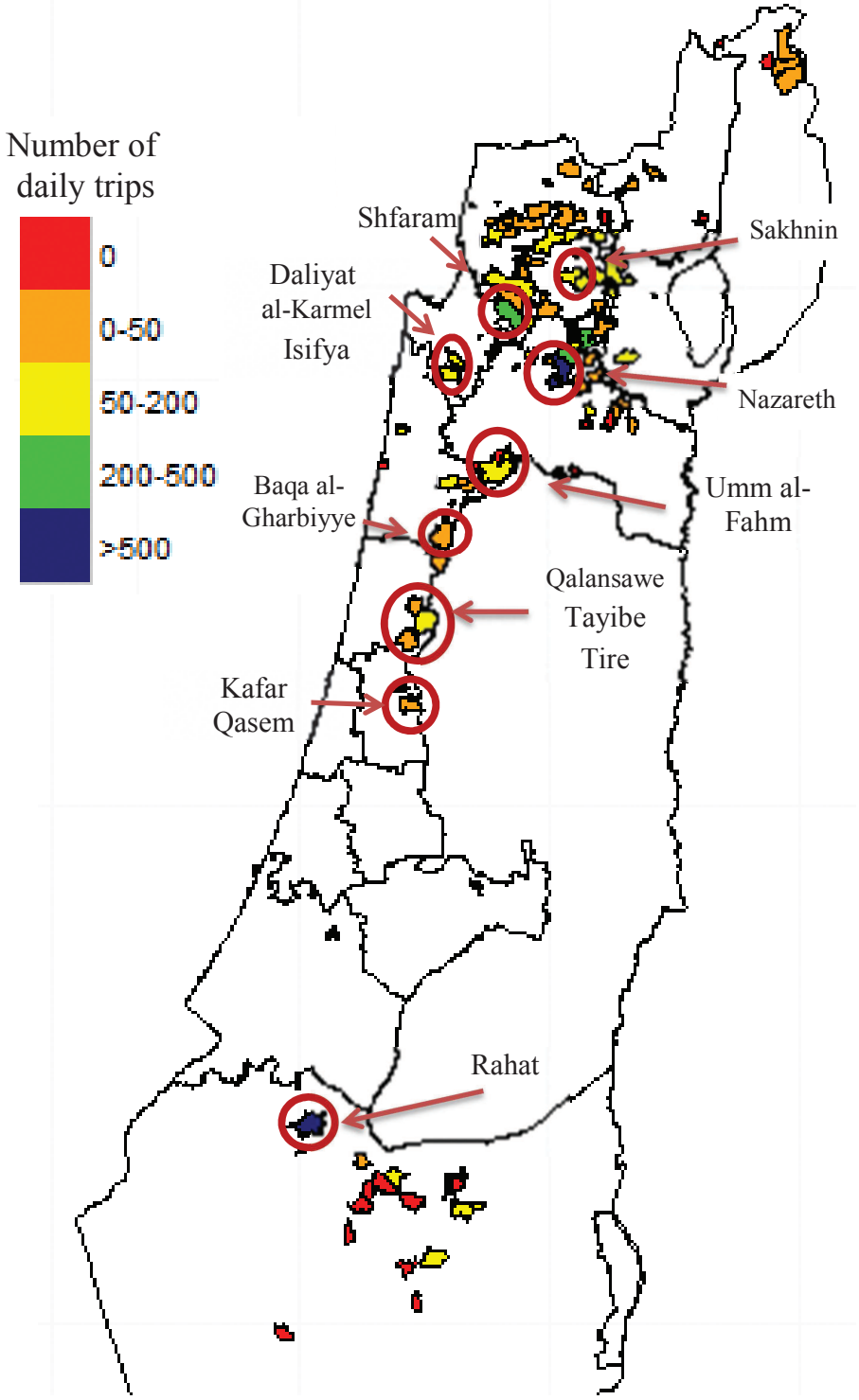
[18] Despite the rapid growth in these years, the number of trips per capita in the Arab localities is still considerably low (Table 2).

[19] Data on the number of passengers are available only from July 2011 onward and therefore 2012 is the first year with complete data.

[20] Data on the number of trips of all passengers are based on Rav Kav ticket validations. The data do not include information on the boarding bus stop and therefore it is not clear how much of the increase in the number of passengers stems from population that live in the Arab localities.

The Public Transit Map of the Arab Localities[21]

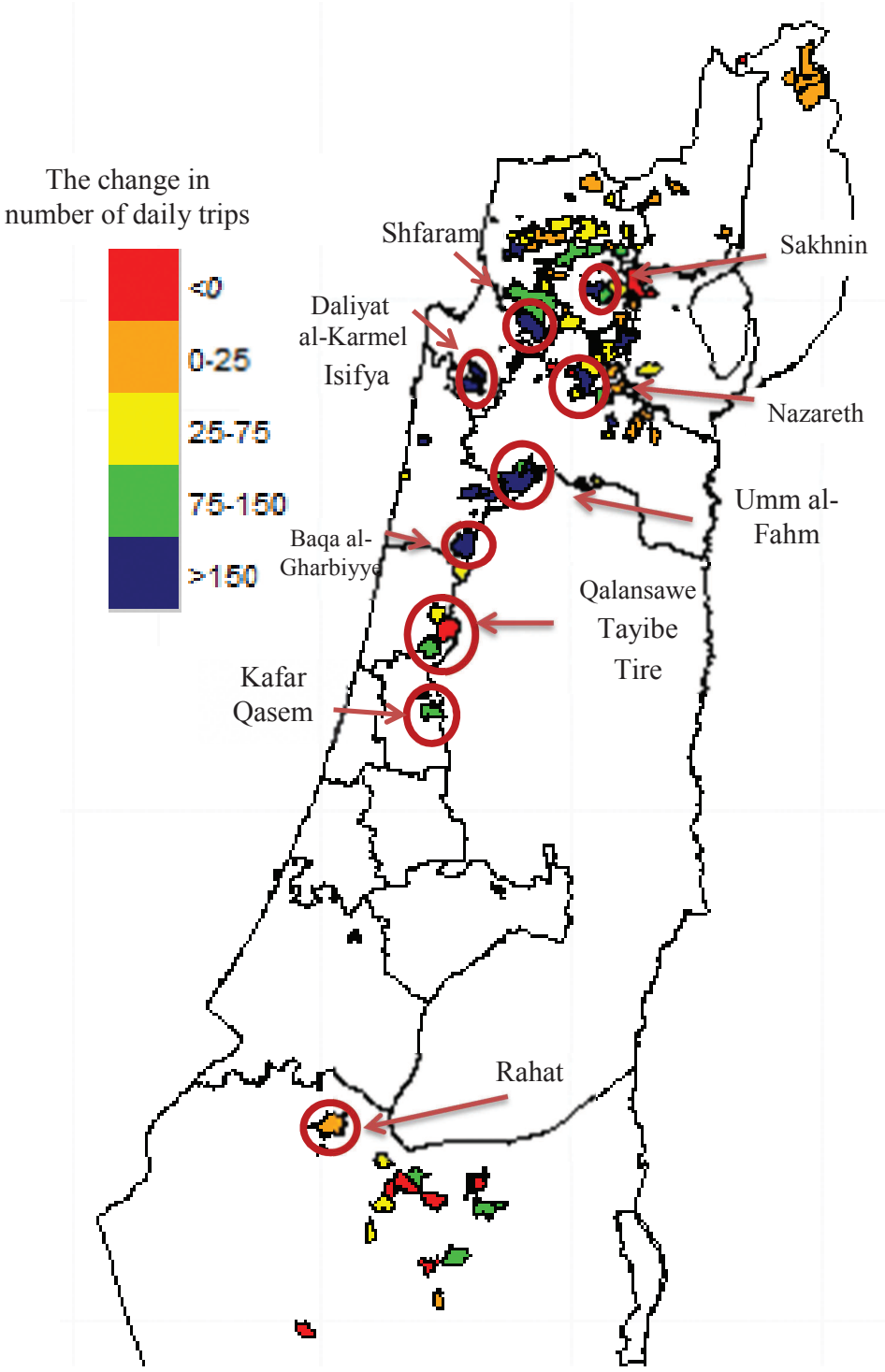
Figure 2A: Number of trips on a representative day in 2010



[21] The author thanks Yotam Sofer for his assistance in preparing the maps.

The Public Transit Map of the Arab Localities[22]

Figure 2B: The change in the number of trips on a representative day, 2015 compared with 2010



[22] The author thanks Yotam Sofer for his assistance in preparing the maps.

3. Methodology

To estimate the effect of changes in public transit on employment outcomes, we exploit the extensive improvement that occurred in the bus service in the Arab sector localities. To estimate the effect of changes in public transit on employment, our main concern is that additional trips are not exogenous and instead stem from an increase in the demand for workers or an increase in the supply of work that is unrelated to the public transit changes. For example, if we know that an industrial zone is planned for construction in the vicinity of a specific locality, the public transit system may be expanded there as a result. It is reasonable to assume a connection between the ability of a local authority or the public to promote public transit developments, and their ability to develop jobs and employment centers. The standards of infrastructure frequently also have a critical effect on the decision to locate service additions. To address these situations in which public transit service is correlated with such changes, we control for differences in the features of localities that remain constant over time, using individual-specific fixed effects.

As long as a constant feature of a locality is involved, controlling for fixed effects resolves the endogeneity issue, but another concern may emerge, for example, when a newly elected head of locality promotes employment and public transit simultaneously. However, due to the operating practices of the Ministry of Transportation, there are grounds to assume that this factor is typically not significant. One reason is that the main method used to add trips is through public transit operation tenders. Since 1997, tenders have been used to select public transit operators, in a move that was designed to open the market to competition and introduce operators in addition to Egged and Dan. In each tender, the Ministry of Transportation uses the opportunity to improve the scope of services by adding new lines and expanding the services of existing lines. An operator who is awarded a tender signs an operating agreement for 12 years, at the conclusion of which a new tender procedure is conducted. If the operator fails to meet the terms of the agreement, the Ministry of Transportation may conduct a new tender at the end of 6 or 9 years. Consequently, services are not upgraded in response to changes in the demand for work, because, at least in the timeframe that we are studying, service upgrades depend primarily on the timing of tenders and their conclusion. This also implies that even if workers from a specific locality gain employment in a new employment area, the addition of trips in that locality is not necessarily the result of the opening of that employment area. Moreover, since a tender is conducted for an entire public transit region at a time,[23] it is reasonable to assume that the timing of most tenders is not significantly affected by the features of the Arab localities in the region.

Trips may also be added through efforts to expand service through other means, based on field surveys and requests of local authorities and the public. Clearly such additions pose more of an endogeneity concern, but even such additions are occasionally exogenous for localities located "between hubs." For example, if the Afula-Tel Aviv line is expanded in response to a demand by

[23] There are a total of 15 public transportation clusters nationwide.

Afula residents, the Arab localities in Wadi Ara, which are located between Afula and Tel Aviv, can be expected to benefit from additional trips, independent of their own changing needs.[24]

Since an exogenous upgrade to public transit services, either through a tender or because the locality is "between hubs," does not account for all the additional trips to a locality, endogeneity concerns must be addressed. To do so, we not only use the variance between the localities but also the variance between the population groups in each locality: We examine how changes in public transit affected individuals with access to a private vehicle at the beginning of the period (individuals who have a driver's license and access to a private vehicle[25]) compared to individuals with no access to a private vehicle. Since public transit users typically have no access to a private vehicle, we expect them to be more sensitive to service additions compared to individuals with access to a private vehicle; and an effect on employment outcomes that is concentrated in the group with no access to a private vehicle will be evidence that the effect stems from these service additions and not from other factors. Therefore, to examine the effect of public transit changes on the supply of work, we estimate the following basic equation:

$$(1)\ emp_{it} = \beta_0 + \beta_1 trans_{t-1,z} + \beta_2\left(trans_{t-1,z} * no\_access_i\right) + \boldsymbol{\gamma} X_{it} + \delta_i + \theta_t + \varepsilon_{it}$$

The explained variable is the employment status[26] of individual *i* (who lives in locality *z*) in year *t* and the explanatory variable is public transit in locality z, measured by the number of bus trips in the vicinity of the locality, plus an interaction variable, which represents various public transit effects based on differences in access to a private vehicle. Since it is unlikely that a change in the number of trips has an immediate effect on employment, this variable is lagged by one year. Furthermore, the above equation also includes individual-level control variables (personal status and number of children) and constant factors for each individual and each year: δ_i is individual level Fixed Effects[27] while θ_t reflects time effects using a dummy variable for each period. The research hypothesis is that public transit increases the probability of employment, and the employment status of individuals who lack access to a private vehicle will be more strongly dependent on service levels, and therefore we expect $\beta_2$to be positive. This coefficient (β_2) represents the effect of a change in the number of trips on individuals who lack access to a private vehicle, compared to the control group — individuals who had such access.[28]

[24] Implementation of this approach to examine the effect of the Paris metropolitan train appears in Mayer and Trevien (2017).

[25] We defined an individual with private vehicle access as an individual who owned or whose spouse owned a private car or motorcycle, or an individual who received or whose spouse received a company car value equivalent from their employer. Furthermore, we defined that an individual had private vehicle access only if her driver's license was consistent with the type of vehicle she owned.

[26] We defined an individual employed in a specific year as an individual who was employed at least three months in that year.

[27] Controlling for access to a private vehicle is included in the individual-level constant factor (see Discussion on the next page).

[28] We had no prediction regarding β_1 in advance because opposing considerations exist: On the one hand, improvements in public transportation expand mobility opportunities for the entire population and therefore may be

At this point note that we elected to adopt a more stringent definition for access to a private vehicle for married women, based on the assumption that if both spouses hold a driver's license and own one car, in most cases the car will be regularly used by the male spouse for traveling to work. Therefore we defined a married woman with access to a private vehicle as a woman who has a driver's license and she and her spouse have access to at least two vehicles. In contrast, in the case of men and unmarried women, we defined access to a private vehicle if they hold a driver's license and have access to at least one car. Of course it is possible that both spouses use their car to travel to work, or even that the female spouse is the primary user of the car, but it is reasonably assumed that these are not the most prevalent cases in Arab society. Moreover, beyond the gender effect, the definition of access to a private vehicle is admittedly subject to the limitations of the available administrative data, which lack information on the number of individuals who use a specific car or whether individuals use a car that is registered in their name. Nonetheless it is reasonable to assume that holding a driver's license and ownership of a vehicle are good proxies for private vehicle use.

According to the above equation, in each locality we compare changes in employment of individuals who had no access to a car at the beginning of the study (2010) and individuals who had access to a car (the control group). Changes in access to a car over time are, of course, endogenous and the direction of this bias is not known in advance. For example, it might stem from a positive shock to household income, which positively affects the female spouse's probability of having access to a private vehicle and concurrently reduces the probability that she becomes employed outside the home. Such a shock would reduce the employment rate of women who have access to a car and in such case, $\beta_2$is expected to be biased upward. Another option is that $\beta_2$is biased toward the zero, in the event that employment rates increased due to public transit improvements, and subsequently, the newly employed purchase a car due to a rise in their income. To address this issue, we use data on access to cars at the starting point of the study rather than access in each year in order to prevent the situation in which individuals move between comparison groups due to an (endogenous) change in their access to a car over time.

Admittedly, using private vehicle access data for only the first year of the study disregards cases in which individuals receive access to a car for reasons that are unrelated to the labor market[29], and consequently join the labor market. However, insofar as these reasons are exogenous, there is no reason to assume that they will be correlated with public transit upgrades and therefore they are not expected to bias the coefficient.

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a facilitating factor also for individuals with access to a private vehicle; On the other hand, it is reasonable to assume that the public transportation improvements reduce the relative commuting advantage of individuals with access to a private vehicle, and therefore, given a limited supply of jobs (at least in the short term), public transportation improvements may have a negative effect on the probability of individuals with access to a private vehicle to be employed.

[29] For example, we might imagine the case in which parents purchase a new vehicle and give their old vehicle to one of their children as a gift.

4. The dataset and descriptive statistics

4.1 The dataset

The dataset available to us includes over 30,000 individuals between the ages of 15 and 74 in 2014 who lived in one of the 125 Arab localities in Israel. This population comprises 18,000 women and 13,500 men, and constitutes a representative sample of each of these groups separately. The sample was constructed such that the percentage of women in the sample exceeds their percentage in the population, to ensure proper representative of women in all (including the smallest) Arab localities, based on the assumption that public transit improvements may affect Arab women more than Arab men. For these individuals, we obtained the following data from the CBS for the years 2006-2016:

1. Individual parameters (Population Registry) – sex, age, religion, nationality, personal status, number of children, and locality of residence.
2. Employment status (Employer-Employee File) – includes number of employment months and annual wages. The file also includes car use equivalent value, which was used to identify individuals who had access to a company car.
3. Education (Education Registry) — most advanced degree, number of years of education, psychometric exam score, and Matriculation scores.
4. Access to private vehicle (Roster of Drivers and Vehicles) – driver's license and ownership of private vehicle or motorcycle.

Each individual was also linked to the parameters of his or her spouse (not including the spouse's number of employment months).

Data on bus lines in the period 2010-2017 were obtained from Adalya, in its capacity as the operator of the Public Transit Administration on behalf of the Ministry of Transportation. The data were generated at annual frequency for all Arab localities and include all the bus lines[30] that stop either in or adjacent to the locality on a representative Tuesday. We use the total daily number of trips as an indicator of the service quality in each locality. The advantage of this variable is its simplicity and minimum assumptions, yet it disregards a locality's diversity of destinations: This variable receives an identical value if one bus line passes in proximity to the locality 50 times a day or if 5 bus lines each pass 10 times a day. To address this issue, we also present the results of estimations using the number of different bus lines passing a locality as an indicator of public transit quality.

Furthermore, we obtained data regarding the public transit coverage rate in each locality. This index was constructed as follows: The built-up area in each locality was divided into 250 square-meter cells. Serviced cells were defined as cells in which an active bus stop was located, and coverage rate was defined as the percentage of serviced squares in the locality. In combination,

[30] Excluding bus lines for pupils.

these two variables — number of trips and coverage rate — should reflect the quality of public transit, taking into account the frequency of service and spatial distribution. Nonetheless those indices are clearly limited and do not take into account other features that also determine the quality of public transit such as trip length, hours of operation, price, congestion, signage, reliability, and others. Moreover, the database available to us does not include information on the detailed addresses of individuals' place of residence and place of employment and therefore we were unable to take into account the variance in service quality experienced by different individuals in the same locality.

4.2 Descriptive statistics

For the purpose of the current study, we focused on the residents of the Arab localities[31] between the ages of 20 and 64 who resided in the same locality between 2010 and 2016.[32] Table 3 presents 2010 data for this group (by sex) on employment patterns, access to a private vehicle, education, and several demographic parameters. Consistent with the picture that emerged from the social survey,[33] gender differences are evident: Men work more and earn more, and accordingly have greater access to a private vehicle. Although a portion of the gender effect on access to a private vehicle stems from the more stringent definition applied to married women, it essentially reflects differences in driver's license possession and car ownership.[34]

In Figure 3 we see that individuals with access to a private vehicle, both men and women, have a higher employment rate than individuals with no car access. In the years presented and specifically in the study period (from 2010 onwards), differences in employment rates between individuals with and without car access (at the starting point) are maintained for each gender group. However, while employment rates of men remain steady, employment of women in both access groups increased at a similar rate. Moreover, pre-2010 employment patterns were similar to the patterns observed in the study period.[35]

[31] Excluding the city of Nazareth, which is the largest Arab locality whose public transportation system has been highly developed for many years, and is the exception among Arab localities.
[32] This group includes 92% of the women and 96.5% of the men of the data obtained from the CBS.
[33] It is possible that some of the differences with respect to the Social Survey stems from the fact that Table 2 presents data for salaried employees in the Arab localities only, while the findings of the Social Survey also include self-employed individuals and Arabs living in mixed localities. Moreover, there are differences between the administrative data of the National Insurance Institute and CBS surveys: On this matter see the review by the Chief Economist of the Ministry of Finance (June 24, 2018):" Trends in employment and wages in the past twenty year, analysis based on administrative data."
[34] In the study period, access to a private vehicle among men increased from 63.5% to 79.9%, and among women from 22.7% to 32.5%.
[35] Although the employment rate of men with no access to a private vehicle increased before 2010 (yet remained stable thereafter), the increase occurred primarily in 2006 and therefore this does not appear to be a trend.

Table 3
Descriptive statistics, by gender, 2010

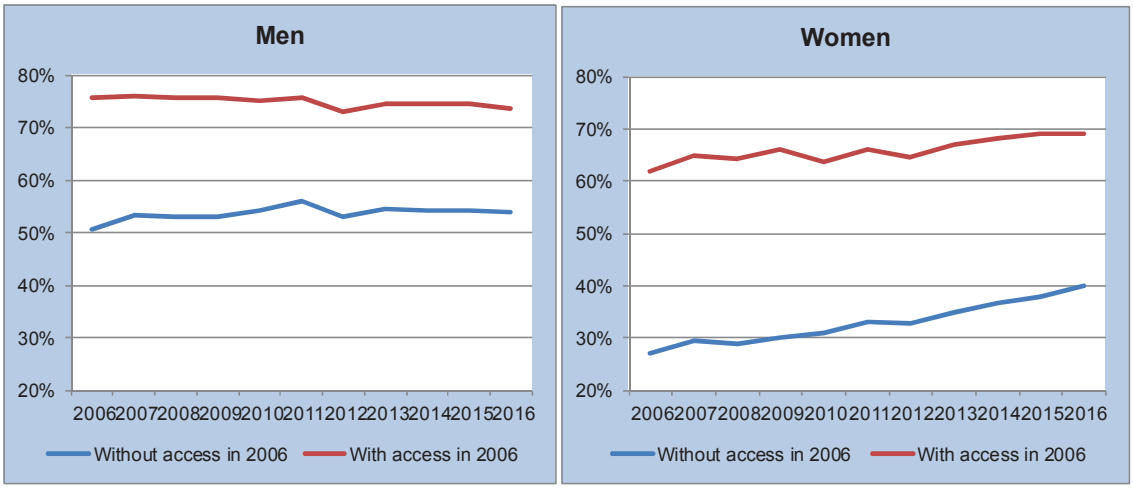
Variable	Women	Men
Employment rate[a]	43.0	72.2
3-month employment rate[b]	38.9	69.1
Average salary per month of work	4,353	6,909
Share holding a driver's license	45.8	84.6
Share owning a private vehicle	22.8	53.1
Share of access to a private vehicle[c]	22.6	63.4
Average years of schooling	11.1	11.7
Average age	36.6	35.6
Share of married	75.8	67.8
Number of children	2.89	2.35
Number of observations	11,762	9,266

[a] According to this definition, an employed person is one who has worked at least 1 month during the year.

[b] According to this definition, an employed person is one who worked at least 3 months during the year.

[c] A married woman has access to a private vehicle if she has a driver's license and she and her spouse combined have at least two cars. For unmarried women and for men, we defined access to a private vehicle as their having a driver's license and they have the use of at least one car (together with the spouse, for a married man). When all women are defined the same as men, their access rate increases to 36.6 percent, but remains markedly lower than that of men.

Figure 3
Employment rate, by gender and access to private vehicle, 2006–16

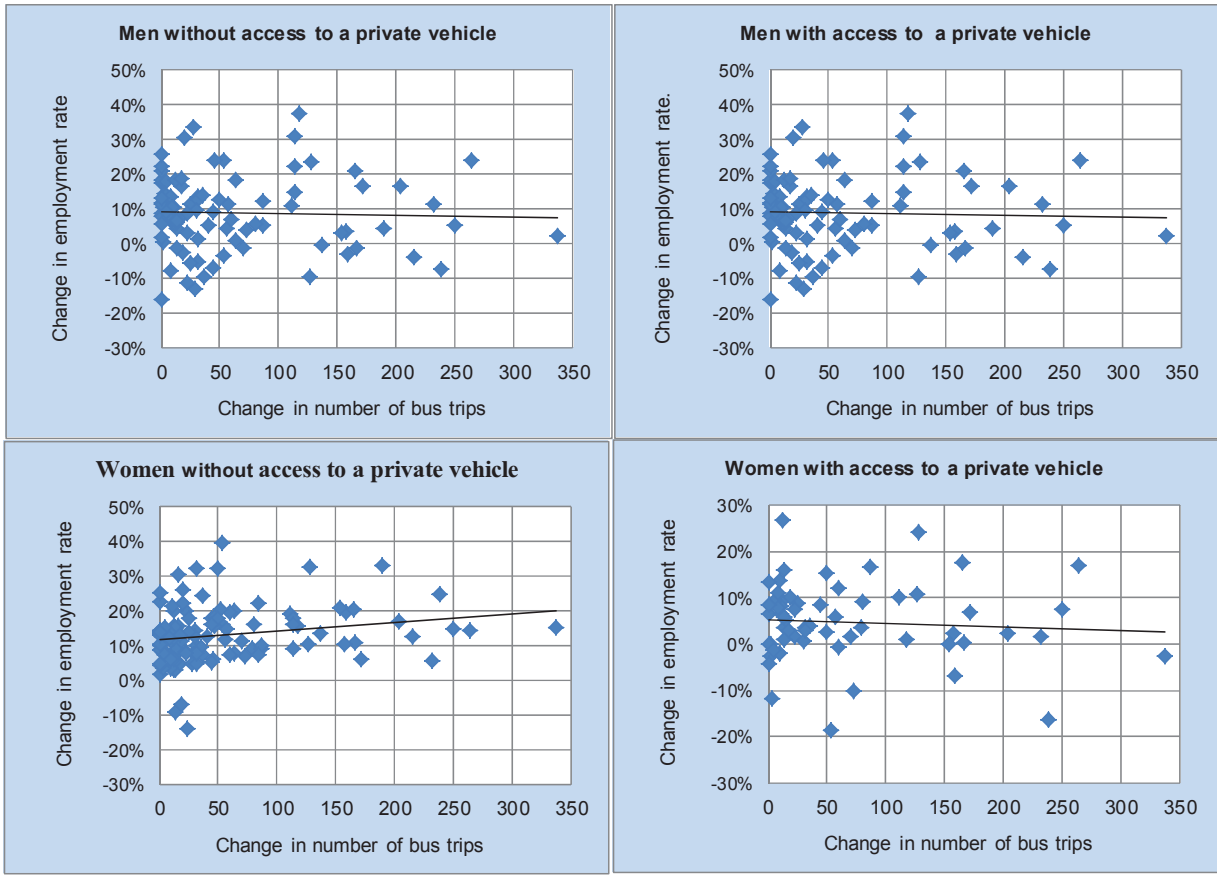


* An employed person is one who worked at least 3 months during the year.

To link the public transit improvement to employment outcomes, Figure 4 presents correlations between changes in employment rates in each Arab locality, and changes in the (lagged) number of bus trips in the vicinity of the locality. Data are presented by sex and car access (in 2010), and the only group for which a positive correlation emerges is women with no car access. These findings are in line with our research hypothesis, and with the prediction that any effect of public transit improvements on employment outcomes would occur primarily in this group.

Figure 4

Changes in the number of bus trips in the locality and employment rates, by gender and access to a private vehicle, 2016 compared with 2011



* The employment rate in a locality is only presented if there are at least 10 observations (therefore there are fewer data regarding women with access to a private vehicle).

* The change in the number of trips refers to the years 2010–15.

* Access to a private vehicle in 2010.

5. Results

5.1 The effect of public transit on employment

Table 4 presents the main results, which show that the public transit reform did not lead to a significant increase in employment rates of most men and women. Column 1 in the uppermost section of the Table refers to all the men in the sample and indicates that the coefficient of the number of bus trips passing in proximity to their locality is negligible. As it is reasonable that individuals with no car access would be more sensitive to changes in public transit, in Column 2 we added an interaction of the number of trips and no car access in 2010 (as explained in the Methodology section), but the coefficient of number of trips remains close to zero. These results should not be surprising because the employment rate of Arab men is high and similar to the employment rate of the general population, and many of them use a private vehicle or an organized shuttle service (Suhoy & Sofer, 2019). In contrast, Arab women have a much lower

Table 4
The effect of public transportation on employment, by gender and employment status

Sample population	(1)	(2)	(3)	(4)
	Men		**Women**	
Public transportation in locality[a]	-0.006	-0.009	-0.002	-0.011
	(0.008)	(0.007)	(0.008)	(0.017)
Public transportation[a] * No access to private vehicle[b]		0.009		0.012
		(0.012)		(0.015)
Married	0.039***	0.040***	0.000	-0.001
	(0.008)	(0.008)	(0.009)	(0.009)
Number of children under age 2	-0.003	-0.003	-0.061***	-0.061***
	(0.005)	(0.005)	(0.006)	(0.006)
R^2	0.002	0.002	0.012	0.012
Number of observations	9,266	9,266	11,762	11,762
	Only men who were unemployed in 2011		**Only women who were unemployed in 2011**	
Public transportation in locality[a]	-0.006	-0.024	-0.004	0.011
	(0.016)	(0.024)	(0.009)	(0.024)
Public transportation[a] * No access to private vehicle[b]		0.030		-0.021
		(0.023)		(0.024)
Married	0.065***	0.057***	0.034**	0.028*
	(0.017)	(0.016)	(0.015)	(0.015)
Number of children under age 2	0.024**	0.021*	-0.057***	-0.058***
	(0.011)	(0.011)	(0.011)	(0.011)
R^2	0.114	0.120	0.088	0.095
Number of observations	2,557	2,557	6,513	6,513
	Only men who were employed in 2011		**Only women who were employed in 2011**	
Public transportation in locality[a]	-0.009	-0.009	0.004	-0.021
	(0.006)	(0.006)	(0.013)	(0.021)
Public transportation[a] * No access to private vehicle[b]		-0.002		0.034*
		(0.020)		(0.019)
Married	0.038***	0.035***	0.005	-0.006
	(0.008)	(0.008)	(0.013)	(0.012)
Number of children under age 2	-0.006	-0.006	-0.051***	-0.053***
	(0.004)	(0.004)	(0.007)	(0.007)
R^2	0.028	0.029	0.031	0.034
Number of observations	6,709	6,709	5,249	5,249

Standard deviations are in parentheses. * indicates significance at the 10% level, ** indicates significance at the 5% level, *** indicates significance at the 1% level. In each column, the dependent variable is the individual's employment status, and all of them include fixed effects and year effects. In columns where an interaction variable is included, we also added interaction variables between the year effects and the lack of access to a private vehicle in 2010.

[a] Public transportation in a locality is defined as the number (in hundreds) of buses that pass near the locality on a representative day during the year.

[b] A married woman has access to a private vehicle if she has a driver's license and she and her spouse combined have at least two cars. For unmarried women and for men, we defined access to a private vehicle as their having a driver's license and they have the use of at least one car (together with the spouse, for a married man).

employment rate, and many lack access to a private vehicle or other transportation solutions and therefore we expected to find a statistically significant positive effect with respect to them. Nonetheless, Columns 3-4 indicate that the results for women were similar to the results for men. With respect to the variables controlling for individual personal status, we obtained statistically significant coefficients in the expected direction: Marriage increases the likelihood of a man's employment, and the number of children under age 2 reduces the likelihood of a woman's employment.

Access to place of employment may not be a sufficiently significant factor in helping unemployed individuals or others who are non-participants in the labor market for various

reasons, because employment in these groups is generally limited by a number of barriers. In contrast, it is more reasonable to assume that if improved access contributes to employment, this effect is concentrated in those individuals who are already employed yet deliberate whether to maintain their employment status. Accordingly, the middle section of Table 4 presents the results for men and women who were not employed at the beginning of the period (2011), and the results for men and women who were employed at that time are shown separately in the bottom section of Table 4. Even in this case, however, the coefficients obtained for most groups are not significantly different from zero. A statistically significant and positive interaction effect was obtained only for women who were employed in 2011, and even then the statistical significance was a mere 10%.[36]

We wondered if our difficulty in identifying the effect of public transit improvements can be attributed to the limitations of our selected proxy for public transit quality: the number of trips. As this measure does not capture destinations or bus routes, it is incapable of distinguishing between a new bus line and extension to an existing bus line, for example. This issue can be partially resolved by using the number of distinct bus lines that pass through a locality, which is a better reflection of the range of destinations and routes.[37] Another limitation of using the number of trips as a proxy for service quality is that this measure fails to take into consideration the spatial distribution of bus stops in a locality. This is a significant shortcoming on two counts: If a certain locality has few bus stops, public transportation in that locality is probably irrelevant for many residents because they do not have an operating bus stop in reasonable walking distance of their homes. Moreover, our measure will not identify a public transit improvement that consists of an addition in the number of bus stops without an increase in the number of trips. Therefore, to take spatial distribution into account, we used a locality's public transit coverage rate, which measures the percentage of cells in the locality's built-up area that contain working bus stops (see our explanation in the Section 4). However, the results presented in Table 5 indicate that even when we used the number of bus lines or the coverage rate, we found no effect on the majority of the groups defined above.

The sole case in which Table 5 shows a statistically significant effect was men who were employed in 2011, when we used coverage rate as the proxy for public transit quality. Although the percentage of men with no access to a private vehicle in this group is only 30%, yet due to the high employment rate, they constitute a large group that accounts for 20% of the working age population (20-64) of Arab men. However, the coefficient implies that an increase of 2

[36] One possible reason for the low statistical significance is that the improvement in public transportation indeed increased the change of individuals with no access to a private vehicle to be employed, but this effect is weak in annual terms and therefore is difficult to identify. If this is the case, we can more easily identify the cumulative effect over time and therefore the results presented in Table A.2 support this argument with respect to employed women.

[37] The number of bus lines does indeed reflect diversity but admittedly it does not take into consideration the employment relevance of the destinations. That is to say, it does not distinguish between a line that reaches areas of employment and a line that serves the population's other needs.

percentage points[38] in the average coverage rate of Arab localities generated a mere 0.2% increase in the likelihood of men who were employed in 2011 and had no access to a private vehicle to continue to be employed. Consequently, it appears that public transit improvements have a weak economic effect on employed men with no private vehicle access.

Table 5
The effect of public transportation on employment, selected indices

Sample population	(1)	(2)	(3)	(4)	(5)	(6)
		Men			**Women**	
	# of trips	# of lines	Coverage rate	# of trips	# of lines	Coverage rate
	Only men who were unemployed in 2011			**Only women who were unemployed in 2011**		
Public transportation in locality[a]	-0.024	-0.001	0.049	0.011	0.007*	0.126*
	(0.024)	(0.004)	(0.064)	(0.024)	(0.004)	(0.076)
Public transportation[a] * No access to private vehicle[b]	0.030	0.002	-0.001	-0.021	-0.007	-0.119
	(0.023)	(0.005)	(0.105)	(0.024)	(0.004)	(0.075)
R^2	0.120	0.120	0.120	0.095	0.095	0.095
Number of observations	2,557	2,557	2,557	6,513	6,513	6,513
	Only men who were employed in 2011			**Only women who were employed in 2011**		
Public transportation in locality[a]	-0.009	-0.003**	-0.041	-0.021	0.004	-0.059
	(0.006)	(0.001)	(0.028)	(0.021)	(0.002)	(0.057)
Public transportation[a] * No access to private vehicle[b]	-0.002	0.001	0.099**	0.034*	-0.001	0.077
	(0.020)	(0.003)	(0.045)	(0.019)	(0.003)	(0.085)
R^2	0.029	0.029	0.029	0.034	0.034	0.034
Number of observations	6,709	6,709	6,709	5,249	5,249	5,249

Standard deviations are in parentheses. * indicates significance at the 10% level, ** indicates significance at the 5% level, *** indicates significance at the 1% level.
In each column, the dependent variable is the individual's employment status, and all of them include control variables for family status, fixed effects, year effects, and interaction variables between the year effects and access to a private vehicle in 2010.

[a] Public transportation in a locality is defined as the number (in hundreds) of buses that pass near the locality on a representative day during the year.

[b] A married woman has access to a private vehicle if she has a driver's license and she and her spouse combined have at least two cars. For unmarried women and for men, we defined access to a private vehicle as their having a driver's license and they have the use of at least one car (together with the spouse, for a married man).

Table 6
The effect of public transportation on employment, by gender, age group and employment status

Age group	(1) 20-64	(2) 20-35	(3) 30-50	(4) 40-64	(5) 20-64	(6) 20-35	(7) 30-50	(8) 40-64
	Only men who were unemployed in 2011				**Only women who were unemployed in 2011**			
Public transportation in locality[a]	-0.024	-0.008	-0.016	-0.033	0.011	0.003	-0.005	-0.002
	(0.024)	(0.031)	(0.033)	(0.022)	(0.024)	(0.034)	(0.026)	(0.038)
Public transportation[a] * No access to private vehicle[b]	0.030	0.003	0.025	0.073**	-0.021	-0.018	0.001	0.002
	(0.023)	(0.037)	(0.034)	(0.029)	(0.024)	(0.036)	(0.027)	(0.039)
R^2	0.120	0.177	0.092	0.068	0.095	0.144	0.088	0.043
Number of observations	2,557	1,058	1,462	1,194	6,513	2,651	3,891	3,068
	Only men who were employed in 2011				**Only women who were employed in 2011**			
Public transportation in locality[a]	-0.009	-0.007	-0.010	-0.011	-0.021	-0.011	-0.009	-0.049
	(0.006)	(0.007)	(0.009)	(0.013)	(0.021)	(0.024)	(0.026)	(0.055)
Public transportation[a] * No access to private vehicle[b]	-0.002	0.002	-0.002	-0.016	0.034*	0.027	0.033	0.048
	(0.020)	(0.022)	(0.030)	(0.029)	(0.019)	(0.026)	(0.025)	(0.050)
R^2	0.029	0.019	0.033	0.049	0.034	0.030	0.033	0.046
Number of observations	6,709	3,836	3,669	2,068	5,249	3,142	2,953	1,424

Standard deviations are in parentheses. * indicates significance at the 10% level, ** indicates significance at the 5% level, *** indicates significance at the 1% level.
In each column, the dependent variable is the individual's employment status, and all of them include control variables for family status, fixed effects, year effects, and interaction variables between the year effects and access to a private vehicle in 2010.

[a] Public transportation in a locality is defined as the number (in hundreds) of buses that pass near the locality on a representative day during the year.

[b] A married woman has access to a private vehicle if she has a driver's license and she and her spouse combined have at least two cars. For unmarried women and for men, we defined access to a private vehicle as their having a driver's license and they have the use of at least one car (together with the spouse, for a married man).

[38] Similarly to the average annual growth rate recorded in the period 2010-2015.

Another direction we examined was whether it was possible to identify differences in effect by locality features — either geographic region or population size — but in this case, too, we found no statistically significant effect for any group.[39] Columns 1-2 in the upper section of Table A.3 present the results for men who were not employed in 2011, in small (up to 2,000 residents) and large localities, and in Columns 3-4 — in the northern region, where the majority of the population that lives in Arab localities is concentrated, and in the remaining regions. Columns 5-8 show the results of the same regressions for women who were not employed in 2011, and the bottom section of the Table presents the results for men and women who were employed at that time.

In Table 6, we divided the men and women by age group, in addition to the division by employment status. The prominent result here is a statistically significant positive effect on older men (40-64) with no private vehicle access who were not employed in 2011. This result implies that a mean addition of 10 trips to a locality[40] led to a 0.7% increase in the employment rate of these men. This result is somewhat surprising because we estimated that the mobility barrier is not a significant factor for men. Still, this result is consistent with the fact that older men who are unemployed are the exception: Only 38% of unemployed men in 2011 have private vehicle access compared to 63% of all men.

With respect to women, we found no statistically significant effect in any group.[41] Moreover, we obtained coefficients that were negative or close to zero for women who were unemployed in 2011. With respect to women who were employed in 2011, we obtained coefficients in the expected direction in all age groups, but these were not statistically significantly different from zero. In Table 7 we focus on women in the intermediate age group (30-50) who were employed, and divide them into groups by various personal attributes. We focus on women in this age group because they apparently are more open to changes in their travel habits than older women, and therefore service improvements may have a stronger impact in helping them maintain their employment status. With respect to young women (20-35), the identical estimation failed to generate statistically significant and stable results for any sub-division (see Table A.4). The reason for this may be that young women not only benefited from improved access to places of employment but also to academic institutions, and this had a negative effect on their short-term employment rate.[42]

[39] Table A.3 does show a positive and statistically significant coefficient for the interaction effect with respect to employed women in the north region, but since the coefficient of public transportation on locality is statistically significant and negative and a similar magnitude, the sum of these coefficients is zero. Therefore the overall effect of public transportation in this case is questionable.

[40] Similar to the average annual growth rate recorded in the period 2010-2015.

[41] Excluding statistical significance at the 10% level for all employed females in 2011.

[42] According to CBS Labor Force Surveys in the period 2012-2016, 16% of younger females (18-34) are unemployed because they study while the percentage of middle-age females (30-54) who are unemployed for the same reason is close to zero (the difference in the age range of this group stem from the fact that in these data, respondents did not provide precise information on their age and only noted an age group).

The upper section of Table 7 presents the results for all localities; the middle section refers only to localities in which public transit improved significantly, because these are the localities in which it is more reasonable to expect an effect on employment; the bottom section focuses on localities that experienced a significant improvement in public transit and had a coverage rate of at least 10%, which further increases the likelihood that public transit in those localities serves a relatively broad section of the population. The most positive, statistically significant, and stable effect was obtained for women with 12 or more years of education.[43] The economic meaning of this result is that an addition of 10 daily trips to a locality increased in 0.5% the probability that educated women who were employed in 2011 and had no private vehicle access would maintain their employment status.[44]

The result for educated women is surprising because it is conventionally believed that reducing public transit costs of working outside the home should be expected to affect less educated women who typically have limited employment opportunities and relatively lower earning potential. Had that been the case here, we would have seen the greatest effect on women with the lowest monthly wages, but that is not the case (Columns 13-14). In view of these findings, we ran separate regressions by level of education and found that the effect was concentrated in the group of educated women in the bottom part of the wage distribution (see Table A.5). This result is consistent with economic reasoning that these are the women on the margins of the labor market: It is reasonable that women who are high-wage earners work regularly, independent of the quality of public transit, while women who are low-wage earners deliberate whether to continue to work and are therefore more sensitive to changes in the cost of working outside the home.[45]

The findings of the current study are in line with the results of a study by Schlosser (2006) who studied the effect of opening day care centers on employment of Arab women. Schlosser reported that she found an effect only on educated Arab women. She explained this finding by stating that these women come from less traditional sectors of society and are therefore more responsive to economic incentives. Schlosser explained the differences between educated and uneducated women in joining the labor market, but a similar version of this argument can also apply to women who are already employed: It is possible that uneducated women who typically belong to more traditional sectors of society are subject to social pressure to leave their jobs (especially if they are located outside the locality). In this case, even improvements in public transit are

[43] As noted above, we did not find a similar effect in the 20-35 age group (see Table A.4).
[44] According to CBS Labor Force Surveys for the years 2012-2016, these women are mainly employed in education, commerce and healthcare and welfare services. It is therefore possible to conclude with a high degree of confidence that the increase in their employment rate stemmed from reduced costs of transportation to work and not because they were hired for the new jobs that opened up in the public transportation sector as a result of expanded public transportation services.
[45] It is important to note that we found no effect for uneducated women even when we focused on the group of females with lower income. Therefore the result for this group is independent of the definition used for high/low income.

Table 7

The effect of public transportation on women's employment at ages 30–50 who worked in 2011, selected groups

Sample population	(1) Total	(2) Without children under age 2 (in the entire period)	(3) Married women (in the entire period) ×	(4) Married women (in the entire period) ✓	(5) Muslim women ×	(6) Muslim women ✓	(7) 12+ years of schooling ×	(8) 12+ years of schooling ✓	(9) 12+ years of schooling of spouse ×	(10) 12+ years of schooling of spouse ✓	(11) Spouse's access to private vehicle (in 2010) ×	(12) Spouse's access to private vehicle (in 2010) ✓	(13) Monthly wage over NIS 4,000 (in 2011) ×	(14) Monthly wage over NIS 4,000 (in 2011) ✓
Public transportation in locality[a]	-0.009	-0.011	-0.030	-0.004	0.031	-0.012	0.028	**-0.019**	-0.048	0.018	-0.005	-0.010	0.006	-0.040
	(0.026)	(0.026)	(0.060)	(0.025)	(0.031)	(0.030)	(0.034)	**(0.024)**	(0.047)	(0.028)	(0.064)	(0.020)	(0.012)	(0.075)
Public transportation[a] * No access to private vehicle[b]	0.033	0.042	0.026	0.036	0.058	0.027	-0.035	**0.052****	0.057	0.027	0.006	0.047*	0.018	0.052
	(0.025)	(0.027)	(0.069)	(0.023)	(0.041)	(0.029)	(0.048)	**(0.022)**	(0.051)	(0.026)	(0.063)	(0.024)	(0.019)	(0.067)
R^2	0.033	0.033	0.034	0.033	0.051	0.029	0.049	0.020	0.040	0.030	0.045	0.026	0.019	0.047
Number of observations	2,953	2,014	504	2,357	773	2,180	1,002	1,782	1,089	1,402	1,208	1,745	1,570	1,383
Only localities with a notable increase in number of trips														
Public transportation in locality[a]	-0.002	-0.003	-0.020	0.001	0.039	-0.000	0.045	**-0.013**	-0.052	0.029	0.008	-0.006	0.008	-0.017
	(0.027)	(0.027)	(0.066)	(0.027)	(0.034)	(0.032)	(0.040)	**(0.025)**	(0.051)	(0.030)	(0.071)	(0.022)	(0.013)	(0.080)
Public transportation[a] * No access to private vehicle[b]	0.042	0.042	0.018	0.047*	0.064	0.032	-0.036	**0.059****	0.076	0.035	0.023	0.047*	0.034	0.046
	(0.026)	(0.028)	(0.075)	(0.025)	(0.046)	(0.031)	(0.054)	**(0.024)**	(0.056)	(0.027)	(0.067)	(0.026)	(0.022)	(0.070)
R^2	0.038	0.037	0.035	0.039	0.051	0.035	0.058	0.024	0.049	0.036	0.055	0.028	0.023	0.056
Number of observations	2,298	1,549	375	1,853	755	1,543	747	1,428	796	1,157	902	1,396	1,264	1,034
Only localities with a notable increase in number of trips and the coverage rate in them was at least 10 percent														
Public transportation in locality[a]	-0.001	-0.016	-0.018	0.005	0.025	0.001	0.034	**-0.005**	-0.079	0.033	0.014	-0.006	0.004	-0.005
	(0.031)	(0.032)	(0.077)	(0.026)	(0.031)	(0.037)	(0.058)	**(0.023)**	(0.066)	(0.023)	(0.083)	(0.019)	(0.012)	(0.111)
Public transportation[a] * No access to private vehicle[b]	0.035	0.035	-0.058	0.044*	0.055	0.029	-0.031	**0.061****	0.096	0.042	-0.014	0.060*	0.018	0.047
	(0.029)	(0.031)	(0.090)	(0.026)	(0.050)	(0.031)	(0.074)	**(0.024)**	(0.069)	(0.030)	(0.073)	(0.030)	(0.017)	(0.098)
R^2	0.034	0.033	0.031	0.036	0.044	0.031	0.056	0.025	0.046	0.036	0.057	0.024	0.022	0.050
Number of observations	1,583	1,078	235	1,304	694	889	422	1,096	509	859	578	1,005	945	638

Standard deviations are in parentheses. * indicates significance at the 10% level, ** indicates significance at the 5% level, *** indicates significance at the 1% level.

In each column, the dependent variable is the individual's employment status, and all of them include control variables for family status, fixed effects, year effects, and interaction variables between the year effects and access to a private vehicle in 2010.

[a] Public transportation in a locality is defined as the number (in hundreds) of buses that pass near the locality on a representative day during the year.

[b] A married woman has access to a private vehicle if she has a driver's license and she and her spouse combined have at least two cars. For unmarried women and for men, we defined access to a private vehicle as their having a driver's license and they have the use of at least one car (together with the spouse, for a married man).

insufficient to prevent their withdrawal from the labor market. In contrast, educated women who are less susceptible to such pressures might benefit from enhanced public transit access.

It might be presumed that the reason is that educated women use public transit more frequently and are therefore possible more strongly affected by it. Although this argument cannot be directly confirmed or refuted because we have no data on public transit use by individual attributes, we do however have partial evidence that suggests that this is not the reason: Of all employed women, the percentage of educated women with private vehicle access was 50%, while the percentage of women with fewer than 12 years of education who had access to a private vehicle was only 20%. Moreover, according to CBS labor surveys, for women between the ages of 30 and 50 in Arab localities, the percentage of educated women who are employed in their respective localities is greater than the percentage of less educated women (70% vs. 55%, respectively).[46]

In addition to the result for educated women, we obtained a similar coefficient, albeit at 10% statistical significance, for women whose spouse had access to a private vehicle. It appears the reason for this result is that these women receive assistance from their spouse to travel to the bus stop in the vicinity of their locality, which they would otherwise have trouble reaching. That is to say, when service is limited, public transit does not constitute a complete substitute for private transportation, but rather only a supplementary means of transportation for women who have partial access to a private vehicle (through their spouse). Consequently, the statistically significant results (in the middle and bottom sections) for married women apparently reflect their access to a private vehicle through their spouse.

5.2 Robustness checks and addressing potential identification concerns

Table 8 presents the results we reported for educated women between the ages of 30 and 50 who were employed in 2011, and for men between the ages of 40 and 64 who were unemployed at that time, including a gradual inclusion of the control variables. In Column 1 we see that the coefficient of the number of trips is not statistically significant for women or men, and the coefficient increases in size and statistical significance only after adding the interaction effect of number of trips and private vehicle access (Column 2). The reason is the positive effect that public transportation improvements had on individuals with no private vehicle access, in contrast to the insignificant effect on individuals with private vehicle access. Column 3 presents the results presented above, where the regression also includes a control of changes in individuals' personal status and number of children below age 2.

[46] The Labor Force Survey data refer to average figures in the years 2012-2016 for the ground of middle-age female (34-50); The data only contain information on respondents' age group and lack precise identification of respondents' ages.

Columns 4-5 presents the results of tests designed to confirm that the results we obtained do not stem from other policy changes related to the labor market that occurred in the same years in Arab localities:

A. Ryan Employment Centers. These programs provide vocational training and a range of related services for participants from Arab communities, with the aim of helping them integrate and advance in the labor market. In the period of the study, new Ryan centers were opened in several localities, and to address this development we control for the year in which each center opened.[47]
B. Day care centers. These centers include day care centers of all types, including morning, afternoon, and all-day settings, and home-based childcare in Arab localities. These settings increased in number and their operations expanded in scope considerably during the study period. Therefore, in Column 5, we include the number of children registered in all day care centers in each locality, according to data from the Ministry of Economics.[48]

Table 8
Robustness test - adding selected control variables

	(1)	(2)	(3)	(4)	(5)	(6)
	Educated women, aged 30-50, who worked in 2011					
Public transportation in locality[a]	0.031	-0.002	-0.005	-0.003	-0.006	-0.004
	(0.020)	(0.024)	(0.023)	(0.023)	(0.022)	(0.023)
Public transportation[a] * No access to private vehicle[b]		0.060**	0.061**	0.060**	0.062***	0.060**
		(0.024)	(0.024)	(0.024)	(0.023)	(0.023)
Ryan employment center (lagged)				-0.012	-0.006	-0.001
				(0.017)	(0.018)	(0.020)
Daycare centers (lagged)					0.058**	0.066***
					(0.023)	(0.024)
R^2	0.017	0.020	0.025	0.025	0.026	0.033
Number of observations	1,096	1,096	1,096	1,096	1,096	1,096
	Men aged 40-64 who did not work in 2011					
Public transportation in locality[a]	0.013	-0.033	-0.033	-0.033	-0.033	-0.032
	(0.013)	(0.022)	(0.022)	(0.022)	(0.022)	(0.021)
Public transportation[a] * No access to private vehicle[b]		0.074**	0.073**	0.073**	0.073**	0.074***
		(0.029)	(0.029)	(0.029)	(0.029)	(0.028)
Ryan employment center (lagged)				0.009	0.008	0.012
				(0.015)	(0.016)	(0.015)
Daycare centers (lagged)					-0.021	-0.021
					(0.015)	(0.016)
R^2	0.062	0.067	0.068	0.068	0.068	0.073
Number of observations	1,194	1,194	1,194	1,194	1,194	1,194
YE	✓	✓	✓	✓	✓	✓
YE * access to prviate vehicle		✓	✓	✓	✓	✓
Family status			✓	✓	✓	✓
Trend variable for cluster						✓

Standard deviations are in parentheses. * indicates significance at the 10% level, ** indicates significance at the 5% level, *** indicates significance at the 1% level.
[a] Public transportation in a locality is defined as the number (in hundreds) of buses that pass near the locality on a representative day during the year.
[b] A married woman has access to a private vehicle if she has a driver's license and she and her spouse combined have at least two cars. For unmarried women and for men, we defined access to a private vehicle as their having a driver's license and they have the use of at least one car (together with the spouse, for a married man).

[47] Data on Ryan employment centers are based on a study by Deutsch, et al. (forthcoming), who define the effective opening date of a program based on the number of participants who joined the program. See Interim Report by the Brookdale Institute on "Assessment of Ryan employment centers": http://employment.jdc.org.il/knowledge/1550
[48] The author thanks Hagay Forges of the Ministry of Economics for the data and his cooperation.

The findings indicate that the coefficients of number of trips and interaction effects remained the same even after controlling for new Ryan centers and day care centers. With respect to the control variables themselves, the coefficient of children's daycare centers is positive and statistically significant while the coefficient of Ryan employment centers is not different from zero. However caution is required when interpreting these coefficients, and no causal relationship should be inferred. It is not inconceivable that Ryan centers were opened specifically in those localities in which greater challenges in integrating into the labor market were identified, while day care centers were opened in response to a demand from women working outside the home.

We also performed a range of tests to confirm that the above results are not sensitive to our specific definitions. Table A.6 shows that the results are robust to various definitions of private vehicle access, as reflected in Columns 2 and 5 where private vehicle access is defined for 2011 rather than 2010, and in Columns 3 and 6 which include only individuals whose access to a private vehicle access did not change over the entire period. In contrast, Column 7 highlights the significance of using the most suitable definition of private vehicle access for married women.

Table A.7 presents similar results under different definitions for the number of months used to define employment in a year: These definitions range from the most relaxed — individuals who were employed at least one month — to the most stringent — individuals who were employed 12 months.

Table A.8 indicates that the findings we reported are generally valid for different definitions of education (number of years), whether we defined an educated woman as a woman with at least 11 years of education or as a high school graduate (i.e., by the highest certificate achieved). At the same time, statistical significance depends on the group of educated women including the large group of women who have exactly 12 years of education.

Finally, we ran the regressions excluding one locality each time, and also found that the results do not depend on any single locality (These results are not shown).

5.3 Additional outcome variables

From the results presented till now, it appears that public transportation improvements had no significant effect on employment rates. We now turn to the status of the employed individuals themselves. First, we found no evidence that additional trips led to an increase in the number of employment months of employed individuals (see Table A.9).

We also examined whether public transportation changes affected the wages of individuals who were employed at the beginning of the period. Added services may have increased working individuals' employment opportunities, and if this was the case, it is reasonable to think that some individuals used these opportunities to find a new job or improve the terms of their current

employment. Such effects could be expected to find expression in wage levels, but we can see from Table 9 that no such effects were found for any age group, either for men or for women.

Table 9
The effect of public transportation on monthly wage of those who worked in 2011, by gender and age group

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Men				Women			
Age group	20-64	20-35	30-50	40-64	20-64	20-35	30-50	40-64
Public transportation in locality[a]	136.6	49.7	106.8	368.5	187.2	152.4	263.1	309.3
	(101.3)	(165.2)	(153.9)	(253.5)	(193.9)	(232.9)	(188.9)	(355.3)
Public transportation[a] * No access to private vehicle[b]	-176.0	-16.3	-43.1	-435.7	-127.8	-155.3	-178.4	-141.0
	(125.9)	(254.7)	(244.9)	(313.0)	(183.2)	(236.2)	(190.2)	(341.5)
R^2	0.091	0.129	0.078	0.058	0.148	0.201	0.124	0.077
Number of observations	6,709	3,836	3,669	2,068	5,249	3,142	2,953	1,424

Standard deviations are in parentheses. * indicates significance at the 10% level, ** indicates significance at the 5% level, *** indicates significance at the 1% level. In each column, the dependent variable is the individual's employment status, and all of them include control variables for family status, fixed effects, year effects, and interaction variables between the year effects and access to a private vehicle in 2010.

[a] Public transportation in a locality is defined as the number (in hundreds) of buses that pass near the locality on a representative day during the year.

[b] A married woman has access to a private vehicle if she has a driver's license and she and her spouse combined have at least two cars. For unmarried women and for men, we defined access to a private vehicle as their having a driver's license and they have the use of at least one car (together with the spouse, for a married man).

We similarly failed to find any wage effect on the group of educated women, for which we found an employment effect (Table A.10). It is, nonetheless, important to note that a rise in the employment rate of these women did not generate a statistically significant decline in the supply of work for their spouses, as evident from the regressions on the employment status and annual wages of their spouses, which might have been expressed as a decline in the number of their work hours (Column 3-4).

6. Summary

The aim of this research was to examine the significance of public transportation for employment outcomes in Arab society, and specifically for Arab women. To this end we examined how an increase in the number of bus trips affected employment rates in Arab localities. The findings of the study indicate that women did not join the labor market following service improvements, however improved service primarily helped women who were already working outside the home to maintain their employment status. The effect was concentrated in the group of educated employed women between age 30 and 50 who had no access to a private vehicle. As of the study period, this group accounted for a mere 8% of all working age Arab women (20-64). It is, however, reasonable to assume that this group will constitute an increasing share of Arab women in the future as the result of the upward trend in education and employment rates among Arab women.[49] In quantitative terms, an addition of 10 bus trips per day to a locality increases the probability that a woman in this group will remain employed by 0.5% on average. With respect to men, we found a similar effect for unemployed men between age 40 and 64 with no private vehicle access. Similarly to the above group of women, this group accounts for a mere 8% of all

[49] The sustained increase in percentage of individuals with access to a private vehicle may moderate the increasing weight of this group, but a genuine improvement in public transportation may lower incentives for private vehicle use and depress the upward trend in private vehicle use.

working age Arab men (20-64). In this case, however, it is less probable that they will account for a greater share of this group in the future.

The main conclusion of this study is that there are more important factors that prevent the integration of Arab women in the labor market, such as cultural and structural factors. Nonetheless, our findings concerning the positive effect of public transportation on educated women who were employed in the past show that improvements in public transportation indeed help women who overcame these structural and/or cultural barriers and are deliberating their employment status. Moreover, it is not inconceivable that the employment outcomes of added public transit service will manifest only several years in the future,[50] because genuine changes in the labor market occur gradually.

The findings of this study thus support the argument that the way to increase employment rates of Arab women is by removing other barriers, and public transportation is a complementary factor in such efforts. Furthermore, it is important to stress that the public transportation reform improved the quality of life in Arab communities in other respects: The rise in number of trips indicates that the population used public transportation to satisfy various needs and benefited from service expansions that reduced their costs of travel in terms of time and money.

Looking at the issue beyond the period of the current study reveals that as of 2016, levels of public transportation services in Arab localities were still low compared to service in Jewish localities, even after taking into account that Arab localities are relatively small and peripheral One of the expression of the low level of service is that the population in Arab localities have fewer opportunities to commute by public transportation than by private transportation (Suhoy & Sofer, 2019). Developments in public transportation services in Arab localities are in process. During the study period (2010-2015), service improvements focused on the number of trips, but poor infrastructure in many Arab localities limited bus routes, which is perhaps why the added number of trips was not relevant for large sections of the Arab population. In 2016-2018, following Government Resolution 922, the public transportation system in Arab localities was further developed and expanded, and in addition to accelerated growth in the number of trips and diversity of bus routes, work on infrastructure also improved bus access to localities and neighborhoods that previously had no access to public transportation. Further research is warranted on this issue to explore whether the more significant expansion of the public transportation network, and especially increased coverage rates, had a more extensive effect on employment outcomes.

[50] However, over time, the probability of identifying the effect and attributing it to past changes in public transportation decreases.

References

Baum, C. L. (2009). "The Effects of Vehicle Ownership on Employment", *Journal of Urban Economics*, *66*(3), 151-163.

Cervero, R., Sandoval, O., & Landis, J. (2002). "Transportation as a Stimulus of Welfare-to-Work: Private versus Public Mobility", Journal of Planning Education and Research, 22(1), 50-63.

Committee for Economic and Social Change, (2011). The Report of the Committee for Economic and Social Change. (in Hebrew)

Duranton, G., & Turner, M. A. (2012). "Urban Growth and Transportation", Review of Economic Studies, 79(4), 1407-1440.

Frish, R. and Tsur, S. (2010). "Transport Infrastructure Investment, Commuting and Wages", Israel Economic Review 7:2, pp. 55–79.

Gautier, P. A., & Zenou, Y. (2010). "Car Ownership and the Labor Market of Ethnic Minorities", Journal of Urban Economics, 67(3), 392-403.

Gibbons, Stephen and Lyytikäinen, Teemu and Overman, Henry G. and Sanchis-Guarner, Rosa (2016). "New Road Infrastructure: The Effects on Firms" (April 2016), *CEPR Discussion Paper No. DP11239*. Available at SSRN: https://ssrn.com/abstract=2769855

Greenwald, D., Grossman G., & Levi A. (2018). "Does Greater Public Transit Access Increase Employment for the Israel-Arab Population? A Preliminary Analysis", *Harvard Kennedy School*. Available at: https://www.hks.harvard.edu/centers/mrcbg/publications/awp/awp95

Holzer, H. J., Quigley, J. M., & Raphael, S. (2003). "Public Transit and the Spatial Distribution of Minority Employment: Evidence from a Natural Experiment", *Journal of Policy Analysis and Management*, *22*(3), 415-441.

Kawabata, M. (2003). "Job Access and Employment among Low-Skilled Autoless Workers in US Metropolitan Areas", Environment and Planning A, 35(9), 1651-1668.

Kain, J. F. (1968). "Housing Segregation, Negro Employment, and Metropolitan Decentralization", The Quarterly Journal of Economics, 82(2), 175-197.

Malki, S. (2011). "The Place of Public Transportation in the Entry of Arab Israeli Women into the Labor Force", Milken Institute.

Mayer, T., & Trevien, C. (2017). "The Impact of Urban Public Transportation Evidence from the Paris Region", Journal of Urban Economics.

Ong, P. M., & Houston, D. (2002). "Transit, Employment and Women on Welfare", *Urban Geography*, *23*(4), 344-364.

Rotger, G. P & Nielsen, T. S. (2015). "Effects of Job Accessibility Improved by Public Transport System: Natural Experimental Evidence from the Copenhagen Metro", *European Journal of Transport & Infrastructure Research*, *15(4)*.

Sanchez, T. W. (1999). "The Connection between Public Transit and Employment: The Cases of Portland and Atlanta", *Journal of the American Planning Association*, *65*(3), 284-296.

Sanchez, T. W., Shen, Q., & Peng, Z. R. (2004). "Transit Mobility, Jobs Access and Low-Income Labour Participation in US Metropolitan Areas", Urban Studies, 41(7), 1313-1331.

Schlosser, A. (2006). "Public Preschool and the Labor Supply of Arab Mothers: Evidence from a Natural Experiment", Economic Quarterly, Booklet 3, pp. 517–553.

Suhoy, T. and Sofer, Y. (2019). "Getting to Work in Israel: Locality and Individual Effects", Discussion Paper 2019.02 (in Hebrew; English translation forthcoming), Discussion Paper Series, Bank of Israel.

Tyndall, J. (2017). "Waiting for the R Train: Public Transportation and Employment", Urban Studies, 54(2), 520-537.

Yashiv, E. and Kasir, N. (2012). "Arab Women in the Israeli Labor Market: Characteristics and Policy Proposals", Discussion Paper 2012.05, Discussion Paper Series, Bank of Israel.

Yashiv, E. and Kasir, N. (2013). "The Labor Market of Israeli Arabs: Key Features and Policy Solutions", Tel Aviv University.

Yi, C. (2006). "Impact of Public Transit on Employment Status: Disaggregate Analysis of Houston, Texas", Transportation Research Record: Journal of the Transportation Research Board, 1986(1), 137-144.

Appendix

Table A.1
List of the main variables

Individual data		Locality data	
Variable	**Source**	**Variable**	**Source**
Gender	Central Bureau of Statistics (CBS)	Population	CBS
Age	CBS	Locality religion	CBS
Religion (grouped)	CBS	Number of bus trips	Adalya - Public Transportation
Population group	CBS	Number of bus lines	Adalya - Public Transportation
Family status	CBS	Coverage ratio	Adalya - Public Transportation
Number of children	CBS	Public transportation cluster	Adalya - Public Transportation
Number of children up to age 2	CBS	Year Ryan employment center was opened	Deutsche and partners (Brookdale Institute)
Residential locality	CBS	Number registered in childcare system	Ministry of the Economy
Month started work	CBS		
Year started work	CBS		
Total months of work	CBS		
Total income	CBS		
Use value of car	CBS		
Years of schooling	CBS		
Highest degree earned	CBS		
Motorcycle license	CBS		
Private vehicle license	CBS		
Number of vehicles owned	CBS		
Type of vehicle owned	CBS		

Table A.2
Cumulative effect of public transportation on employment, by gender and employment status

Sample population	(1)	(2)	(3)	(4)
	Men		**Women**	
Public transportation in locality[a]	-0.004	-0.005	0.007	-0.014
	(0.008)	(0.009)	(0.009)	(0.015)
Public transportation[a] * No access to private vehicle[b]		0.003		0.028
		(0.017)		(0.017)
Married	0.072***	0.073***	-0.020	-0.021
	(0.015)	(0.015)	(0.014)	(0.015)
Number of children under age 2	-0.002	-0.002	-0.080***	-0.080***
	(0.008)	(0.008)	(0.010)	(0.010)
R^2	0.005	0.005	0.021	0.021
Number of observations	9,266	9,266	11,762	11,762
	Only men who were unemployed in 2011		**Only women who were unemployed in 2011**	
Public transportation in locality[a]	0.002	0.004	0.001	0.019
	(0.019)	(0.027)	(0.011)	(0.028)
Public transportation[a] * No access to private vehicle[b]		-0.009		-0.026
		(0.030)		(0.031)
Married	0.130***	0.118***	0.034	0.025
	(0.036)	(0.034)	(0.023)	(0.022)
Number of children under age 2	0.048***	0.043**	-0.090***	-0.092***
	(0.018)	(0.018)	(0.016)	(0.015)
R^2	0.266	0.277	0.211	0.226
Number of observations	2,557	2,557	6,513	6,513
	Only men who were employed in 2011		**Only women who were employed in 2011**	
Public transportation in locality[a]	-0.010	-0.012	0.020	-0.029
	(0.006)	(0.009)	(0.016)	(0.021)
Public transportation[a] * No access to private vehicle[b]		0.003		0.069***
		(0.025)		(0.022)
Married	0.064***	0.059***	-0.002	-0.023
	(0.016)	(0.015)	(0.020)	(0.019)
Number of children under age 2	-0.007	-0.008	-0.043***	-0.047***
	(0.008)	(0.008)	(0.011)	(0.011)
R^2	0.091	0.094	0.084	0.093
Number of observations	6,709	6,709	5,249	5,249

Standard deviations are in parentheses. * indicates significance at the 10% level, ** indicates significance at the 5% level, *** indicates significance at the 1% level. In each column, the dependent variable is the individual's employment status, and all of them include control variables for family status, fixed effects, year effects, and interaction variables between the year effects and access to a private vehicle in 2010.

[a] Public transportation in a locality is defined as the number (in hundreds) of buses that pass near the locality on a representative day during the year.

[b] A married woman has access to a private vehicle if she has a driver's license and she and her spouse combined have at least two cars. For unmarried women and for men, we defined access to a private vehicle as their having a driver's license and they have the use of at least one car (together with the spouse, for a married man).

Table A.3

The effect of public transportation on employment, by gender, employment status, and selected characteristics at the locality level

Sample population	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Men				**Women**			
	Small localities (less than 2,000 people)		North district		Small localities (less than 2,000 people)		North district	
	✓	×	✓	×	✓	×	✓	×
	Only men who were unemployed in 2011				**Only women who were unemployed in 2011**			
Public transportation in locality[a]	-0.057*	-0.023	-0.010	-0.040	-0.006	0.011	0.027	-0.010
	(0.029)	(0.027)	(0.036)	(0.033)	(0.101)	(0.024)	(0.044)	(0.030)
Public transportation[a] * No access to private vehicle[b]	0.041	0.034	0.026	0.031	-0.010	-0.020	-0.038	0.001
	(0.049)	(0.025)	(0.038)	(0.029)	(0.104)	(0.023)	(0.045)	(0.029)
R^2	0.122	0.120	0.121	0.122	0.087	0.098	0.095	0.095
Number of observations	606	1,951	1,966	591	1,818	4,695	4,877	1,636
	Only men who were employed in 2011				**Only women who were employed in 2011**			
Public transportation in locality[a]	-0.010	-0.009	-0.013	-0.006	-0.002	-0.026	-0.052**	0.024
	(0.010)	(0.007)	(0.010)	(0.006)	(0.017)	(0.025)	(0.020)	(0.034)
Public transportation[a] * No access to private vehicle[b]	0.013	-0.006	0.000	-0.007	0.031	0.034	0.054***	0.000
	(0.029)	(0.023)	(0.017)	(0.036)	(0.023)	(0.023)	(0.018)	(0.034)
R^2	0.030	0.029	0.031	0.024	0.035	0.034	0.035	0.036
Number of observations	1,758	4,951	5,080	1,629	1,313	3,936	4,156	1,093

Standard deviations are in parentheses. * indicates significance at the 10% level, ** indicates significance at the 5% level, *** indicates significance at the 1% level.
In each column, the dependent variable is the individual's employment status, and all of them include control variables for family status, fixed effects, year effects, and interaction variables between the year effects and access to a private vehicle in 2010.

[a] Public transportation in a locality is defined as the number (in hundreds) of buses that pass near the locality on a representative day during the year.

[b] A married woman has access to a private vehicle if she has a driver's license and she and her spouse combined have at least two cars. For unmarried women and for men, we defined access to a private vehicle as their having a driver's license and they have the use of at least one car (together with the spouse, for a married man).

Table A.4
The effect of public transportation on women's employment at ages 20–35 who worked in 2011, selected groups

Sample population	(1) Total	(2) Without children under age 2 (in the entire period)	(3) Married women (in the entire period) ×	(4) Married women (in the entire period) ✓	(5) Muslim women ×	(6) Muslim women ✓	(7) 12+ years of schooling ×	(8) 12+ years of schooling ✓	(9) 12+ years of schooling of spouse ×	(10) 12+ years of schooling of spouse ✓	(11) Spouse's access to private vehicle (in 2010) ×	(12) Spouse's access to private vehicle (in 2010) ✓	(13) Monthly wage over NIS 4,000 (in 2011) ×	(14) Monthly wage over NIS 4,000 (in 2011) ✓
Public transportation in locality[a]	-0.011	-0.014	-0.008	-0.026	-0.004	-0.01	-0.06	-0.01	0.002	-0.034	0.021	-0.055	-0.005	-0.017
	(0.024)	(0.029)	(0.023)	(0.036)	(0.037)	(0.027)	(0.096)	(0.025)	(0.025)	(0.042)	(0.022)	(0.035)	(0.022)	(0.032)
Public transportation[a] * No access to private vehicle[b]	0.027	-0.017	-0.073	0.06	0.006	0.03	0.017	0.029	0.052	0.051	-0.018	0.080**	0.026	0.031
	(0.026)	(0.038)	(0.045)	(0.037)	(0.074)	(0.028)	(0.119)	(0.027)	(0.042)	(0.042)	(0.034)	(0.037)	(0.025)	(0.036)
R^2	0.030	0.017	0.018	0.037	0.028	0.032	0.059	0.025	0.049	0.027	0.033	0.029	0.026	0.036
Number of observations	3,142	1,170	697	2,105	765	2,379	461	2,634	738	1,672	1,684	1,458	1,324	1,818
Only localities with a notable increase in number of trips														
Public transportation in locality[a]	-0.006	-0.014	0.004	-0.020	-0.003	-0.002	-0.016	-0.008	0.022	-0.025	0.024	-0.047	0.002	-0.016
	(0.025)	(0.031)	(0.026)	(0.038)	(0.038)	(0.029)	(0.101)	(0.027)	(0.027)	(0.045)	(0.024)	(0.038)	(0.024)	(0.034)
Public transportation[a] * No access to private vehicle[b]	0.035	-0.017	-0.076	0.067*	0.028	0.033	-0.007	0.036	0.063	0.050	0.010	0.070*	0.024	0.048
	(0.028)	(0.040)	(0.046)	(0.039)	(0.084)	(0.030)	(0.125)	(0.029)	(0.045)	(0.045)	(0.031)	(0.040)	(0.027)	(0.038)
R^2	0.034	0.017	0.020	0.042	0.030	0.037	0.069	0.028	0.063	0.028	0.039	0.030	0.028	0.041
Number of observations	2,534	938	549	1,707	751	1,785	360	2,134	566	1,394	1,359	1,175	1,098	1,436
Only localities with a notable increase in number of trips and the coverage ratio in them was at least 10 percent														
Public transportation in locality[a]	0.013	0.010	0.008	0.015	-0.007	0.025	0.012	0.014	0.014	0.011	0.038	-0.028	0.024	-0.003
	(0.027)	(0.035)	(0.035)	(0.034)	(0.041)	(0.031)	(0.214)	(0.027)	(0.037)	(0.035)	(0.031)	(0.029)	(0.019)	(0.049)
Public transportation[a] * No access to private vehicle[b]	0.012	-0.047	-0.130*	0.027	0.021	0.009	-0.112	0.014	0.055	0.024	0.003	0.032	0.005	0.029
	(0.029)	(0.053)	(0.068)	(0.032)	(0.085)	(0.031)	(0.197)	(0.031)	(0.058)	(0.039)	(0.046)	(0.038)	(0.029)	(0.048)
R^2	0.031	0.020	0.024	0.039	0.028	0.037	0.087	0.026	0.056	0.030	0.042	0.023	0.027	0.038
Number of observations	1,654	624	362	1,095	685	971	171	1,465	326	949	877	777	747	907

Standard deviations are in parentheses. * indicates significance at the 10% level, ** indicates significance at the 5% level, *** indicates significance at the 1% level.

In each column, the dependent variable is the individual's employment status, and all of them include control variables for family status, fixed effects, year effects, and interaction variables between the year effects and access to a private vehicle in 2010.

[a] Public transportation in a locality is defined as the number (in hundreds) of buses that pass near the locality on a representative day during the year.

[b] A married woman has access to a private vehicle if she has a driver's license and she and her spouse combined have at least two cars. For unmarried women and for men, we defined access to a private vehicle as their having a driver's license and they have the use of at least one car (together with the spouse, for a married man).

Table A.5

The effect of public transportation on women's employment at ages 30–50 who worked in 2011, by schooling and wage levels

Sample population	(1)	(2)	(3)	(4)
	All the women in the group		Only educated women with 12+ years of schooling	
Average monthly salary over NIS 6,500	×	✓	×	✓
Public transportation in locality[a]	-0.026	0.005	-0.053	0.005
	(0.045)	(0.007)	(0.046)	(0.007)
Public transportation[a] * No access to private vehicle[b]	0.048	0.004	0.097**	0.004
	(0.043)	(0.009)	(0.045)	(0.010)
R^2	0.040	0.005	0.029	0.006
Number of observations	2,154	799	1,034	748
	Only localities with a notable increase in number of trips			
Public transportation in locality[a]	-0.011	0.005	-0.038	0.006
	(0.048)	(0.007)	(0.049)	(0.007)
Public transportation[a] * No access to private vehicle[b]	0.052	0.003	0.099**	0.003
	(0.045)	(0.009)	(0.047)	(0.010)
R^2	0.047	0.005	0.035	0.007
Number of observations	1,647	651	817	611
	Only localities with a notable increase in number of trips and the coverage rate in them was at least 10 percent			
Public transportation in locality[a]	-0.001	0.007	-0.008	0.007
	(0.061)	(0.008)	(0.049)	(0.008)
Public transportation[a] * No access to private vehicle[b]	0.038	0.005	0.079*	0.007
	(0.057)	(0.012)	(0.047)	(0.013)
R^2	0.043	0.007	0.036	0.009
Number of observations	1,063	520	607	489

Standard deviations are in parentheses. * indicates significance at the 10% level, ** indicates significance at the 5% level, *** indicates significance at the 1% level. In each column, the dependent variable is the individual's employment status, and all of them include control variables for family status, fixed effects, year effects, and interaction variables between the year effects and access to a private vehicle in 2010.

[a] Public transportation in a locality is defined as the number (in hundreds) of buses that pass near the locality on a representative day during the year.

[b] A married woman has access to a private vehicle if she has a driver's license and she and her spouse combined have at least two cars. For unmarried women and for men, we defined access to a private vehicle as their having a driver's license and they have the use of at least one car (together with the spouse, for a married man).

Table A.6

The effect of public transportation on employment - various definitions of access to private vehicle

Definition of access to private vehicle	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Men, ages 40–64, who did not work in 2011			**Educated women, ages 30–50, who worked in 2011**			
	Had access in	Had access in	Access in both years	Had access in	Had access in	Access in both years	Had access in 2010, by men's definition
Public transportation in locality[a]	-0.033	-0.027	-0.029	-0.005	0.000	0.006	0.014
	(0.022)	(0.022)	(0.026)	(0.023)	(0.027)	(0.030)	(0.019)
Public transportation[a] * No access to private vehicle[b]	0.073**	0.066**	0.076**	0.061**	0.052**	0.077**	0.054
	(0.029)	(0.028)	(0.034)	(0.024)	(0.024)	(0.034)	(0.039)
R^2	0.068	0.066	0.072	0.025	0.024	0.027	0.027
Number of observations	1,194	1,194	741	1,096	1,096	660	1,096

Standard deviations are in parentheses. * indicates significance at the 10% level, ** indicates significance at the 5% level, *** indicates significance at the 1% level. In each column, the dependent variable is the individual's employment status, and all of them include control variables for family status, fixed effects, year effects, and interaction variables between the year effects and access to a private vehicle in 2010.

[a] Public transportation in a locality is defined as the number (in hundreds) of buses that pass near the locality on a representative day during the year.

[b] A married woman has access to a private vehicle if she has a driver's license and she and her spouse combined have at least two cars. For unmarried women and for men, we defined access to a private vehicle as their having a driver's license and they have the use of at least one car (together with the spouse, for a married man).

Table A.7
The effect of public transportation on employment - various definitions of employment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Minimum number of months of work in the year to be defined as employed	1	2	3	4	6	9	12
	Educated women, ages 30–50, who worked in 2011						
Public transportation in locality[a]	-0.019	-0.001	-0.005	-0.003	0.011	-0.007	-0.015
	(0.015)	(0.019)	(0.023)	(0.023)	(0.021)	(0.021)	(0.028)
Public transportation[a] * No access to private vehicle[b]	0.061**	0.057**	0.061**	0.056**	0.031	0.055**	0.089**
	(0.024)	(0.025)	(0.024)	(0.025)	(0.020)	(0.026)	(0.036)
R^2	0.041	0.030	0.025	0.022	0.017	0.016	0.057
Number of observations	1,096	1,096	1,096	1,096	1,096	1,096	1,096
	Men, ages 40–64, who were not employed in 2011						
Public transportation in locality[a]	-0.037**	-0.036*	-0.033	-0.027	-0.024	-0.022	-0.008
	(0.019)	(0.020)	(0.022)	(0.021)	(0.019)	(0.021)	(0.020)
Public transportation[a] * No access to private vehicle[b]	0.080***	0.082***	0.073**	0.072**	0.070***	0.062**	0.028
	(0.025)	(0.027)	(0.029)	(0.030)	(0.025)	(0.028)	(0.023)
R^2	0.072	0.069	0.068	0.062	0.058	0.054	0.046
Number of observations	1,194	1,194	1,194	1,194	1,194	1,194	1,194

Standard deviations are in parentheses. * indicates significance at the 10% level, ** indicates significance at the 5% level, *** indicates significance at the 1% level.
In each column, the dependent variable is the individual's employment status, and all of them include control variables for family status, fixed effects, year effects, and interaction variables between the year effects and access to a private vehicle in 2010.

[a] Public transportation in a locality is defined as the number (in hundreds) of buses that pass near the locality on a representative day during the year.

[b] A married woman has access to a private vehicle if she has a driver's license and she and her spouse combined have at least two cars. For unmarried women and for men, we defined access to a private vehicle as their having a driver's license and they have the use of at least one car (together with the spouse, for a married man).

Table A.8
The effect of public transportation on employment - various definitions of educated woman

Minimum threshold for educated woman	(1) 11 years of schooling	(2) 12 yeasr of schooling	(3) 13 yeasr of schooling	(4) High school matriculation diploma	(5) Bachelors degree
	Educated women, ages 30–50, who worked in 2011				
Public transportation in locality[a]	-0.005	-0.005	0.003	0.007	-0.002
	(0.023)	(0.023)	(0.013)	(0.020)	(0.014)
Public transportation[a] * No access to private vehicle[b]	0.056**	0.061**	0.038	0.055**	0.040
	(0.024)	(0.024)	(0.034)	(0.022)	(0.032)
R^2	0.026	0.025	0.021	0.025	0.019
Number of observations	1,162	1,096	641	1,050	590

Standard deviations are in parentheses. * indicates significance at the 10% level, ** indicates significance at the 5% level, *** indicates significance at the 1% level.
In each column, the dependent variable is the individual's employment status, and all of them include control variables for family status, fixed effects, year effects, and interaction variables between the year effects and access to a private vehicle in 2010.

[a] Public transportation in a locality is defined as the number (in hundreds) of buses that pass near the locality on a representative day during the year.

[b] A married woman has access to a private vehicle if she has a driver's license and she and her spouse combined have at least two cars. For unmarried women, we defined access to a private vehicle as their having a driver's license and they have the use of at least one car.

Table A.9

The effect of public transportation on the number of months of work for those who worked in 2011, by gender and age group

Age group	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Men				Women			
	20-64	20-35	30-50	40-64	20-64	20-35	30-50	40-64
Public transportation in locality[a]	-0.030	-0.013	-0.060	-0.036	-0.069	0.111	-0.071	-0.618
	(0.091)	(0.103)	(0.125)	(0.173)	(0.200)	(0.207)	(0.251)	(0.699)
Public transportation[a] * No access to private vehicle[b]	0.035	0.227	0.008	-0.223	0.207	0.062	0.361	0.683
	(0.209)	(0.258)	(0.288)	(0.312)	(0.218)	(0.300)	(0.279)	(0.585)
R^2	0.018	0.008	0.023	0.042	0.027	0.031	0.024	0.035
Number of observations	6,709	3,836	3,669	2,068	5,249	3,142	2,953	1,424

Standard deviations are in parentheses. * indicates significance at the 10% level, ** indicates significance at the 5% level, *** indicates significance at the 1% level. In each column, the dependent variable is the individual's employment status, and all of them include control variables for family status, fixed effects, year effects, and interaction variables between the year effects and access to a private vehicle in 2010.

[a] Public transportation in a locality is defined as the number (in hundreds) of buses that pass near the locality on a representative day during the year.

[b] A married woman has access to a private vehicle if she has a driver's license and she and her spouse combined have at least two cars. For unmarried women and for men, we defined access to a private vehicle as their having a driver's license and they have the use of at least one car (together with the spouse, for a married man).

Table A.10

The effect of public transportation on educated women, ages 30–50, who worked in 2011—selected outcome variables

Dependent variable	(1)	(2)	(3)	(4)
	Monthly wage	Annual wage	Spouse's employment	Spouse's wage
Public transportation in locality[a]	-60.3	763	0.018	-6,478
	(316.5)	(3,063)	(0.026)	(11,874)
Public transportation[a] * No access to private vehicle[b]	-17.1	2,882	-0.068	6,309
	(351.4)	(3,312)	(0.054)	(13,046)
R^2	0.112	0.136	0.030	0.024
Number of observations	1,096	1,096	993	993

Standard deviations are in parentheses. * indicates significance at the 10% level, ** indicates significance at the 5% level, *** indicates significance at the 1% level. In each column, the dependent variable is the individual's employment status, and all of them include control variables for family status, fixed effects, year effects, and interaction variables between the year effects and access to a private vehicle in 2010.

[a] Public transportation in a locality is defined as the number (in hundreds) of buses that pass near the locality on a representative day during the year.

[b] A married woman has access to a private vehicle if she has a driver's license and she and her spouse combined have at least two cars. For unmarried women, we defined access to a private vehicle as their having a driver's license and they have the use of at least one car.