The impact of investment in transport infrastructure on employment: the case of Israel

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Abstract

Policy makers make decisions on public investments based on the contribution of investment to the economy, inter alia, the contribution of investment to employment growth. However, examination of these contributions is usually based on short-term impact, i.e. direct employment resulting from project implementation. In contrast, the long-term effects do not receive significant attention. In this article, i examine the effect of investment in transportation on both short- and long-term employment. The long-term effects of such investment are far more significant than those in the short term and therefore should be central to policy makers' considerations.

The direct employment effects were examined through input-output tables, while the extensive employment effects were examined using an econometric model. The results indicate that the extensive long-term effects are 12 times greater than the direct short-term effects or more (the calculation was done for 50 years). The resulting cost-benefit ratio of the total effects was 1:6.6, indicating high profitability. The high returns received by the model are to some extent a result of Israel's relatively low capital stock of transport infrastructure.

Keywords: econometric model; employment; infrastructure; investment; transport

1. Introduction

The question whether transport infrastructure investments promote wider economic benefits continues to cause debate and controversy in economic science (Banistera and Berechman, 2001; Knaap and Oosterhaven, 2003; Vickerman, 2007). This debate is not over direct transport benefits, such as savings in travel time, but revolves around whether such investments lead to additional economic benefits, and if so, how to measure these benefits (Banistera and Berechman, 2001). Periods of prolonged economic downturn may lead governments to reduce expenditures on public infrastructure investment, such as transport infrastructure, more than other types of spending. Yet, postponement or cancellation of such investment projects may affect total economic output. Investment in transportation infrastructure may play a role in

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reducing the impact of economic crisis through immediate job creation, while building the basis for achieving fast-paced growth when the crisis subsides (Lavee et al 2011). Empirical studies have made substantial attempts over the past decades to examine whether transport infrastructure investments can create broader job opportunities within an economy; these studies provide mixed and inconclusive evidence (Jiwattanakulpaisarn, 2008). Policy makers usually base decisions on short-term impact, focusing on direct employment resulting from project implementation. In contrast, the long-term effect of such investment does not receive significant attention, even though the primary incentive for economic development should be permanent long-term employment gain. Some policy makers have already examined long-term impacts.

According to Forkenbrock and Plazak (1986), one of the main aims of economic development-related highway programmes in several states in the U.S. was to attract and maintain employment-generating activities. Similarly, transport investment strategies were implemented in the United Kingdom and continental Europe to encourage job opportunities, particularly in disadvantaged regions (Hart, 1993). However, the debate regarding the impact of transport infrastructure on jobs, and especially the long-term impact, may cast some doubt on proposals by policy makers advancing transport infrastructure expansion (Jiwattanakulpaisarn, 2007, Iacono & Levinson 2016). Although political interest in transport infrastructure for employment growth has remained high, direct use of empirical evidence for supporting particular investment decisions and determining transport policies has remained rather limited (Jiwattanakulpaisarn, 2008).

Jiwattanakulpaisarn (2010) claims that in the short-term, highway development projects generate temporary jobs. However, since government funds are used in majority of highway projects, those jobs could have been created by public investment in any other sector.

Chakrabarti (2018) analyzed changes in non-agricultural private sector employment over a 10-year period (2003–2012) across 25 states in India in response to changes in the density of national highways. He found that 10% increase in national highway density in India is associated with 1–6% increase in private sector employment, all else equal. His research provides empirical evidence that transport infrastructure has positive impact on jobs.

Israel is among the most densely populated countries in the world in terms of number of cars per kilometer-paved road. The number of vehicles in Israel has increased during the last decade by more than 50%, and the extent of car travel has also increased with this growth, causing considerable congestion on the roads. The cost of congestion to the Israeli economy, manifested mainly in loss of time, is conservatively estimated to be about 14 billion NIS[2] per year (Economic policy and budget policy for 2011-2012). This cost, together with Israel's limited territory and the physical difficulties involved

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[2] USA Dollar was 3.8557 NIS according to the average annual rate of 2012 (Source: Israel Central Bureau of Statistics, Foreign Exchange Rates 2012.
http://www.cbs.gov.il/www/hodaot2013n/16_13_001e.pdf)

in a significant expansion of the road network, has direct implications for strategic planning of the transportation system for years to come and requires immediate planning (The Samuel Neaman Institute, 2011). Israel's small size makes it easier to build the necessary transportation infrastructure and bear the related costs, yet the level of investment in transportation infrastructure as a percentage of GDP is lower in Israel than in other countries (Lavee et al 2011).

The aim of this study is to examine the impact of transport infrastructure investment on two types of employment effects: 1. The impact on direct short-term employment during the establishment and operation of the project—common to all infrastructure projects; and 2. The impact on extensive long-term employment as a result of transport development projects—unique to transport projects. This paper contributes to the current state of empirical knowledge on the causal linkages between transport infrastructure investment and employment by running a simulation on the Israel Data.

In addition, I compare the effects of investment on short-term employment with long-term effects. Because government policy in many countries, is based only on short-term effects, it is important to show that long-term effects have a far more significant impact then short-term effects, so decision-making needs to change and take these effects into account.

The paper continues as follows: The next section reviews the literature. Section 3 presents our empirical model, and section 4 presents our empirical analysis based on data from Israel. Section 5 concludes the paper.

2. Literature review

2.1. The effect of transportation infrastructure investment on employment

Since the influential work of Aschauer (1989) on the effects of public capital on output, many empirical studies have examined the relationships between transportation capital investment and economic development. Many studies have found that employment is positively affected by road infrastructure capital (Clark and Murphy, 1996; Dalenberg, Partridge and Rickman, 1998; Lombard, Sinha and Brown, 1992; Mills and Carlino, 1989), government expenditure on roads (Carroll and Wasylenko, 1994; Crane, Burke and Hanks, 1991; Islam, 2003; Jones, 1990), and accessibility of highways (Boarnet, 1994; Luce, 1994).

Transportation infrastructure has three main effects on the labor market (Department for Transport, 2005): 1. People choosing to work as a result of the savings in travel time and costs; 2. People choosing to work overtime as a result of spending less time traveling to and from work; and 3. Workplaces relocating due to convenient transportation access to firms and workers.

Apart from these effects, which permanently affect the employment market, there is an additional temporary effect, since construction, operation and maintenance of transport infrastructure affects employment through job creation and job relocation (OECD, 2002).

Some studies found that transportation investments cause long-term employment growth in the industrial and service sectors; however, in the construction sector, employment benefits exist only in the short term (Chandra and Thompson, 2000; Crane et al., 1991; Rephann and Isserman, 1994;). A study conducted in the Netherlands indicates infrastructure investment has a strong effect on direct and indirect employment, but this is only a short-term effect (Bruinsma, Nijkamp and Rietveld, 1989).

Studies examining the impact of transport infrastructure investment on employment usually divide the effects into short-term effects on employment, due to infrastructure planning, establishment, management, maintenance and operation, and long-term or permanent effects, such as shortening travel time to work, development of industrial zones, trade and services, etc.

However, some studies found that the effects on employment are not significant (Clark and Murphy, 1996; Duffy-Deno, 1998; Eagle and Stephanedes, 1987; Thompson, Weller and Terrie, 1993). In a study conducted in North Carolina between the years 1985 and 1997, the researchers did not find that improvements to main roads affected employment (Jiwattanakulpaisarn, Noland, Graham and Polak, 2009). Moreover, several studies found that an increase in capital roads (Pereira, 2000) or in public expenditure on roads (Dalenberg and Partridge, 1995; Lombard et al., 1992) could lead to reduced demand for labor.

2.2. Estimation methods

Various studies have used different methods to estimate the effects of infrastructure investment, including the use of input–output tables, econometric models and cost functions. Following we examine the main methods that are used to estimate the short-term and long-term employment effects.

2.2.1 Short-term estimation methods

The use of input-output tables is a common method to estimate the short-term direct and indirect employment expected as a result from infrastructure construction and operation. This method illustrates the interrelationships between industries in the production process, tracing all inputs that go into producing a given output (Levine, 2008; Litman, 2009). Thus, by estimating the number of direct workers to be employed in a project, it is possible to calculate additional effects of the investment. Due to high costs of input-output modeling, it is accepted to draw from available data to examine a particular situation (Litman, 2009). In this manner, for instance, the U.S. Federal Highway Administration estimated that $1 billion of Federal highway expenditure supported on average 30,000 jobs in 2007 (FHWA, 2008). Similarly, a study conducted in Victoria, Australia, estimated the direct effect of infrastructure construction on employment (Dixon, 2009). Using an average output per employee in the construction industry showed that an increase of $8.5 billion USD in construction output is expected to generate about 20,000 jobs.

A different method was developed by the Ministry of Transport in Germany. In this method, the effects on employment as a result of the infrastructure construction are measured, and then the impact on infrastructure maintenance employment is measured (Birn, Bolik and Rieken, 2005). The effect is estimated by using several equations with parameter values based on data from projects in Germany. According to this estimation method, on average, an investment of €100 million will lead to 2,350 years of work, of which 40% (940 years of work) are expected in the project area. Both the American and the German models refer to the narrow effects of construction projects, and do not take into account the existence of broader impacts on employment.

An additional, more comprehensive methodology, was developed in the U.S. for estimating the effect of the construction of road infrastructure on employment and assessing the macroeconomic impact of employment (OECD, 2002). The methodology refers to three main employment effects: 1. Direct effects—on the highway construction industry and related sectors which supply construction materials and equipment; 2. Indirect effects—income and employment benefits from other production sectors of the economy that expand output and employment to meet the project's demand; and 3. Induced employment—income expenditures of construction and other production sector employees, directly traceable to project spending for construction materials and services. The main contribution of this U.S. study is the greater detail available to input-output accounts, due to expanding the number of industries that provide road and highway construction services. The employment effects for expenditures of 1 billion USD in worker years were 11,059 for direct employment, 12,493 for indirect employment and 18,694 for induced employment.

Another method—the effect method—was developed and applied to transport projects in France (OECD, 2002). This method's objective is to estimate the project's impact on additional domestic intermediary consumption and the additional value added, thus allowing estimation of the number of jobs affected. This assessment takes into account employment during construction, in terms of maintenance work and new jobs created. The examined variable is the number of full-time jobs throughout the project. There is a division for several types of jobs: direct employment, associated with the site and the head office; indirect employment, associated to the manufacturing of site supplies; employment associated to construction supply; and employment associated to distributed revenues. The employment effects for expenditures of 1USD billion in worker years were 7,940 for direct employment, 8,070 for indirect employment and 5,250 for induced employment (a total of 21,260 worker years).

The methods presented in this section quantify the employment that would derive from the project; however, the methods do not refer to the period in which the increase in employment is expected to occur.

2.2.2 Long-term estimation methods

Employment elasticity of growth

When discussing transportation projects, it is likely that other activities will benefit from improvement in transportation efficiency following the completion of the project

(Das, 2006). The employment effect of economic growth, or employment elasticity of growth, is measured as employment growth with respect to GDP growth. Many studies have examined the relationship between GDP and employment through several estimation methods.

A study conducted in the U.S. by Seyfried (2005) found that the elasticity of employment to GDP is 0.47 for the U.S. The relationship was assessed by examining the effect of GDP on labor demand, since this demand determines the equilibrium in the labor market. A study conducted in Korea between the years 1971 and 2005 examined the impact of transport infrastructure on the increase in the number of employees and GDP by employing an equilibrium labor market model (Choi, 2007). According to the findings of Choi, employment elasticity to GDP in those years ranged between -0.35 and 0.49. A study published by the International Labor Office in Geneva (Jha, 2009) examined the net effects of GDP on employment in both developed and developing countries. It was found that in most countries, the general elasticity for all sectors of the economy is positive, ranging from 0.1 to 0.7. That is, when there is an increase in GDP, employment growth also exists, albeit at a lower rate (Das, 2006). According to Chen and Cui (2005), the employment elasticity to GDP in several developed economies is relatively low. In Japan, for example, the elasticity is 0.08, in Germany, France and Italy, elasticity is 0.06, and in the UK elasticity stands at 0.05.

Walterskirchen (1999) examined two major effects in the EU: the relationship between economic growth and change in employment, and the relationship between changes in employment and unemployment rates. To this end, two estimation methods were used: 1. Time series analysis for individual EU countries; and 2. Panel data for a cross-country analysis of EU countries from 1988–1998. The findings showed a strong positive correlation between growth in GDP and changes in employment for both estimation methods. For the cross-country analysis, an employment elasticity of 0.65 was found, while for the time series analysis for individual EU country, an employment elasticity of 0.8 was found.

In a study conducted in Israel, Shaharabani (2008) examined the effect of infrastructure capital on the productivity of twenty-three manufacturing industries in Israel, based on annual series for the years 1990–2003. Shaharabani (2008) estimated the elasticity of GDP to infrastructure (transportation and communications) at 0.125.

Although the range of economic growth effects measured by the different studies discussed here varies, the positive elasticity between transportation investment and economic development is commonly accepted. It should be noted that the calculation of employment elasticity with respect to GDP does not take into consideration additional effects on employment, such as wages and technological improvements (Das, 2006). Hence, estimating employment elasticity by using historical data on employment and growth is not completely accurate, as it is possible and even likely that some data affecting the elasticity are not taken into account by this method (Kapsos, 2005).

Econometric regressions

Several studies carried out empirical estimation using econometric methods, estimating the effect of various macroeconomic variables on the level of employment, allowing estimation of changes in employment correlated with the growth of these variables in different time horizons. Studies based on econometric methods examine the rate of change or elasticity of the employment as a result of changes in transportation infrastructure while the other variables remain constant (Jiwattanakulpaisarn, 2008; Plaut and Pluta, 1983).

A publication of The World Bank (Rutkowski and Scarpetta, 2005) presents a regression for estimating growth in employment, while addressing parameters such as growth in GDP in the same period, interest rate, budget surplus and dummy variables, taking into account two periods—before 1997 and after 1997—to address the effects of the recession caused by the financial crisis in Russia in 1998. In the late forties, Verdoorn (1949) published a study which found a linear relationship between the increase in industrial production and productivity in the long run. The elasticity efficiency relative to industrial output was 0.45. A study conducted in the U.S. used econometric models to examine the impact of transportation infrastructure on employment from 1985 to 1997; however, effects on employment were not found (Jiwattanakulpaisarn et al., 2009).

3. The empirical model

The process of constructing the model for estimating the effect of transport infrastructure investment projects on employment included selecting and setting the relevant parameters, data collection for the selected parameters, data analysis and processing, data characterization based on professional knowledge and statistical and econometric models, and the use of input-output tables.

The methodology refers to two effects of transport infrastructure investment on employment: 1. Direct effects on temporary employee, resulting from establishing and operating the project, estimated in terms of "years of work", and 2. Extensive long-term employment effects, resulting from transportation project development, estimated in terms of the number of jobs.

3.1. Direct employment effect

This effect includes employment effects during construction, operation and maintenance of the project and mainly affects the infrastructure employment sector, offices of management, planning and supervision, as well as the industries providing construction materials. This effect is broad and can extend through time and space, but is considered mainly as a temporary effect. The estimation method for this effect was based on input-output tables and provides indication of jobs produced directly from the project.

When considering the direct employment resulting from the project, we should examine whether there are net employment benefits—that is, relative to a situation in which the

investment was allocated elsewhere. In addition, whether new jobs are created should be examined, and whether the new jobs were transferred from elsewhere—if so, there is no benefit to the overall economy from a macro perspective. During the infrastructure establishment, there are many associated short-term jobs. Hiring a worker for building infrastructure that had not previously been employed constitutes a new job, while employing workers from local companies does not constitute the creation of a new job (OECD, 2002).

In order to estimate the employment which is expected to result from transport infrastructure establishment and operation, input-output tables of Israel were used (CBS, 1995).

Calculations were conducted similarly to those in a number of studies in the field (Becker, Fishman and Sheinfeld, 2005; Marmor and Avriel, 1977). The number of employees added to the economy was calculated by dividing the value of the added job by the average annual salary for an employee. The calculation results reflect the expected years of work received as a result of the investment. The methodology for estimating the employment resulting from establishment and operation is shown in Figure 1.
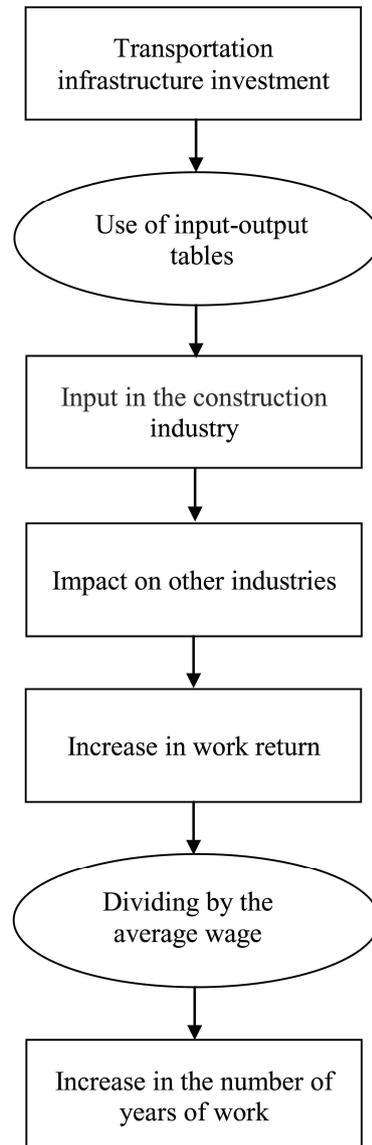
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Figure 1 The methodology for estimating the change in employment following the establishment and operation of transportation infrastructure projects

3.2. Extensive employment effects

Improving accessibility and upgrading and opening access roads allow efficient and wider resources use (human capital, raw materials, etc.), positively influencing employment. This effect is relevant only to transport infrastructure investments, since the increase in the employment scope stems from development project created by transportation.

Estimating the overall impact of transportation development on employment includes both the effect of transportation infrastructure on GDP and estimating the GDP impact on employment. As mentioned in the literature review, the impact of transportation infrastructure on GDP was previously examined by Shaharabani (2008). Therefore, the

results of Shaharabani (2008) were utilized to estimate the effect of GDP on employment.

According to the literature review, the common estimation method for examining the effect of GDP on employment is estimating the elasticity, which has two accepted forms. The first method is a simple division of the change of employment by the change in GDP; however, various studies noted that this method is not accurate since it does not take into account the effects of other parameters, such as salary, technological improvements, etc., on employment (Das, 2006; Kapsos, 2005). The second method, which was used in this study and is described below, is more complex, calculating the elasticity using an econometric equation. With this method, parameters that can affect the level of employment (such as wages) can be added to the equation, thus obtaining a more accurate result. Since the estimation includes the overall impact of transportation development on employment, the direct effect resulting from building and operating the project, estimated in section 3.1, is subtracted.

3.2.1 The econometric model

Our econometric model focuses on the estimation of the employment function related to GDP and wage variables in Israel's industry sectors, by using a panel data technique. The panel-data analysis technique has econometric advantages over the time series technique, particularly in the case of a short time series span. Using the following model:

$$\log Employment_{i,t} = \alpha_0 + \alpha_1 \cdot \log GDP_{i,t} + \alpha_2 \cdot \log Wage_{i,t} + \varepsilon$$

Where

i =1, …,39 indicates the industry sectors

t = 1995, …, 2010 indicates years

Employment = employee jobs index in industry sector i in year t

GDP = annual index of GDP

Wage = annual index of wage per hour

Since the equation is based on the natural logarithm of the variables, the estimated coefficients represent the employment elasticity with respect to the variables.

Data

Our panel data set consists of annual employment data for 13 main industry sectors by the ISIC definition[3] in the years 1996–2013. All variables in the model are reported by the Israeli CBS (Central Bureau of Statistics). All variables are presented and collected as an index (base year = 1994). The method to collect all the variables with respect to the same industry sectors in Israel are by ISIC Rev.3 segmentation and by index.

Regression results

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[3] The ISIC sectors included are 25, 26, 27, 28, 29, 31, 32, 33, 34, 35, 36, 38, and 39.

The regression results are presented in Table 1. As can be seen, all variables are significant at the 1% level. As expected, the estimation produces positive elasticity with respect to GDP while the wage variable produces negative elasticity.

Table 1 Fixed effect estimation

Variable	Coefficient	S.D.	t-statistic
GDP	0.593	0.09	**6.33**
Wage	-0.618	0.22	**-2.77**
Constant	4.746	0.81	**5.82**

To find the effect of an increase in transportation infrastructure investment on employment we used the elasticity of 0.125 found by Shaharabani (2008); however, this elasticity was calculated by performing a simple average of each branch, while we present an elasticity calculated as a weighted average of the size of each branch (added value). Thus, the average elasticity we found for the industries is 0.151, and an increase of 1% in transportation infrastructure investment generates an increase of 0.151% of GDP, leading to an increase of 0.089% in employment, as shown in Figure 2.
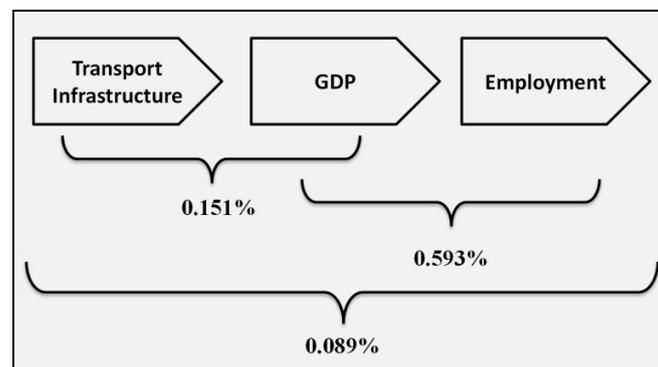

Figure 2 Long term impact of transportation infrastructure investment on employment

It is important to note the limitations of the model. The results obtained are underestimations as a result of the structure of the two parts of the model; when estimating the effect of transport infrastructure on GDP, the database for estimating the elasticity refers only to manufacturing industries. In addition, the range of years on which the model focuses does not include those in which significant growth in transportation infrastructure investment has occurred; hence, the estimate is biased downward (Lavee et al 2011). In addition, examining the effect of GDP on employment focuses only on GDP and wages in the industrial sector. Therefore, it is likely that this estimate is biased downward since for industries like trade and services, the employment elasticity with respect to GDP is higher.

Another limitation is related to flexibility. We assume that flexibility is fixed, which is a problematic assumption because as transportation inventory increases, flexibility is likely to change. Therefore, the results of regression is corect for small changes in transport investment. If we wish to test the impact of large investments, the expected changes in flexibility should be considered.

4. Empirical Analysis

In this section, we apply the model to data from Israel. To illustrate the impact of transport infrastructure investment on direct employment effects as well as the extensive employment effects, we assumed an investment of 10 billion NIS in transportation infrastructure.

4.1. Direct employment effects

By using the input-output tables, we examined how the growth in the construction industry affects all other industries in the economy. Subsequently, we placed the changes in the input-output tables to estimate the total impact of transport investment inputs on the output of the economy.

4.1.1 The estimation results

According to the input-output tables, the effect on labor returns is 0.56637 of the investment. To calculate the number of jobs added as a result of the project, the investment should be multiplied by this rate and divided by the national average wage, since the project's direct impact on employment includes jobs in a variety of industries. According to Table 2, an investment of 10 billion NIS in transportation infrastructure will lead to 58,449 years of work; in other words, an investment of 171 thousand NIS will lead to one year of work.

Table 2 Calculating the number of new jobs due to an investment of 10 billion NIS

Increase in inputs	Investment of 10 billion NIS
Increase in work returns	5,663,749,050 NIS
Annual average wages (2008)	96,900 NIS
Number of added years of work	58,449

4.2. Extensive employment effects

According to the results of the model (section 3.2.3), an increase of 1% in transportation infrastructure will lead to an increase of 0.089% in employment.

Based on data from the Bank of Israel (2008), at the beginning of 2008 transport infrastructure capital stock was 179.1 billion NIS. An addition of 10 billion NIS suggests an increase of 5.58% in transportation infrastructure (under a simplifying assumption regarding capital erosion of existing infrastructure). At the end of 2008, the number of employees in Israel was 2.7767 million (Bank of Israel, 2008). The data above indicates that an increase of 5.58% in spending on transportation infrastructure will lead to an increase of 0.005% in employment. In absolute terms, this change leads to employment of 13,884 new employees, so the number of employees will increase to 2,790,582 in 2009. To examine the long-term impact of transport infrastructure investment, a simulation was conducted to examine the effect of continuous annual investments of 10 billion NIS in transportation infrastructure. As part of the simulation,

a forecast was conducted for the next 25 years in terms of permanent jobs created following an investment of 10 billion NIS per year.

4.2.1The estimation results

Figure 3 describes the permanent increase in the number of employees over the years following a fixed investment schedule of 10 billion NIS per year. Following the annual investment, more employees will be added every year as a result of the transportation development. In the first year, 13,882 employees will be added, while in the second year, only 13,214 employees will be added following an additional investment of 10 billion NIS. This represents an ongoing trend; the number of new employees added due to the same 10 billion NIS increase in transportation infrastructure spending decreases every year. In this case, where the annual investment remains constant (and is not relative to GDP or capital stock of transport infrastructure), then the proportion of the investment to the transportation infrastructure capital will decrease, and thus the marginal addition to the number of employees will decrease with time (Figure 4).

Figure 3 Expected increase in the number of employees from a fixed investment of 10 billion NIS per year (2009-2025)
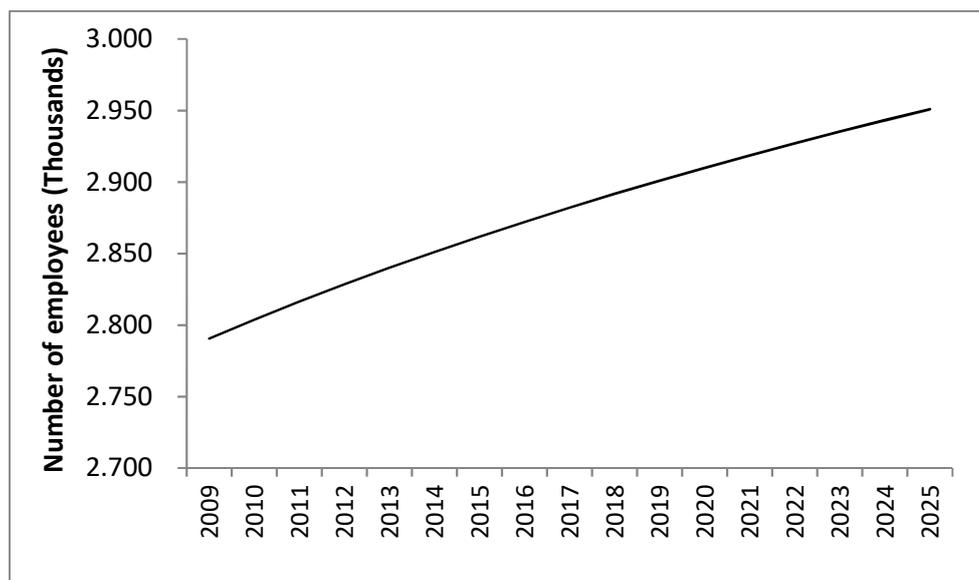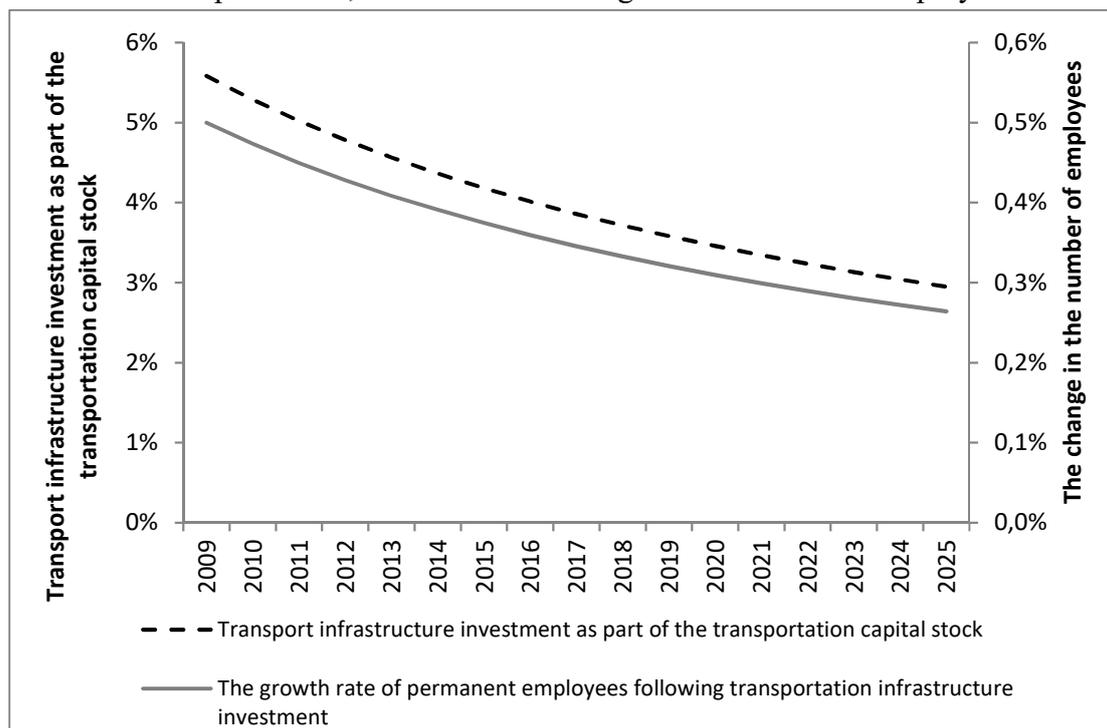
Figure 4The investment in transportation infrastructure as part of the transportation infrastructure capital stock, and the rate of change in the number of employees

4.3 Summary of the total employment effect

Table 3 summarizes the total employment effects of transportation infrastructure investment. In the summary of the results, two major points should be noted:
The total overall impact on the number of jobs (effect 2) includes the effect following establishment and maintenance of the project (effect 1).
The results are not distributed over the same period. Effect 1 is temporary and specified in terms of "years of work", while effect 2 is associated with long-term economic development (calculated for 50 years), and hence a permanent effect on the number of jobs.

Table 3 Summary of the effects of transportation infrastructure investment on employment

Type of effect	Investment of 10 billion NIS
Years of work following the establishment and maintenance of the project	58,449
Total overall effect on the number of jobs	13,882

To divide the estimated effects into direct effects and extensive effects, we deployed the estimated "years of work" following establishment and maintenance of transport projects over the first years of the investment. Figure 5 describes the additional jobs over time following a one-time investment of 10 billion NIS. As shown in Figure 5, the added jobs resulting from construction and operation of a project can be associated to

the first four years from the first investment, while from the fifth year onwards the additional employment effects are associated to wider effects of transportation development. This indicates that the dominant effect of transportation infrastructure investment derives from the extensive employment effects of transportation development.
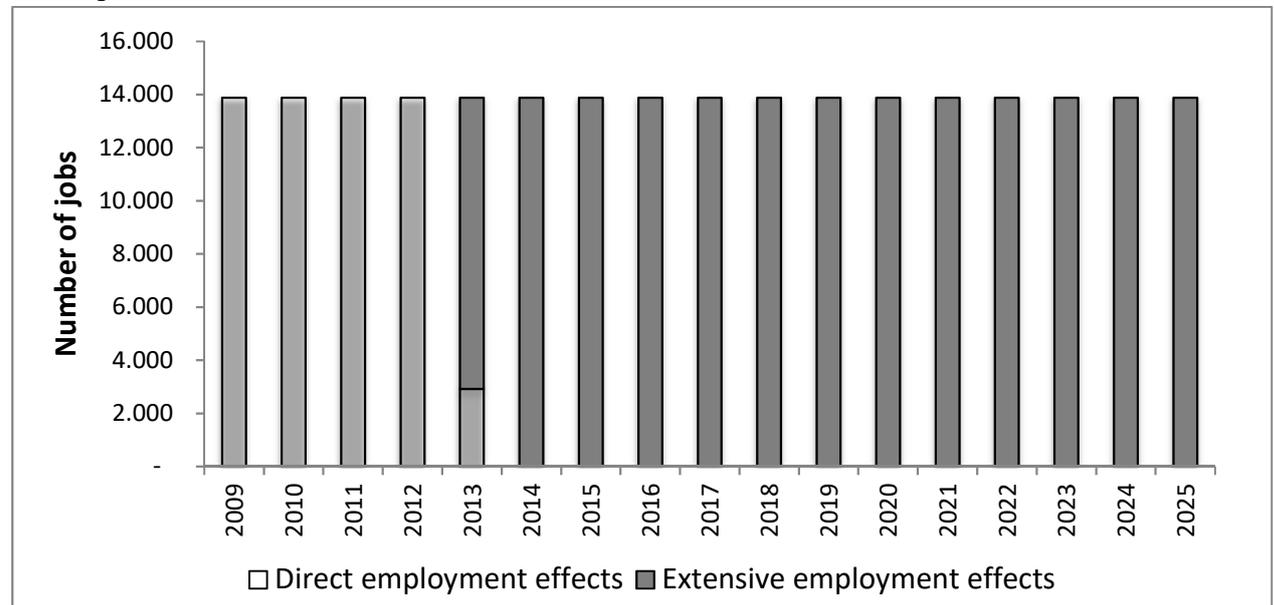

Figure 5 Additional direct and extensive employment effects following an investment of 10 billion NIS in transportation infrastructure

To compare the effects, the expected revenues (wage receipts from jobs) in each of the effects were discounted at an interest rate of 7%, in accordance with the guidelines of the Israeli Budget Department for examining the feasibility of transportation projects (Transportation projects procedure, 2006). Table 4 summarizes the results. The calculations are based on the deployment of the jobs in accordance with Figure 5, the assumption that the permanent effect on the number of jobs is effective for 50 years, and in accordance with the average wage as of 2008 (the calculations do not take into account an increase in the average wage). The data summarized in Table 4 also indicate that the dominant effect is the extensive long-term effect following transportation development. Another clear result is the net present value of the investment to the economy—an investment of 10 billion NIS would lead to a benefit of over 66 billion NIS at present value, a ratio of 1:6.6 in terms of cost-benefit ratio.

Table 4 The present value of employee wage receipts, by effect

	Discounted value of the effect (NIS million)
Establishment and operation effects	4.76
Extensive effects of project development	61.59
Total discounted value of the effects	**66.35**
Investment in the project	-10.00
Present net value of the investment	**56.35**

4.4   Additional macroeconomic effects

The increase in the number of jobs due to infrastructure investment has a broad impact on other macroeconomic parameters such as spending and private savings, firm efficiency, government revenues from taxation, etc. Most of these effects are difficult to measure accurately. In order to present a broader picture of the effects of infrastructure investment, we estimate the increase in revenues from direct taxation on employees (income tax, social security and health insurance) resulting from investment of transport infrastructure. In this case, we also examine a simulation in which 10 billion NIS are invested in transportation infrastructure development.

The total effects are expressed with the addition of 13,882 jobs, starting a year after the investment and over the following 50 years, thus, the investment per employee is estimated at 720,336 NIS. Under the assumption that the average monthly wage in the economy is 8,075 NIS, income tax, social security and health insurance are estimated at 1,055 NIS a month per employee, or an annual rate of 12,658. Thus, by multiplying this sum by the number of the new jobs, the country's tax revenue from taxing new employees is 175.73 million NIS per year. The return on the investment was calculated as an internal rate of return (IRR) on the average annual wage per employee in accordance with the level of investment (Table 5).

Table 5 Return on investment calculations for an investment of 10 billion NIS

	Investment amount (NIS)	Direct taxation return (discounted 7%) (NIS)	Direct return
One employee	720,336	123,591	13.5%
13,882 employees	10,000,000,000	1,715,737,179	13.5%

The calculations presented in Table 5 are conservative and biased downward for two reasons. First, the calculations consider a fixed wage over the years and do not take into account an increase in wages over time. Second, improving transportation infrastructure affects the output of firms, which is followed by an effect on wages; despite this, the calculations do not consider the expected increase in wages following transportation development. Despite the conservative calculations and the partial observation of the expected effect of direct taxation, a return of 13.5% of the transportation infrastructure investment is expected (Table 5). However, it can be expected that the return to the government on the investment will be significantly higher than the partial estimate presented above.

5. Limitations:

This article has a number of limitations: In the regression we controlled the wages, but did not take into account other effects that may have an impact on the outcomes. For example, technological improvements, changes in tastes, the level of openness of the economy and the level of flexibility of the labor market include opportunities for work abroad. We also assumed a constant level of flexibility, while with the increase in the level of infrastructure, flexibility is likely to change.

Therefore, the results of the regression are correct for small changes in transport investment. If we wish to test the impact of large investments, the expected changes in flexibility should be considered.

The results obtained in this paper are significant, so despite the limitations, the main results will not change. Correction and accuracy of the model may moderate the results but not the main understanding that investment in infrastructure Brings employment growth.

6. Summary and conclusions

This paper examined the effects of transport infrastructure investment on employment in Israel while addressing two main employment effects: a direct short-term effect resulting from the establishment and operation of the project, as well as more extensive long-range effects arising from transport development.

The direct employment effects were examined through input-output tables. Regarding the extensive long-range effects, we presented a model connecting between two effects studied extensively in the literature—transport infrastructure impact on GDP and GDP impact on employment, connecting the effect of an increase in transportation infrastructure to employment. This was accomplished by using existing models and introducing an econometric model.

Subsequently, a simulation was introduced for examining the employment effect of an investment of 10 billion NIS in transportation infrastructure. The results indicate that the extensive long-term employment effects following transportation development is at least 12 times greater than the direct short-term employment effects resulting from establishing and operating the project. In addition, it was found that the cost-benefit ratio resulting from a 10 billion NIS investment is 1:6.6, indicating a high profitability to the economy. Apart from the macro-economic effects, investment in infrastructure has additional micro-economic effects such as wage receipts returning to the government from direct taxes on employees. It should be noted that the high returns on investment in transportation infrastructure received by the model result to some extent from the relatively low capital stock of transport infrastructure in Israel.

In conclusion, investment in transportation infrastructure will lead to a substantial increase in employment as well as other forms of economic development such as GDP growth, increased productivity within firms, and an expected increase in state revenues. In view of the ongoing debate regarding the impact of transport infrastructure on jobs, the results of this study contribute to the voices supporting policy makers advancing transport infrastructure expansion.

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