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Public Capital and Economic Growth in Israel

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Introduction

The October 7 war and its ramifications have created a new security reality, mandating a substantial increase in Israel's defense expenditure. Consequently, restoring the economy to a path of rapid growth is ever more pressing, given the need to finance defense spending while limiting the harm to citizens' standard of living. Since, according to the recommendations of the Nagel Committee, the defense budget is expected to average more than NIS 100 billion per year, about 5% of GDP in 2023, over the coming decade, Israel needs to expand its tax base and increase its growth rates in order to continue to prosper. The members of the Nagel Committee themselves emphasized that creating new growth engines within the framework of the budget is essential to Israel's economic strength and international standing (Nagel Committee Report, 2025, p. 46). This article focuses on a central growth engine that, in our view, can yield enormous returns: investment in infrastructure and public capital in Israel.

Even before the war, public discussion about the state of Israel's infrastructure relative to other developed countries had intensified. Much was said about the relative shortage of transportation, electricity, sewage, and water infrastructure (Hudi, 2022; Kedem Levy, 2022; Zagrizak, 2021), as well as about gaps in "soft" infrastructure, such as the education and health systems (Pilut, 2019; Sela, 2022). In light of these claims, researchers have addressed questions relating to the quantification of various infrastructure stocks, and government investment in them, and to the analysis of their effects on quality of life, poverty, total productivity, and economic growth. Eckstein et al. (2019), for example,

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argued that a low level of public capital, alongside a shortage of human capital, is one of the most important factors behind the gap in productivity and living standards between Israel and other developed countries, and recommended doubling investment in public capital. Sarel (2021) expressed a somewhat less categorical view, but confirmed that there is evidence of a shortage of public capital in Israel and concluded that it is desirable "to expand the research on this issue and try to diagnose how severe the problem is" (Sarel, 2021, p. 49). In a later study, Eckstein et al. (2022) examined the issue in greater depth, characterized the gap between Israel and developed reference countries in infrastructure stocks, and proposed a plan for accelerated investment in public capital, even through an increase in the national debt. This article joins this body of work and focuses on the effect of government investment in infrastructure on economic growth.

The aim of the study is to examine the effect of government investment in public capital in Israel on economic growth using research approaches that have not yet been applied in the Israeli context.[1] To this end, we present background data in an international comparison and conduct a microeconomic empirical analysis based on Central Bureau of Statistics (CBS) data from the Manufacturing, Mining and Quarrying Surveys and the Business and Trade Surveys. This analysis differs from previous studies in that it makes it possible to distinguish between the effects of government investment in different areas on economic industries. In addition, focusing on the output of plants or businesses, rather than on the aggregate output of the economy, bypasses possible reciprocal links between the general business cycle and government decisions regarding investment in public capital, making it possible to identify the causal effect of investment on growth.

In our analysis, we examined several examples of "hard" infrastructure: roads, railway tracks, and the electricity grid, as well as examples of "soft" infrastructure, whose measurement is naturally more complex. With regard to these "soft" infrastructures, we adopted Tatom's (1993) approach and focused on investment in government-owned fixed assets used for education and health, such as buildings, equipment, and intellectual property. This choice, along with others detailed below, was intended to produce conservative estimates that,

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1 As is customary in the economics literature, we use the term "public capital" as synonymous with public infrastructure. For further discussion of the terminology, see Aschauer (1990).

in our view, provide a lower bound for the true effect, which is likely larger than the one we present.

The empirical analysis, whose methodology is detailed in Appendix A, was based, as noted, on firm and plant data from the CBS Manufacturing, Mining and Quarrying Surveys and Business and Trade Surveys. The analysis estimated the effect of annual national investment in various types of infrastructure on the annual output of businesses within a microeconomic production model, while controlling for unobserved annual factors, such as the general state of the economy, that may mediate between the stock of public infrastructure and the output of a given business beyond the causal effect itself.

The results of the microeconomic analysis are unequivocal: increasing the stock of each type of public capital examined was found to have a significant positive effect on the output of firms in the Israeli economy. However, this effect is not uniform. Investment in transportation infrastructure appears to affect mainly high-tech manufacturing, finance, and knowledge-intensive services that are neither high-tech nor financial services, while investment in the electricity grid affects traditional manufacturing and high-tech services. In addition, investment in human capital and health mainly benefits service industries.

In addition, we calculated how these microeconomic results translate into macroeconomic implications for output in the entire private sector within a simple aggregate production model. Under our most conservative assumptions, the model predicts that increasing the stock of public capital by NIS 1 billion in each of the infrastructures examined would increase output by a total of 0.4%; different types of infrastructure contribute between 0.03% and 0.14% to this figure.[2] This estimate falls within the range of estimates commonly found in the international literature, although our more realistic, and less conservative, estimates predict a much higher return. These high estimates may stem from Israel's low stock of public capital relative to the countries examined in most studies, the United States and Western European countries, and from the higher marginal return to public capital in such a state of relative shortage. In any case, the analysis strongly supports the hypothesis that investment in each of the infrastructures examined is worthwhile from the perspective of the economy as a whole.

2 The stock of public capital in Israel is about NIS 600 billion (see Figure 1). According to the 2025 budget proposal, the budget allocated to investment in public infrastructure is about NIS 53.8 billion; see Knesset, 2024.

Literature review

The idea that investment in public capital may serve as an engine of economic growth is long-standing; it has been a policy issue in various parts of the world for many years (Dalgaard et al., 2018; Tanimoto & Wong, 2019). Attempts to examine the issue using empirical tools began in the second half of the twentieth century, and at different times focused on the expansion of transportation infrastructure, such as railways in the Western world in the nineteenth century (Fogel, 1964; Fremdling, 1977), or highways in the United States in the mid-twentieth century (Fernald, 1999).

A deeper integration of the issue of investment in public capital with macroeconomic theory began with the work of Baxter and King (1993). The model they developed, which estimates national output as a function of workers, private capital, and public capital, the "production function" approach, continues to serve as a basis for research in this field. The researchers calibrated the theoretical model using these economic variables for the United States in the years 1930–1985, and found that the direct elasticity of output with respect to public capital is about 0.05. Moreover, investment in public capital leads to changes in the stock of private capital and in labor input, in a way that may increase the effect by as much as 2.5 times.

Pereira and De Frutos (1999) adopted a different approach: instead of examining how public capital affects output given private capital and labor, they examined how public capital affects final output also through other inputs, the "equilibrium" approach. According to this mechanism, increasing the stock of public capital raises the marginal returns to private capital and labor, encourages their accelerated accumulation accordingly, and thereby increases output further. According to their estimates, which were based on time series and mutual effects over time, the long-run elasticity of output with respect to public capital is 0.63, a value far higher than other estimates, even for the long-run effect, such as those of Baxter and King (1993).

In an effort to establish a clearer range of estimates, Bom and Ligthart (2014) conducted a comprehensive review of 578 estimates of the elasticity of output with respect to public capital from 68 different studies from 1983–2008. The analysis yielded an average estimate of 0.083 for the elasticity parameter. The researchers also found that the "short-run" elasticity, without an indirect effect on output through other factors, is about 0.085, while the "long-run" elasticity, including the indirect effect, is 0.122. In addition, they found that, for "core infrastructure," including roads, railway tracks, airports, electricity, sewage, water, and the like, the estimates are twice as large.

Ramey (2020) deepened the theoretical framework and developed a long-run equilibrium model that incorporates government investment in productive infrastructure that takes time to build. Like other researchers, she also emphasized the difference between the long-run benefit, which stems, as noted, from the increase in other production inputs following the rise in total factor productivity, and the short-run benefit, which is more similar to government consumption than to investment. She found that the time required to allocate budgets and actually build the infrastructure significantly reduces the short-run benefit, whereas in the long run the effect is large and substantial.

By contrast, Devadas and Pennings (2018) emphasized not only the nominal capital stock but also its quality, the congestion in its use, and its interaction with private capital. The researchers developed a long-term growth model (LTGM) designed to calculate the effect of investment in public capital on growth over time. This model takes into account a range of structural factors and characteristics of the public capital stock in a given country, its quality, and the extent of its actual use, and is publicly available as an interactive Excel file that allows users to run policy simulations under different assumptions. Their study examined the model's results for a sample of 147 countries, and showed that increasing the public investment rate, as a percentage of GDP, by one percentage point increases growth by 0.1–0.2 percentage points in subsequent years. This effect fades over time and falls to 0.05 percentage points or less within 30 years. They also found that the effect may be larger for developing countries than for developed countries.

Beyond predicting the aggregate effect of a given investment in public capital on the economy as a whole, one must ask what the effect of different types of investment is, and which businesses actually benefit from them; in other words, how investments in a specific type of infrastructure serve businesses in different industries or with different needs. In the literature, this issue is usually separate from the macroeconomic research discussed above, although it is examined from time to time. One of the pioneers in this field was Hulten (1996), who showed how investment in transportation affects the geography of economic activity in addition to its effect on total factor productivity, to the extent that "excessive" investment in transportation may create a spatial distortion in the economy without improving output at all. Felice (2016) emphasized the long-run effect of differences in returns to one type of public capital or another across industries, which lead to a shift of workers and private capital away from industries that are not sensitive to the type of public capital that has increased and toward industries that benefit from it. A parallel line of research focuses on differences between public investments in different projects. Buffie et al. (2012) examined different types of investment in public capital from a financial perspective, focusing on the risks and returns of such investments in developing countries. Their findings highlight the importance of proper risk assessment, efficient financing, and financial flexibility in relation to investment in public capital, since these factors have a decisive impact on the return on that investment.

Various studies have also noted the distinction between physical public capital and “soft” infrastructure: structural and institutional factors, human capital, social capital, knowledge capital, and the like. The ways in which the stock of “soft” capital is quantified and the ways in which its “public” component is identified are not consistent in the literature, and naturally they generally involve the use of proxy variables. Portugal-Perez and Wilson (2012) examined the effect of certain types of infrastructure of both kinds on exports in about 100 countries in the years 2004–2007, and found that “soft” infrastructure is especially important for exports in developing countries, while richer countries benefit particularly from physical infrastructure. Their study focused mainly on structural factors and less on knowledge capital or other forms of human capital. Maurel et al. (2016), who also focused on the effects of these factors, examined trade between EU countries and countries in Eastern Europe and Africa and found similar results.

The issue of public capital has also been studied extensively in Israel. Eckstein et al. (2019) emphasized the importance of gaps in public capital between the private sector in Israel and that in selected developed countries, and their contribution to the gap in total factor productivity.[3] They found that about one-third of the gap can be explained by Israel’s relative shortage of public

3 The “reference countries” to which Israel was compared were Austria, Belgium, Denmark, Finland, Ireland, Netherlands, and Sweden. They were chosen because of their similarity to Israel in population size and natural assets, and because their GDP per capita is higher. For further reading, see Eckstein et al. (2019). The reference countries included in our study are Austria, Denmark, Finland, Netherlands, and Sweden.

capital; the gap in transportation infrastructure explains about 23% of the productivity gap, the gap in other physical capital explains about 8%, and the gap in digital capital, about 3%. In the conclusions of their position paper, which was published on the eve of the outbreak of the COVID-19 crisis at the end of 2019, the researchers called for doubling investment in public capital in Israel. Similar findings emerged in a review of Israel's economic capital stock and its components (Sarel, 2021). Sharel found that Israel may have a shortage of physical capital, and that it likely has a shortage of public capital. With regard to different types of capital and investment in increasing them, he also found that although investment in research and development is exceptionally high, both the degree of innovation and the scope of knowledge capital services in Israel are not exceptional relative to other high-income countries.[4, 5] Later, Eckstein et al. (2022) deepened the analysis of the low level of public capital in Israel and its effect on growth. In their work, they detailed some of the specific infrastructure gaps between Israel and the reference countries, and calculated that closing the gap within 15 years would require an annual increase of about 5% in the stock of public capital per capita. Such an increase translates into annual investment of 5%–6% of GDP in public capital, under the study's baseline assumptions. The researchers formulated a comprehensive policy scenario, according to which accelerated investment in public capital in the coming years (2023–2024), financed by debt, would bear fruit later in the decade that would dwarf the burden of the additional debt.

Public capital and GDP in international comparison

Israel's stock of public capital is considerably lower than that of other developed countries with a similar population size and higher GDP than Israel. Figure 1 presents the ratio of public capital to GDP in Israel compared with the average ratio in the reference countries over the past three decades. As can be seen, the ratio of public capital stock to GDP in Israel is consistently about half the corresponding ratio in the reference countries.

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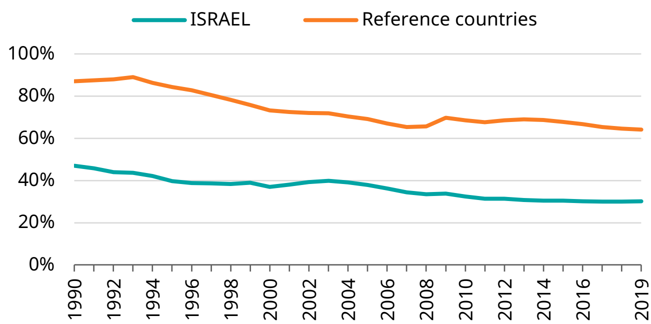
4 "Knowledge capital services" refers to the flow of "services," or the actual input, derived from the stock of "knowledge capital," which includes software, patents, and other intangible assets.

5 "Not exceptional" means less than one standard deviation above or below the average among developed countries. For further reading, see Sarel, 2021.

Figure 1. Public capital and GDP, 1990–2019

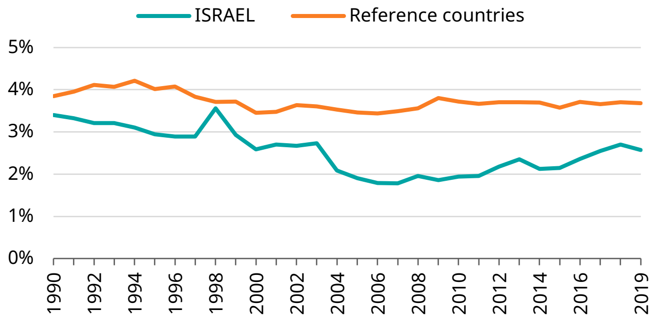


Note: Reference countries are Austria, Denmark, Finland, Netherlands, and Sweden. The values shown are based on a simple average of these countries.

Source: Benjamin Bental and Michael Debowy, Taub Center | Data: IMF

To close the gap in the stock of public capital relative to GDP, the Israeli government would have had to increase its rate of investment in public capital beyond that of the reference countries. As can be seen in Figure 2, this did not happen. On the contrary, Israel's relative investment rate, which in 1990–1999 was about 80% of the average in the reference countries, fell in 2010–2019 to about 62% of that in the reference countries. As the figure shows, Israel's relative deterioration stemmed mainly from a decline in the investment rate in Israel, which fell by almost one percentage point between the 1990s and the second decade of this century, from an average of 3.1% to an average of 2.3%, while the investment rate in the reference countries remained fairly stable, though it declined slightly. It is likely that part of Israel's economic lag behind these countries stems from the gap in public capital, since a higher stock of public capital is associated with higher income in an international cross-section, as we show next.

Figure 2. Gross investment of the government sector as a percentage of GDP, 1990–2029



Note: Reference countries are Austria, Denmark, Finland, Netherlands, and Sweden. The values shown are based on a simple average of these countries.

Source: Benjamin Bental and Michael Debowy, Taub Center | Data: IMF

Using OECD GDP data and IMF data on the stock of public capital, we estimated a model examining the relationship between public capital per capita and GDP per capita in OECD countries in 2000–2019, controlling for unobserved country-specific factors that are fixed over time and for shocks common to all countries in each year. This naïve analysis reveals a statistically significant association between the two, with a 10% larger public capital stock being associated with 3.4%-3.9% larger GDP per capita (see Table A1 in Appendix B).

In more detailed specifications, we control for more covariates to reduce the bias in the estimated correlation between public capital and GDP. In particular, we estimated a model based on an aggregate production function at the country level, including the active labor force, private capital, and public capital.[6] This estimation indicates that the elasticity of GDP with respect to public capital in a two-way-fixed-effect panel framework is about 0.11, so that a 10% increase in the stock of public capital corresponds to an increase of about 1.1% in GDP, on average. This point estimate lies in the upper tail of the range of estimates commonly found in the literature for this value. The models show that when public capital is omitted from the analysis, its contribution is

6 The estimation model is: $Y_{i,t} = A_i L_{i,t}^{\alpha} K_{p_{i,t}}^{\beta} K_{g_{i,t}}^{\gamma}$ where $Y_{i,t}$ is the country GDP I in the t, L is the labor force, K_p is private capital, and K_g is public capital.

absorbed into that of private capital, and the elasticity of GDP with respect to private capital is estimated at about 0.33 instead of about 0.20. In other words, in a cross-country framework, public capital operates mainly by increasing the return to private capital, and contributes less to increasing the return to labor.[7]

This confirmation of commonly accepted estimates in a sample of countries that includes Israel does not necessarily make it possible to rely on such estimates for Israel as well. These models average the effect of public capital across many countries, and they are not specific to each country's economy. Moreover, an aggregate estimate of the effect of public capital on GDP may mask substantial heterogeneity across different types of capital, for example physical infrastructure versus "soft" infrastructure, and across different types of industries, for example manufacturing versus services. To address both of these issues, we conducted an empirical analysis of the effects of different investments in public capital on the output of different industries in the Israeli economy. This analysis is presented in the next section.

Public capital and productivity of firms and manufacturing in Israel's private sector

The aim of the empirical analysis is to examine how different types of public capital stock and investment in it affect the productivity of industries in the Israeli economy. Public capital can be divided into two main types: physical infrastructure and "soft" infrastructure. With regard to physical infrastructure, we focus on transportation, represented by the cumulative length of active railway tracks in the country and the cumulative area of its roads,[8] as well as the length of voltage lines in the electricity grid (transmission and distribution).[9] With regard to "soft" infrastructure, we focus on two proxy measures: human capital and health.

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7 From the results of Table A1 in Appendix B it follows that the sum of the coefficients is 1 for combinations that lie within a wide 95% confidence interval.

8 The variable we use to measure the stock of transportation capital is a weighted product of road area (km^2) and railway track length (km), assuming that these are substitutable components of an unobserved "transportation quality/convenience" variable. For further information, see Appendix A.

9 We focus on electricity transmission rather than generation capacity, assuming that transmission is the binding constraint in electricity supply.

As measures of the level of public capital, we use the values of fixed assets in these industries, calculated as cumulative government investment in them since 1961, with annual depreciation of 3%.[10]

For the analysis, we relied on a comprehensive database composed of data from the CBS Manufacturing, Mining and Quarrying Surveys and Business and Trade Surveys for the years 2004–2018, which includes data on about 25,000 firms and establishments in a range of economic industries, including revenue, number of jobs, compensation of jobs, and capital. To this database, we added data on the public infrastructure described above. The final analysis included estimation of the production model of the firms and establishments within a panel regression framework, where in each year the dependent variable is productivity at the level of an individual establishment or firm, and the control variables include employment and private capital in that establishment or firm, as well as the level of public capital, which is identical for all firms and establishments in each year. The coefficients on private inputs and on public capital were estimated as constant over time, but varying across industries.[11]

We distinguish between seven categories of firms and establishments, according to sector of activity, manufacturing or services, and the technological intensity of the firm or establishment, a measure of the type of economic activity that derives mainly from the average research and development intensity in the sub-industry in which the firm operates.[12] We assume that businesses will benefit in different ways from investment in each type of public capital, according to their assignment to one of the seven categories, and we also estimate productivity elasticities with respect to the stock of public capital for

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10 Descriptive statistics on the different infrastructure stocks can be found in Table A2 in Appendix B. The sources for the analysis of investment costs in the different types of infrastructure are mentioned in Appendix A.

11 For further information on the data and methodology, see Appendix A.

12 For full details on the categories, the industries included in them, and their share of total employment in the economy, see Table A5 in Appendix B. According to EU definitions, manufacturing industries are classified into four levels of technological intensity, and service industries are classified into several groups of “knowledge intensity.” We aggregate the “knowledge intensity” groups into three levels of technological intensity: high-tech services and financial services (high-tech knowledge intensive and financial knowledge intensive), other knowledge-intensive services (market knowledge intensive and other knowledge intensive), and less knowledge-intensive services (less knowledge intensive). The last group is the baseline category in the statistical estimation, and employs about 43% of workers in the economy.

each combination of category and infrastructure. The identification method omits the baseline category, non-knowledge-intensive services, and therefore all the estimates presented are relative to that category. The estimation results are presented in full in Table A3A in Appendix B. Below we present findings regarding the national stock of physical infrastructure, followed by findings regarding the national stock of "soft" infrastructure.

Figure 3 presents the output elasticity of manufacturing establishments and service firms with respect to country-wide investment in physical infrastructure by the activity groups we defined, based on regressions run separately for each type of infrastructure, with any estimate that was not significant at least at the 10% level omitted.[13] The figure shows that the stock of physical public infrastructure yields a private return for both service firms and manufacturing establishments. With respect to the electricity grid, the output elasticity for traditional manufacturing establishments and high-tech and financial services is 0.23–0.26, a substantial effect.[14] The stock of transportation infrastructure has an even greater effect on productivity, although it is concentrated mainly in high-tech manufacturing and other knowledge-intensive services. We emphasize that examining each component separately shows that the main effect for high-tech manufacturing comes from roads, while in services the main effect comes from railway tracks, a plausible

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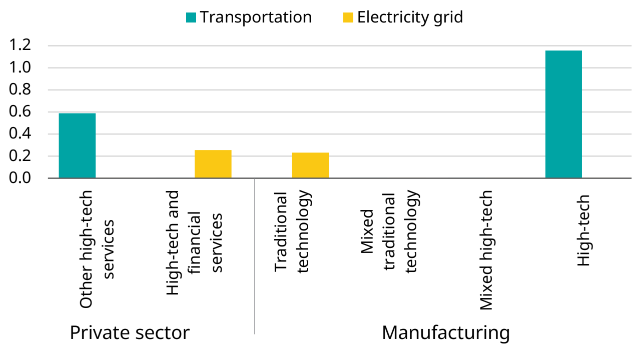
13 A notable limitation of this simple model stems from the different channels through which public capital affects output, as described in the literature review. Estimating the production function of an establishment or firm treats the effect of public capital as simultaneous with, but separate from, the effects of private capital and labor, even though these are determined, to some extent, in response to the stock of public capital to which the establishment or firm has access. This multicollinearity means that the model properly estimates the combined effect of public capital and the other inputs, but the significance of each individual factor may be biased downward. Therefore, our estimate of the effect of public capital on output captures, at most, the direct effect together with the indirect effect through the increase in other inputs, but it may also capture an intermediate value, the direct effect and part of the indirect effect, or the direct effect only, and may even be an underestimate of the direct effect if private capital and labor "absorb" the effect of public capital. In any case, this method is not expected to lead to upward-biased estimates; that is, the true effect is probably larger than the one we present.

14 Firms in less knowledge-intensive services serve as the control group, and the elasticity estimates presented for the other businesses are relative to this group, under the imposed assumption that the elasticity in this group is effectively zero. In practice, this assumption is likely violated, and therefore our estimate is biased downward and the true effect is probably larger.

finding given that the first group relies mainly on roads to transport inputs and goods, while the second relies on Israel Railways to transport workers, who are the main input in these industries.[15]

Figure 3. Output elasticity with respect to national investment in physical infrastructure, by type of infrastructure, main industry, and technological intensity



Note: The figure presents the output elasticity at the firm or establishment level with respect to the national stock of different types of public capital, the estimates of parameter γ_c from Equation (2) in Appendix A, following multivariate estimation. The full results, of which only those statistically significant at the 90% level or higher are shown here, are presented in column (1) of Table A3A, Appendix B.

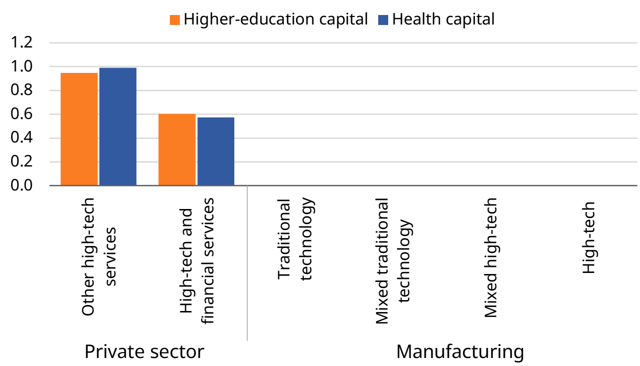
Source: Benjamin Bental and Michael Debowy, Taub Center | Data: CBS

As noted, our analysis also included an examination of the effect of "soft" infrastructure on productivity. Figure 4 presents the results of this analysis in a manner parallel to Figure 3. A significant elasticity was documented only for knowledge-intensive services, at a level of about 0.6 for high-tech and finance and 0.9–1.0 for other services, with similar levels for the two types of infrastructure. Other knowledge-intensive services also include the health industry, limited to its business components, meaning that the effect of investment in health on this group is almost self-evident. Interestingly, higher education assets yield a lower return in high-tech and finance, industries in which the quality of human

15 Based on an estimation similar to that presented in column (1) of Table A3A, in which the stock of roads and the stock of railway tracks are included as two separate variables.

capital is presumably critical. However, it is possible that these industries are able to recruit high-quality talent and rely less on the higher education system compared with the other knowledge-intensive industries.[16] It should also be emphasized again that the definition of human capital and health assets in this study is very conservative, and likely does not fully reflect the stock of human capital available to firms in the economy.

Figure 4. Output elasticity with respect to national investment in "soft" infrastructure, by type of infrastructure, main industry, and technological intensity



Note: The figure presents the output elasticity at the firm or establishment level with respect to the national stock of different types of public capital, the estimates of parameter $c\gamma$ from Equation (2) in Appendix A, following multivariate estimation. The full results, of which only those statistically significant at the 90% level or higher are shown here, are presented in columns (2)–(5) of Table A3A in Appendix B.

Source: Benjamin Bental and Michael Debowy, Taub Center | Data: CBS

16 Alternatively, the absence of a statistically significant effect of investment in health or higher education assets on the other industry groups may stem from the consistent increase in health and education over the years. This increase affects the entire economy broadly and makes it difficult to identify significant differences between industries; knowledge-intensive services capture most of the effect because they employ most of the labor force, about two-thirds of the total labor force excluding less knowledge-intensive services.

In sum, the productivity of different industries in the Israeli economy appears to be strongly affected by the stock of different types of infrastructure, and the size of the effect, when significant, approaches the higher estimates in the macroeconomic literature. However, this is an analysis at the firm or establishment level, and it is not sufficient to quantify the macroeconomic elasticity of GDP with respect to the stock of public capital. The implication of the results we estimated for the nominal output of different businesses for macroeconomic productivity depends on the distribution of the different businesses in the economy, their position in the value chain, and their relative contribution to final output in the private sector. We now present such an analysis within an aggregate production model.

From micro to macro: Public capital and aggregate private-sector GDP in Israel

Comprehensive and precise modeling of the Israeli economy is a challenging undertaking, with many potential weaknesses that could introduce substantial measurement and modeling biases into our analysis. We therefore avoid doing so in this study. As a low-assumption alternative, we adopt a simple and flexible theoretical framework that requires only two key assumptions regarding the contribution of different goods and services to aggregate GDP. We consider a range of possibilities in order to cover as many alternatives to these assumptions as possible. The baseline assumptions are calibrated to the most common option in the literature. More conservative assumptions treat the contribution of goods and services within industries to total industry output, and the contribution of entire industries in the economy to aggregate GDP, as complementary to one another, so that increasing the output of each component separately has only a limited effect on increasing the GDP of the aggregate of components, and broad-based growth in all components is required in order to increase aggregate GDP. More lenient assumptions treat goods, services, and entire industries as substitutes, so that total GDP grows alongside increases in individual components.[17]

17 The national accounts sum value added at each level, thereby assuming perfect substitution at all levels. For further details on the model, see Appendix A; for the full results, see Table A4 in Appendix B.

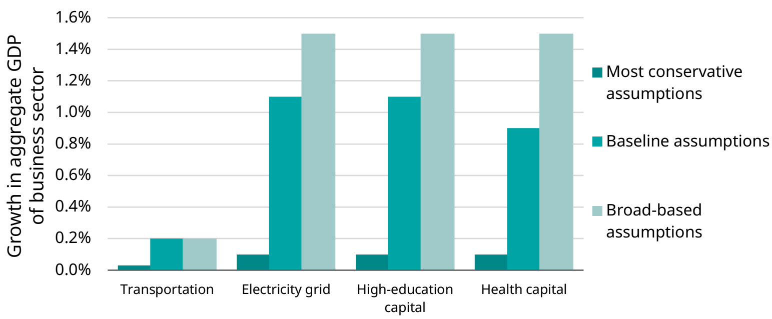
To calculate the returns to investments in infrastructure measured in monetary values according to the model — which was estimated, for transportation and electricity infrastructure, based on physical data on road area and the length of railway tracks and voltage lines — we require assumptions that allow conversion from monetary value to physical value, or in other words, allow us to price the infrastructure. The conversion coefficients were derived from data on investment in infrastructure on the one hand and the change in its physical stock on the other. The estimate of the conversion from physical data, area and length, to monetary values was based on monetary investments in the different types of infrastructure and on the development of their physical components, such as the length of railway tracks or the overhead voltage line network, over time, as reflected in CBS and Israel Electric Corporation data. It should be emphasized that the value of NIS 1 billion in relative terms differs greatly across types of infrastructure: in transportation infrastructure, such an investment purchases less than a 0.5% increase in the stock, while in electricity infrastructure it purchases more than 8%. The "soft" infrastructures are measured in monetary values from the outset. For them, the total amount is normalized to the average population size in the sample years, based on the view that investments in education and health have the character of "individual consumption expenditure," unlike a road or an electricity transmission line, which have the character of a public good. In the "soft" infrastructures, NIS 1 billion represents an addition of about 3%–6% to the stock. For further details on the cost assessment and data sources, see Appendix A.

After calibrating the model and assessing the cost of investment in infrastructure, it is possible to formulate estimates of the return on a shekel investment in the different types of infrastructure in terms of private sector GDP. Figure 5 presents the range of estimates obtained under the different assumptions regarding the calculation of aggregates, based on the microeconomic estimates, which are presented in full in Table A3A in Appendix B. The table presents the expected increase in the aggregate GDP of the private sector resulting from a one-time investment of about NIS 1 billion in the different areas, which increases the stock of physical assets in that area,[18] according to the distribution and size of the microeconomic estimates, converting monetary values into physical magnitudes, presented above. Under the baseline assumptions, an investment

18 For scale, it should be emphasized that planned investment in transportation infrastructure alone in 2025 was about NIS 41.7 billion. See Knesset, 2024.

of NIS 1 billion in the transportation network is expected to increase aggregate private sector GDP by about 0.2%, about NIS 2.8 billion, while an investment of NIS 1 billion in the electricity grid or in human capital assets is expected to increase it by about 1.1%, about NIS 14 billion. Investment in health capital assets is expected to have an effect of 0.9%, about NIS 13 billion.

Figure 5. Estimates of growth in aggregate GDP of the private sector as a result of an investment in infrastructure of NIS 1 billion



Note: The figure presents a range of estimates for the effect of an investment of NIS 1 billion in one type of public capital or another on aggregate business-sector GDP, according to Equation (4) in Appendix A. The estimates of the microeconomic effect were taken from Table A3A in Appendix B, and the range of macroeconomic estimates results from different calibrations of the parameters in Equation (4), where the most conservative assumptions correspond to $\theta=½$ and $\sigma=½$; the baseline assumptions correspond to $\theta\to1$ and $\sigma=3$; and the most lenient assumptions correspond to $\theta=2$ and $\sigma=10$. The full estimates are presented in Table A4 in Appendix B.

Source: Benjamin Bental and Michael Debowy, Taub Center | Data: CBS

In sum, the average effect of an additional investment of NIS 1 billion across all baseline estimates is an increase in business-sector GDP of about 0.8%. This amounts to an addition of more than NIS 10 billion per year from investment in a single infrastructure area, or NIS 40 billion from a broad-based investment of NIS 1 billion in each of the infrastructures. Alternatively, if we sum the most conservative estimates, an additional broad-based investment of NIS 4 billion, NIS 1 billion in each of the infrastructures examined, is expected to increase business-sector GDP by 0.4%, equivalent to about NIS 6 billion per year, a return of 50% in one year and hundreds of percent over time. This estimate, although somewhat lower, is close in order of magnitude to the estimate of Eckstein et al. (2022), who projected returns of hundreds of percent, over a decade, from investment in infrastructure.[19]

Conclusion

In this article, we have shown that the stock of public capital in Israel is consistently smaller than the average in the reference countries. Moreover, the rate of public investment relative to GDP is also lower than in the reference countries. We also presented aggregate statistical analyses of the elasticity of GDP with respect to the stock of public capital for Israel and the other OECD countries, and found an average elasticity of 0.11.

To focus on the Israeli economy, we conducted a microeconomic estimation to identify the effect of investment in different types of infrastructure on output in different establishments and firms in the private sector. We found that investment in transportation has a significant effect mainly on high-tech manufacturing establishments and on knowledge-intensive industries that are not high-tech, while investment in the electricity grid has an effect both on manufacturing industries and on high-tech services. We also found that investment in health assets and higher education assets has a significant effect on all knowledge-intensive services. These findings point to the industry-level implications of investments in different types of infrastructure, which benefit different businesses in the economy to varying degrees. Therefore, the characteristics of any infrastructure investment program have implications for the country's industrial policy, since investment in a given infrastructure encourages a particular type of economic activity.

We also presented a macroeconomic analysis based on an aggregate production model, in an attempt to extrapolate from our microeconomic estimates to the economy as a whole. The model showed that increasing investment in any given infrastructure by NIS 1 billion is expected to increase GDP by about 0.8% on average under assumptions commonly used in the economics literature, while broad-based investment of NIS 1 billion in each of the infrastructures examined is expected to increase GDP by at least 0.4% under the most

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19 Eckstein et al. (2022) calculated a cumulative increase in GDP of NIS 290 billion over the period 2021–2030 following an investment whose financing entails about NIS 11 billion.

conservative assumptions. This return points to the macroeconomic viability of investment in infrastructure, based on the microeconomic analysis and all its implications discussed above.

In sum, our findings point to the great opportunity currently inherent in significant investment in physical infrastructure and "soft" infrastructure in Israel. The expected return we calculated supports the recommendations of Eckstein et al. (2019), who called for doubling investment in public capital, including advancing human capital through implementation of the recommendations of the "Employment 2030 Committee," promoting the metro plan for the central region, substantially increasing the level of public investment in information and communication technologies, and expanding the use of digital tools in the public sector. To these, we add a call to invest in infrastructure so that it serves as a means of local development, strengthens local producers, and ensures quality employment for residents. We emphasize that investment in infrastructure, both local and national, is expected to strengthen businesses in the area in which they operate.

The comparison between the different investments and their returns should be made with caution. The different types of infrastructure develop similarly over time, creating sharp collinearity between them. For this reason, we had to conduct a separate estimation for each type of infrastructure. This means that the estimate obtained for one type of infrastructure or another may also reflect, among other things, the effects of other types of infrastructure, although the substantial differences in the significance and size of the effect suggest that this is not the case. This difficulty requires particular caution in interpreting the findings, especially with regard to the desirability of investing in one type of infrastructure rather than another. In addition, our estimates are based on the actual changes in infrastructure stocks, which in most years are modest relative to what would be expected from massive investment of billions of shekels. It is possible that an injection of public capital on a much larger scale than observed in the data would lead to a smaller increase in output than estimated, in line with the law of diminishing marginal returns. Moreover, the model presented in this article is static, and does not take into account the waiting time between budgeting the investment and inaugurating the infrastructure, or depreciation and maintenance costs for all infrastructures in calculating the return on investment. We also reiterate that the quantification of public infrastructure stocks carried out in this study is somewhat arbitrary, and that more precise and richer measures of the different types of infrastructure may have yielded somewhat different results. Nevertheless, despite these reservations, our findings converge with other analyses from recent years, which suggest that the expected return from modest investment in infrastructure, in terms of the state budget, is very large, and that such investment is one of the most efficient growth engines for the Israeli economy in its current condition.

All of the above refers exclusively to the measurable economic effect of investments in different types of infrastructure. We did not address at all other effects on citizens' quality of life or the personal benefit they may derive from transportation and electricity networks, health assets, or educational institutions. There is no doubt that this benefit makes investment in public capital even more worthwhile.

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Appendix

Appendix A. Data and methodology

Data

The database used is a combination of two CBS data files. One file contains data from the Manufacturing, Mining and Quarrying Surveys for 2004–2018, and includes about 26,000 observations.[20] The second file contains data from the Business and Trade Surveys for the same years, and includes about 98,000 observations. The survey unit for manufacturing is the establishment; the survey unit for business and trade is the firm. Apart from this difference, the files, both of which constitute representative samples in terms of nominal output, are almost identical in the variables they include: nominal output, number of jobs, compensation of jobs, capital by different classifications, and economic industry. Overall, the database includes about 124,000 observations of economic units operating in Israel's private sector in the years examined.

Data on road length and area and on the length of active Israel Railways tracks were taken from CBS publications, as were data on national investment in health and higher education.[21, 22, 23] Our transportation variable is a weighted product of road area and railway track length, under the assumption that these are substitutable components of a "transportation quality/convenience"

20 Data files at this level of detail are updated with a considerable lag. The study used the files that were available at the time it was conducted.

21 The data on road area for 2010, 2017, 2018, and 2019 are from Table 20.20 of the CBS Civil Engineering Works Survey for 2020. The area in 2014–2016 was calculated based on the completion of paving, widening, and rehabilitation works in each year, according to Table 31 in the Quarterly Statistics of Transportation, No. 3, 2018. The area in 2010–2014 was calculated based on the completion of paving, widening, and rehabilitation works in each year, according to Table 31 in the Quarterly Statistics of Transportation, No. 3, 2014. The area in 2005–2009 was calculated based on the completion of paving, widening, and rehabilitation works in each year, according to Table 33 in the Quarterly Statistics of Transportation, No. 2, 2010.

22 See CBS, Table 2, National Expenditure on Health, 1972/3–2020.

23 See CBS, Table 2, National Expenditure on Education, 1962/3–2019.

variable.[24] As for the weight of each of these two components, our default was two-thirds for roads and one-third for railway tracks, similar to the ratio of expenditure on roads and railways in the Ministry of Transport and Road Safety budget. The estimate of the effect of "transportation stock" presented in the main text refers to these weights, but we also examined alternative weights, including 0 and 1 for each component; the findings are presented in Table A3B in Appendix B. With regard to pricing this variable, we rely on average state investment in transportation during the sample years, which was about NIS 11.6 billion per year.[25] This corresponds to an average annual increase of 2.7% in the transportation variable, and therefore we assume that an investment of NIS 1 billion corresponds to an increase of 0.24% in the transportation variable in that year.

The length of transmission and distribution lines in electricity infrastructure and Israel Electric Corporation investment in the transmission and distribution network, from 2008 onward, were taken from the 2020 State of the Electricity Sector Report. For the eight years 2013–2020, cumulative annual investment of NIS 1 billion in the transmission and distribution network corresponds to an increase of 6,363.1 kilometers in transmission and distribution lines in that year, with an R^2 of 0.9.[26] We use this estimate to analyze the return on investment in the macro model.

Estimating the effect of national investment in public capital on the output of economic units

We estimate the production function of the economic unit, whether a plant or a firm, with investment in public capital included as one of the production inputs, while controlling for economy-wide or industry-specific shocks in each year, using ordinary least squares. We exploit the partially panel-based nature

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24 Formally, the transportation variable in year t is:

$$Transportation_t = Roads_t^{\omega} Rail_t^{\vartheta}$$

where $\mathbf{Roads}_t$ and $\mathbf{Rail}_t$ are the area of roads and the cumulative length of railway tracks in Israel in year *t*, respectively. As a rule, we assume that ω=2/3 and ϑ=1/3.

25 State investments in transportation infrastructure were taken from the CBS, Gross Investment in Fixed Assets and Net Capital Stock by Economic Industry, 1995–2018.

26 The aggregate investment data are taken from the "Total" column in Table 6.1 in the report's data file; the data on the length of transmission and distribution lines are taken from Tables 6.3 and 6.5, respectively.

of the data through a random effects model.[27] Identifying the effect of local investment in public capital on output depends on the assumption that, after controlling for industry-specific or annual shocks, the estimated relationship between the two represents the causal effect.

The baseline model estimated is a Cobb-Douglas production function with uniform output elasticities by economic industry:

$$Y_{i,s,c,t} = A_{i,s,c,t} {K_p}_{i,s,c,t}^{\alpha_s} L_{i,s,c,t}^{\beta_s} {K_g}_t^{\gamma_c} \tag{1}$$

where ($Y_{i,s,c,t}$) is the monetary output, in 2018 prices, of economic unit i in industry s (with technological intensity c) in year t; $K_{pi,s,c,t}$, K_{gt}, and $L_{i,s,c,t}$ are private capital, public capital, and workers, respectively; α_s, β_s, and γ_c are the output elasticities with respect to the inputs; and $A_{i,s,c,t}$ is nominal total factor productivity, which includes the production characteristics specific to the economic unit, as well as demand shocks and other factors.

Based on this model, the estimating equation relates the logarithm of output to a weighted sum of the logarithms of the variables on the right-hand side. Lowercase letters denote logarithms:[28]

$$y_{i,s,c,t} = a + \alpha_s {k_p}_{i,s,c,t} + \beta_s l_{i,s,c,t} + \gamma_c k_{gt} + \delta_t + \mu_{s,c} + \epsilon_{i,s,t,c} \tag{2}$$

where the lowercase letters denote the logarithms of the corresponding variables in equation (1); the variables δ_t and $\mu_{s,c}$ are constants for each year and industry, which, together with a, represent the logarithm of $A_{i,s,c,t}$.

27 As a rule, estimating production functions by ordinary least squares suffers from various biases, and the resulting estimates of output elasticities with respect to inputs are therefore biased. Particularly important is the bias arising from the fact that, in practice, production inputs are correlated with various shocks experienced by the producer, whereas simple estimation assumes no such correlation. These estimates, which are not reported here, have no real interpretation as the elasticity of output with respect to public capital. In practice, we assume that the stock of public capital is determined exogenously to the decisions of the economic unit, and in identifying its effect on output we effectively control for production inputs in case they are correlated with the stock of public capital, whether directly, through the indirect effect of public capital on output as discussed in the literature review, or indirectly, for example through macroeconomic factors not captured by the annual fixed effects.

28 $\epsilon_{i,s,t,c}$, $\mu_{s,c}$, and δ_t are all assigned to the variable $A_{i,s,c,t}$ in equation (1).

They allow us to control for possible correlation between investment in public capital and annual or industry-specific shocks, such as the interest-rate environment or the overall state of the economy; $\epsilon_{i,s,c,t}$ is the estimation residual.

The parameters we seek to estimate are γ_c, corresponding to the number of technological-intensity groups c, seven groups in our estimation; see Table A5 in Appendix B. Since the public-capital variables k_g are constant across economic units in any given period, they cannot be estimated separately from the annual constants δ_t. As a conservative solution, we define one technological-intensity group as the control group, namely less knowledge-intensive services. In effect, we do not measure the effect of public capital on businesses in this field, but only its effect on the other six groups. It should be noted that while this choice strengthens the identification assumptions for the parameter estimates of the six measured groups, when we incorporate these estimates into a macroeconomic model, this choice biases the aggregate effect of public capital downward. This is because, in the model, the control group derives no benefit from public capital, although in reality it is reasonable to assume that it does benefit from it. Nevertheless, even under this conservative choice, the aggregate model predicts very large returns to investment in public capital. If this estimate is biased downward, that only strengthens the arguments presented in the body of the paper.

From micro to macro: An aggregate model

The macroeconomic model is a simple model of monopolistic competition under nested CES demand, in the spirit of Armington (1969), Dixit and Stiglitz (1977), Melitz (2003), and Hsieh and Klenow (2009).

Aggregate output Y_{total} is a CES aggregate of S "industry products," each of which is itself a CES aggregate of n_s nominal outputs of the economic units operating in that industry:

(3)
$$Y_{total} = \left[\sum_{s=1}^{s}\left[\left(\sum_{i=1}^{n_s} Y_{i,s}^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}\cdot\frac{\theta-1}{\theta}}\right]\right]^{\frac{\theta}{\theta-1}}$$

where the parameters σ and θ represent the elasticity of substitution between products within an industry and between industries in the economy, respectively.[29] The outputs of the economic units, $Y_{i,s}$, are explained by various factors, including public capital, according to equation (1). This model rests on three main assumptions:[30, 31]

1. There is a constant and uniform elasticity of substitution between all industries in the economy.
2. There is a constant and uniform elasticity of substitution between all economic units operating within each industry in the economy.
3. Public capital affects aggregate output only through its effect on the output of the economic units, so that:

$$\frac{\partial Y_{total}}{\partial k_g} = \frac{\partial Y_{total}}{\partial Y_{i,s}} \cdot \frac{\partial Y_{i,s}}{\partial k_g}$$

This assumption also reflects a negligible cost of investment in public capital.

To calculate the relative effect of a given investment in public capital, ΔG, on aggregate output, Y_{total}, we insert its effect on the output of each economic unit, $Y_{i,s}$, into equation (4), divide the resulting expression by the original sum, and subtract one:

$$(4) \qquad Y_{\%\,gain\,from\,\Delta K_g} = \frac{Y_{total} + \frac{\Delta Y_{total}}{\Delta K_g}}{Y_{total}} - 1 = \frac{\left[\sum_{s=1}^{S}\left[\left(\sum_{i=1}^{n_s}\left(Y_{i,s,c} + \frac{\Delta Y_{i,s}}{\Delta K_g}\right)^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}\cdot\frac{\theta-1}{\theta}}\right]\right]^{\frac{\theta}{\theta-1}}}{\left[\sum_{s=1}^{S}\left[\left(\sum_{i=1}^{n_s} Y_{i,s,c}^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}\cdot\frac{\theta-1}{\theta}}\right]\right]^{\frac{\theta}{\theta-1}}} - 1$$

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29 σ and θ are positive. As they approach 0 from above, products or industries become more complementary; as they approach 1, the function approaches a Cobb-Douglas function; and as they become larger, above 1, products or industries become more substitutable. The range of possibilities we cover, shown in Table A4, is based on the range discussed in Hsieh and Klenow (2009).

30 The first two assumptions are justified for a specific, unknown pair of values of σ and θ. We therefore use a broad range of values, as far as the literature allows, for both parameters, within which the “true” value is likely to lie. The third assumption is necessary in order to place the micro estimates from equation (2) within a macroeconomic framework.

31 If our estimate of the effect of public capital on output at the economic-unit level includes an indirect effect through changes in labor and private capital, then we must add a fourth assumption: that the economy is able to generate additional private capital and workers as needed, without affecting the return on public capital.

Appendix B. Full results of the empirical estimates

Table A1. Panel estimation results for the relationship between the public capital-to-output ratio and GDP per capita in OECD countries

Dependent variable	Natural log of GDP				
	(1)	(2)	(3)	(4)	(5)
Model, sample	Linear single-variable, full sample	Linear single-variable, observations with public capital to output ratio between 30% and 50%	Linear single-variable, full sample*	Aggregate output model, full sample*	Aggregate output model, full sample*
Nominal public capital (log)	0.392***	0.384***	0.338***		0.114**
	(0.023)	(0.024)	(0.031)		(0.053)
Nominal private capital (log)				0.332***	0.205***
				(0.038)	(0.053)
Active labor force (log)				0.729***	0.777***
				(0.092)	(0.075)
Intercept	9.151***	8.906***	10.087***	2.105***	1.928***
	(0.331)	(0.317)	(0.452)	(0.707)	(0.701)
Fixed effects	Country	Country	Country	Country	Country
Observations	639	266	330	330	330
(Countries)	(36)	(21)	(33)	(33)	(33)
[Years]	[20]	[20]	[10]	[10]	[10]
R^2	0.47	0.54	0.43	0.74	0.75
F	279.3	246.9	117.4	218.57	141.88
(p value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

In the analysis that includes controls for private capital and the labor force, Türkiye, Slovakia, and Korea, as well as the years 2000–2010, were omitted due to missing data. Column (3) reproduces Column (1) using the remaining sample, for comparison with the results of the aggregate output model.

Significance levels: *p < 0.10; **p < 0.05; ***p < 0.01.

Note: Each cell reports the estimate, with the standard error shown below in parentheses. The estimates are based on a panel comprising data for 36 OECD member countries, including Israel, over 20 years. Standard errors are two-way clustered by year and by country. Active labor force applies to people aged 15 and over who worked as employees or self-employed workers during the given year.

Source: Benjamin Bental and Michael Debowy, Taub Center | Data: ILO; IMF; OECD

Table A2. Descriptive statistics for public infrastructure

Variable	Transportation		Electricity	Higher education	Health
	Cumulative area of roads (1,000 km)	Cumulative area of active rail lines (km)	Cumulative length of high-tension wires (km)	Fixed assets per capita (NIS per capita)	Fixed assets per capita (NIS per capita)
Mean	166.3	1,102.8	68,699.9	1,912.2	3,076.3
Standard error	(12.5)	(196)	(3,461.7)	(483.9)	(778)
Years	2004–2018	2004–2018	2013–2018	2004–2018	2004–2018

Source: Benjamin Bental and Michael Debowy, Taub Center | Data: CBS

Table A3A. Estimation results for the effect of the stock of public capital on output in Israel's private-sector industries

Explanatory variable		Dependent variable: Log of output (NIS, 2018 prices)			
		(1)	(2)	(3)	(4)
Major sector	Technological intensity	2/3 X log of roads (km²) + 1/3 X log of rail lines (km)	Log of electricity grid (km of high-tension wires)	Log of health assets (NIS, 2018 prices)	Log of higher education assets (NIS, 2018 prices)
Manufacturing	Traditional technology	-0.020	0.233*	-0.014	-0.014
		(0.0143)	(0.1224)	(0.0102)	(0.0109)
	Mixed traditional technology	-0.089	-0.089	-0.008	-0.007
		(0.0128)	(0.1701)	(0.0083)	(0.0093)
	Mixed high-tech	-0.012	-0.246	-0.010	-0.011
		(0.0114)	(0.5676)	(0.0071)	(0.0079)
	High-tech	1.157**	-0.301	-0.104	-0.074
		(0.4229)	(0.7201)	(0.3089)	(0.3310)
	Base category: Non-high-tech services				
Private sector	Other high-tech services	0.751*	1.202	0.990**	0.948**
		(0.3952)	(0.9377)	(0.3474)	(0.3880)
	High-tech and financial services	-0.046	0.255**	0.575*	0.602*
		(0.3612)	(0.1437)	(0.3470)	(0.3247)
Additional variables		sector X log (labor), sector X log (private capital), sector, year, intercept	sector X log (labor), sector X log (private capital), sector, year, intercept	sector X log (labor), sector X log (private capital), sector, year, intercept	sector X log (labor), sector X log (private capital), sector, year, intercept
R^2		0.847	0.854	0.847	0.847
F statistic for public capital variable		5.23	7.68	5.01	4.35
(p value)		(0.0002)	(0.0000)	(0.0002)	(0.0008)
Number of observations		106,286	54,680	106,286	106,286
Years		2004–2018	2013–2018	2004–2018	2004–2018

Significance levels: *p < 0.10; **p < 0.05; ***p < 0.01.

Note: Each cell reports the estimate, with the standard error shown below in parentheses. The table presents the estimation results, the estimates of γ_c from equation (2). Standard errors are clustered at the industry level.

Source: Benjamin Bental and Michael Debowy, Taub Center | Data: CBS

Table A3B. Estimation results for the effect of the stock of public capital on output in Israel's private-sector industries, by weighting of the transport variable

Explanatory variable: Major sector	Explanatory variable: Technological intensity	Dependent variable: Log of output (NIS, 2018 prices) (1) 1 X log of roads (km²) + 0 X log of rail lines (km)	(2) 2/3 X log of roads (km²) + 1/3 X log of rail lines (km)	(3) 1/2 X log of roads (km²) + 1/2 X log of rail lines (km)	(4) 1/3 X log of roads (km²) + 2/3 X log of rail lines (km)	(5) 0 X log of roads (km²) + 1 X log of rail lines (km)
Manufacturing	Traditional technology	-0.024	-0.020	-0.019	-0.018	-0.016
		(0.0170)	(0.0143)	(0.0133)	(0.0124)	(0.0109)
	Mixed traditional technology	-0.010	-0.008	-0.007	-0.007	-0.006
		(0.0142)	(0.0128)	(0.0133)	(0.0124)	(0.0109)
	Mixed high-tech	-0.015	-0.012	-0.011	-0.011	-0.009
		(0.0123)	(0.0114)	(0.0110)	(0.0107)	(0.0100)
	High-tech	1.557**	1.157**	1.021**	0.913**	0.752**
		(0.5803)	(0.4229)	(0.3714)	(0.3309)	(0.2712)
	Base category: Non-high-tech services					
Private sector	Other high-tech services	0.480*	0.587*	0.659*	0.751*	1.028*
		(0.2609)	(0.3148)	(0.3507)	(0.3952)	(0.5250)
	High-tech and financial services	-0.032	-0.046	-0.048	-0.048	-0.046
		(0.4906)	(0.3612)	(0.3813)	(0.2843)	(0.2339)
Additional variables		sector X log (labor), sector X log (private capital), sector, year, intercept	sector X log (labor), sector X log (private capital), sector, year, intercept	sector X log (labor), sector X log (private capital), sector, year, intercept	sector X log (labor), sector X log (private capital), sector, year, intercept	sector X log (labor), sector X log (private capital), sector, year, intercept
R^2		0.847	0.847	0.847	0.847	0.847
F statistic for public capital		5.20	5.23	5.23	5.23	5.22
(p value)		(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0002)
Number of observations		106,286	106,286	106,286	106,286	106,286
Years		2004–2018	2004–2018	2004–2018	2004–2018	2004–2018

Significance levels: *p < 0.10; **p < 0.05; ***p < 0.01.

Note: Each cell reports the estimate, with the standard error shown below in parentheses. The table presents the estimation results, the estimates of γ_c from equation (2), for transport infrastructure under different assumptions regarding the substitutability between railways and roads. Standard errors are clustered at the industry level.

Source: Benjamin Bental and Michael Debowy, Taub Center | Data: CBS

Table A4. The effect of a NIS 1 billion investment in different types of infrastructure on aggregate output in the private sector, by type of infrastructure and model parameters

Parameters		Change in final output (%) per annum as a result of an additional investment of NIS 1 billion in infrastructure			
θ	σ	Transportation (about 67 km² of roads and 1 km rail lines)	Electricity grid (about 6,400 km of grid lines)	Health	Education
0.5	0.5	0.5	0.1%	0.1%	0.1%
	→1	→1	0.5%	0.5%	0.5%
	3	3	0.8%	0.8%	0.8%
	10	10	0.8%	0.8%	0.8%
→1	0.5	0.5	0.7%	0.6%	0.7%
	→1	→1	0.8%	0.7%	0.8%
	3	3	1.1%	0.9%	1.1%
	10	10	1.2%	0.9%	1.1%
2	0.5	0.5	0.8%	0.7%	0.8%
	→1	→1	0.8%	0.6%	0.8%
	3	3	1.0%	0.8%	0.9%
	10	10	1.5%	1.5%	1.5%

Note: Each cell contains the estimate of the change in final output resulting from an investment of NIS 1 billion in public capital, according to equation (4), where the relevant public capital is given by the column and the model parameters (θ, σ) are calibrated according to the rows shown. The "baseline assumptions" presented in Figure 5 correspond to $\theta \to 1$ and σ=3, the values commonly used in the literature for these parameters; see Hsieh and Klenow (2009).

Source: Benjamin Bental and Michael Debowy, Taub Center | Data: CBS

Table A5. List of industries, by technological intensity

Major sector	Technological intensity	List of branches	Percent of labor force
Manufacturing	Traditional technology	Manufacture of food products; manufacture of beverages; manufacture of tobacco products; manufacture of textiles; manufacture of wearing apparel; manufacture and processing of leather and related products; manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials; manufacture of paper and paper products; printing and reproduction of recorded media, excluding reproduction of recorded materials; manufacture of furniture and other manufacturing	7%
	Mixed traditional technology	Manufacture of coke and refined petroleum products; manufacture of rubber and plastics products; manufacture of other non-metallic mineral products; manufacture of basic metals; reproduction of recorded media; manufacture of fabricated metal products, except machinery and equipment; and building of ships and boats	4%
	Mixed high-tech	Manufacture of chemicals and chemical products; manufacture of electrical equipment; manufacture of machinery and equipment n.e.c.; manufacture of motor vehicles, trailers and semi-trailers; and manufacture of medical, dental and orthopedic instruments and supplies	3%
	High tech	Manufacture of pharmaceuticals; manufacture of computers, electronic and optical products; and manufacture of air and spacecraft and related machinery	3%
Private sector	Non-high tech services	Wholesale and retail trade and repair of motor vehicles and motorcycles; wholesale trade, except motor vehicles and motorcycles; retail trade, except motor vehicles and motorcycles; land transport and transport via pipelines; warehousing and support activities for transportation; postal and courier activities; accommodation; food and beverage service activities; real estate activities; rental and leasing activities; travel agency, tour operator, reservation service and related activities; services to buildings and landscape activities; office administrative, office support and other business support activities; activities of membership organizations; repair of computers and personal and household goods; other personal service activities; activities of households as employers of domestic personnel; undifferentiated goods- and services-producing activities of private households for own use; activities of extraterritorial organizations and bodies	43%
	Other high-tech services	Water transport; air transport; legal and accounting activities; activities of head offices; management consultancy activities; architectural and engineering activities; technical testing and analysis; advertising and market research; other professional, scientific and technical activities; employment activities; security and investigation activities; publishing activities; veterinary activities; education; human health activities; residential care activities; social work activities without accommodation; creative, arts and entertainment activities; libraries, archives, museums and other cultural activities; and sports, amusement and recreation activities	30%
	High-tech and financial services	Computer programming, consultancy and related activities; information service activities; scientific research and development; financial service activities, except insurance and pension funding; insurance, reinsurance and pension funding, except compulsory social security; activities auxiliary to financial service and insurance activities; motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities; and telecommunications	10%

Source: Benjamin Bental and Michael Debowy, Taub Center | Data: CBS