Economic Capital

Economic capital, which encompasses physical capital, knowledge capital, and financial capital, directly and indirectly promotes the well-being of residents. It contributes to a country's capacity to supply goods and services, both in the present and in the future, and is thus crucial to individual welfare in the most basic sense as well as in improving the standard of living. Sustainable well-being thus requires the maintenance of an adequate productive capacity, which in turn requires a suitable level of physical capital. Knowledge capital also plays a vital role in forming a country's productive capacity, while financial capital provides flexibility to acquire other forms of capital, offering protection against adverse economic (as well as medical and other) shocks.

�« 　Definition of Economic Capital

Economic capital comprises physical capital, knowledge capital, and financial capital.[8]

�« 　Physical Capital

Physical capital is regularly measured by statistical agencies, following OECD guidelines. It represents a country's accumulated value of residential buildings, all types of non-residential structures, as well as machines and equipment. To arrive at the net value of physical capital it is necessary to account for depreciation, some of it physical, some due to declining usability. Since different components of physical capital are aggregated to a single monetary value, depreciation is also measured in real value terms. After depreciation is accounted for, the remaining net capital provides a measure of usable capital.

Infrastructure capital, which is counted as part of physical capital, plays a distinct role in the evaluation of sustainability. This capital stock includes the value of items such as roads, bridges, railways, airports, water supply systems, communication infrastructures, and electrical infrastructures, most of which are owned by the government in one form or another.

The 2009 OECD guidelines broadened the definition of physical capital to include accumulated investment in research and development (R&D) and various forms of intellectual property. As a result, the unqualified term "capital" that is now used in national statistics consists of physical capital plus intellectual capital. We, however, believe that for the purpose of measuring sustainability, major forms of intellectual capital belong to the stock of knowledge, which is discussed below.

8   For further discussion on economic capital in general and Israel in particular, see the economic capital review in the Digital Appendix to this report (Sarel, 2021).

�« 　Knowledge Capital

Knowledge capital is paramount for sustainability, because it plays a special role in modern economic growth, as discussed in the next section. At this stage we need to explicitly distinguish knowledge capital from physical capital, despite the fact that large parts of intellectual property (IP) are now included in the physical capital stock by using investments in R&D plus normal accumulated return, which are fairly imprecise measures of the knowledge stock. A country's knowledge capital is also reflected in the quality of its patents, the strength of its academic institutions, and the ability of its population to generate ideas. It is further embodied in its human capital (which is separately addressed in this report), as well as in what is sometimes referred to as organizational capital. The latter represents the tacit knowledge and modes of operation of business firms and governmental agencies (e.g., their organizational structure, "culture" and norms, trust, and the resulting efficiency), which are very hard to measure. It is well known that knowledge capital plays an essential role in shaping an economy's productivity level, which contributes in turn to the economy's capacity to supply goods and services.

An important caveat to measuring knowledge capital is the foreign ownership of the IP assets that have not been valued externally, or at least not adequately reported to the statistical agencies. We address this in our discussion of financial capital below.

�« 　Financial Capital

Financial capital is the claim of the citizens of a country to its financial assets net of their obligations to other countries. Financial assets represent claims to future cash flows that are generated by physical and knowledge assets. For this reason, one has to be careful not to double-count the underlying assets: once as part

of the physical or knowledge capital stock and the second time as part of the ownership claims to the same assets in the form of financial assets. For example, government bonds issued by Israel and owned by Israel's residents generate neither net obligations for the country nor net asset holdings: every shekel of this type of asset has a corresponding shekel obligation. Similarly, ownership by Israeli residents of shares in an Israeli company that has all its physical and knowledge assets in Israel should not be counted as financial capital. Otherwise, the company's assets will be counted twice: once in the physical capital stock and a second time in the financial capital stock. The exception is ownership of natural resources, as their reserves are not counted as physical capital. Financial assets holding such ownership do represent part of financial capital, appropriately apportioned to Israeli owners.

On the other hand, financial assets issued by a country's residents or other entities that are held by foreign residents do generate net obligations. Similarly, any holdings in a sovereign wealth fund should be considered as part of financial capital as they do not have financial obligations against them, while the reserves of the central bank should not. By the same token, holdings of foreign financial assets by a country's residents and other entities generate assets with no corresponding domestic obligations. For this reason, a country's total holdings of financial assets minus its total financial obligations, which equal the country's holdings of foreign financial assets minus foreigners' holdings of the country's financial assets, represent the country's financial capital.

◨ Economic Capital and Well-being

Economic capital impacts well-being in many different ways: some direct, others indirect. Yet all three forms of economic capital – physical, knowledge, and financial – contribute to a country's capacity to supply goods and services, both in the present and in the future. The pathways through which they carry out these tasks differ, however.

Housing, food, and clothing, which represent **physical capital**, are high-priority consumption items in modern societies. Residential buildings provide housing services that are essential for well-being. Indeed, improvements in housing played a leading role in the rise of the standard of living during the second half of the 19th century and the early part of the 20th century. For these reasons, sustainability of well-being depends on the preservation of an adequate housing stock and an increase in its supply to meet the increase in demand, which in Israel grows rather fast.

Commercial buildings and machines and equipment are indispensable items in the production of goods (such as cars) and services (such as financial intermediation or retail). Larger quantities of these components of physical capital raise an economy's productive capacity, enabling it to produce more goods and services, and goods and services play a key role in engendering well-being. GDP measures the aggregate value of an economy's output of goods and services, and GDP per capita is often used as a measure of a country's economic well-being. Although GDP per capita is not an adequate measure of all aspects of well-being, it does contribute immensely to a country's standard of living and is correlated with other measures such as health, education, and personal safety. For this reason, sustainability requires the maintenance of an adequate productive capacity, which in turn requires a suitable level of physical capital.

Knowledge capital plays a vital role in forming a country's productive capacity. Economists distinguish between the contribution of inputs to GDP – such as labor, land, and machines – and total factor productivity. The latter represents many unmeasured factors that influence the value of output (given the inputs), such as quality of technology, institutional capital, organizational capital, and efficiency of resource use. Among these factors, knowledge capital plays a primary role. Knowledge contributes to productivity by enhancing the efficiency with which other inputs are used. It also raises the profitability of investment in capital equipment, thereby altering future capital stocks.

Some of the knowledge capital is embodied in production blueprints, which are often protected by patents and other laws designed to safeguard intellectual property rights. Others are protected by laws governing copyrights, design rights, and trademarks. But, as is widely recognized, specific knowledge-creating processes – such as R&D designed to develop a particular product – also contribute to broad, useful knowledge that is not protected by laws or trade secrets. This nonproprietary useful knowledge is then used by other economic entities to advance their own production of goods and services. It is recognized that these by-products of knowledge creation generate benefits that are not internalized by the knowledge creators themselves because these benefits accrue to other economic entities. As a result, the social benefits of knowledge creation exceed the private benefits by a substantial margin. This argument applies even more forcefully to knowledge acquired from basic research, carried out by Israel's universities, medical centers, and other research institutions. In this sense, investment in knowledge creation differs from investment in machines or infrastructures and it has a significantly higher rate of return. For this reason, it is important to measure the stock of knowledge capital separately from the stock of physical capital

and to emphasize its special role in shaping productivity, as is highlighted by the modern view of economic growth. Depletion of knowledge can indeed be very detrimental to sustainability, but it is very hard to measure in the short run.

As a contributor to sustainability, **financial capital** plays three roles. First, it provides flexibility to acquire other forms of capital according to need. Second, it provides protection against adverse economic (as well as medical and other) shocks. A country with a larger stock of financial capital can better weather severe shocks than a country that lacks these resources. In other words, financial capital acts as an insurance policy against an adverse economic shock that can diminish the country's productive capacity, reducing its well-being. Finally, a sizable stock of financial capital is often (but not always) associated with a well-developed financial system that can channel savings into the best available investment opportunities, increasing the future capacity of the economy to produce goods and services. For these reasons, sustainability requires a country to maintain not only a suitable net asset position, but also a well-functioning, efficient, and nonextractive financial system of adequate size relative to the size of the economy (which is currently not the case in Israel). To meet these needs, measures of financial strengths and weaknesses that are reflective of the entire financial system are required, including banks, stock exchanges, insurance companies, pension funds, and other fund management companies. A variety of measures of the strength of financial systems and their impact on growth are available in the literature (e.g., Beck, Levine, & Loayza, 2000; Levine, Loayza, & Beck, 2000).

◨ Economic Capital Resources and Their Measurement

◨ Physical Capital

It is evident from the above descriptions that some components of economic capital are easier to measure than others. Statistical agencies use a well-established methodology to estimate physical capital, which consists of infrastructures, machines and equipment, and intellectual property products using a well-established methodology. They take the previous net physical capital, add current investment, and subtract depreciation to obtain the current net physical capital. These calculations are done using the prices at which these assets were purchased and converting them to constant prices in order to make the estimates comparable over time in "real terms."

The Israel Central Bureau of Statistics regularly reports the country's net physical capital. Its components are residential buildings, non-residential buildings and other construction, machinery and other equipment, intellectual property products, and cultivated biological resources. While cultivated biological resources constitute a very small part of physical capital (about three-tenths of one percent), intellectual property products are of the same order of magnitude as machinery and other equipment (8% vs. 10%). By far the largest component is residential buildings, which accounts for almost one-half of the net physical capital, indicating that residential housing is the biggest part of this capital.

Physical capital indicator: This is the standard measure of physical capital discussed above. It is recommended to measure the physical capital because maintaining an adequate level of it is paramount for sustainability. In addition, it is recommended to separately report the net capital of residential buildings, because housing is a major contributor to well-being. As for intellectual property products, they should be considered as knowledge capital for the reasons delineated above.

Infrastructure capital indicator: Infrastructure capital should be computed in the same way as physical capital, by adding investment and subtracting depreciation, except that for this measurement investment should include only infrastructure items, such as the construction of roads, railways, bridges, airports, water supply systems, communication networks, electricity supply systems, as well as military installations. The Accountant General in the Ministry of Finance publishes the balance sheet of the Israeli government, and much of the infrastructure capital can be found there.

Distribution of housing ownership indicator: Measures the distribution of housing ownership (in terms of value) by income decile to capture the degree of inequality in the distribution of the main source of wealth in the population.

Green capital indicator: Measures the fraction of green housing and the fraction of green capital in the energy and other sectors. This indicator is recommended to measure the green capital because future sustainability depends on the extent of green economic activity that is driven by green capital.

◘ Knowledge Capital

Knowledge is notoriously difficult to measure. Yet its importance in maintaining sustainability is so great that whatever useful measures can be amassed should be included in the menu of sustainability indicators. Chief among them is R&D capital. R&D capital is calculated in the same way as regular capital, namely, by adding to the previous net value of R&D capital current investment in research and development and subtracting from it depreciation in order to arrive at the current net value of R&D capital. This indicator is easy to compute and it provides essential information about an economy's core ability to produce goods and services.

Much of the private research and development conducted in Israel is performed for foreign multinational corporations (which account for over 40% of the R&D expenditure in Israel). As a result, a large share of the fruits of this research is appropriated by foreign companies. There still exist spillovers that contribute to general knowledge, but it has to be recognized that the net R&D capital indicator may overestimate this component of the knowledge capital. One way to address this difficulty is to adjust the measure of the knowledge capital by multiplying it by the percentage of R&D expenditures that are accruing to Israeli companies.

> **R&D capital indicator:** This is the standard measure of R&D capital (with the possible adjustment) discussed above.

> **Patents indicator:** Analyzing data on patents registered by Israeli entities and their quality is an additional approach to addressing the difficulty of measuring knowledge. This type of data is readily available in standard patent registries, such as the U.S. and the European patent offices. Patent citations can be used as a standard measure of patent quality (e.g., Gandal, Kunievsky, & Branstetter, 2020).

> **Basic research capital indicator:** Measures basic research capital, based on expenditure on basic research in universities and research institutes.

Knowledge capital is calculated as a normative return (determined by the Central Bureau of Statistics) on investment in knowledge companies. In many cases companies are sold at early stages of technological development for values that greatly exceed the cumulative investment in their operation. This implies that only a small portion of the value of these companies' knowledge is captured by R&D accounting. Furthermore, such sales to foreign owners are not recorded as part of the GDP, but rather as international capital movements. As a result, these values are included in the financial capital and not in the knowledge capital. A large portion of profits from sales of these companies accruing to Israeli founders, investors, and workers (through employee options) reflect a return on knowledge and should therefore be considered as part of the return on knowledge capital.

◘ Financial Capital

As we discussed above, calculating financial capital is conceptually simple: it consists of the country's holdings of foreign financial assets minus foreigners' holdings of the country's financial assets. However, this calculation misses the role of abnormal profits that cause the value of a firm's shares to exceed the value of its physical and knowledge capital stocks (a market-to-book value of more than one). One way to correct this measure is to compute the average market-to-book value of firms whose shares are publicly traded and assume that this ratio also applies to the rest of the productive assets with comparable characteristics (not including the value of residential buildings and infrastructure capital). Adding the estimated market-to-book value (minus one) times the value of the productive assets would provide an addition to the estimate of aggregate financial capital.

> **Financial capital indicator:** This is the standard measure of financial capital discussed above.

There are many measures of efficiency of financial systems. The difficulty in applying them to Israel is that the financial system of a small and isolated country (excluding venture capital, which operates separately from the other financial institutions) cannot be easily compared to the financial systems of much larger countries at a similar level of development. Nevertheless, some measures of financial system efficiency need to be included for sustainability evaluation. Moreover, we recommend reporting measures of financial inclusion.

> **Financial inclusion indicator:** Measures the number of people who have bank accounts or retirement savings accounts.