



# And the IMF Said, Let There Be Data, and There Was Data: Private Capital Stocks in the Eastern Bloc

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[LINK TO ABSTRACT](#)

According to an International Monetary Fund (IMF) dataset, most of the economic investment and resultant capital stock in the Soviet Union circa 1965 was private. Isn't it obvious that there's something wrong with the dataset?

Considering the paucity of data for national accounts when looking back more than a few decades, genuine data for the capital stock for so many countries from over fifty years ago would be quite the achievement. The IMF's new "Investment and Capital Stock Dataset" ([link](#)) claims to provide data for stocks of private and public capital from 1960 to 2015 for 170 countries. The current documentation supporting the dataset (IMF 2017a; b) does not describe, much less justify, the assumptions that we criticize in this paper.

There are many reasons for caution when interpreting measures of public capital (see, e.g., Pritchett 2000). However, the IMF makes an important and unreasonable assumption that sets its dataset apart, even considering the sometimes heroic assumptions made in other datasets. The assumption is left unjustified and remains opaque without close scrutiny of the dataset. If the assumption were to be clear and known, it would be immediately obvious that most of the data is synthetic and that the dataset is not credible. The assumption directly applies to 39 percent of the data points in the dataset, and it indirectly impacts nearly all the data points.

Because measuring capital stocks directly is difficult, if not impossible, estimates tend to use what is known as the perpetual inventory method: In each

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period, new investment is added to the existing capital stock to capture the accumulation of capital, and a depreciation rate is applied to the existing capital stock to reflect depreciation. The perpetual inventory method can be used to construct a country's total capital stock (Christensen and Jorgenson 1969; Baier et al. 2006; Berlemaun and Wesselhoft 2014) or its public capital stock (Ratner 1983; Costa et al. 1987; Aschauer 1989; Lynde and Richmond 1993). The IMF uses many of the assumptions made by Christophe Kamps (2006) and Sanjeev Gupta et al. (2014), who construct datasets which provide estimates for both public and private stocks of capital. Surveys of the literature on public capital stocks indicate that increases in their size have positive but heterogeneous effects on growth (Romp and de Haan 2007; Bom and Ligthart 2014).

Those familiar with national accounts may recall that finding a separate measure of private and public investment is more difficult than finding a measure of total investment. Constructing public and private capital stocks would presumably involve a great deal of historical data on public and private investment. The absence of such historical data did not deter the IMF. They assume, in effect, that *the fraction of investment that was private in the earliest year for which there is historical data was also the fraction for all preceding years*. The IMF thereby applies relatively recent data, often from the mid-1990s, to generate data points as far back as 1960 (and the assumption is applied for one hundred years prior to that, in order to construct the 'initial' capital stock of 1960).

The IMF dataset includes data points corresponding to countries operating behind the Iron Curtain, using the modern-day names of countries and constructing synthetic data for them even if they were part of the Soviet Union. For Ukraine, for example, the assumption takes the proportion of public versus private investment as measured in the 1990s and projects that constant proportion backwards in time. But it stands to reason that the private portion of investment was vastly lower when the territory was under Soviet control.

The dataset states that 86.6 percent of all investment in Russia under communism was *private* investment. As a point of reference, by 1990 employment in state enterprises accounted for 90 percent of employment in the Soviet Union, whereas less than four percent of employment was in the private sector (Fischer 1994). Further, during the run-up to transition toward markets and away from central planning, the proportion of public investment likely underwent substantial change. Given the push to industrialize through the accumulation of public physical capital in the Soviet Union, it is unlikely that in Russia the proportion of public investment was constant at 13.4 percent from 1918 to 1990. More anecdotally, in China during the Great Leap Forward private capital was infamously melted down to produce steel for public investment (Li and Yang 2005), a jarring manifestation of compelled changes in the proportion of public and private investment.

One of us (Murphy) uncovered this issue in the midst of searching for new data on public and private stocks of capital or wealth for the *Economic Freedom of the World* (EFW) index. EFW currently lacks such a measure, so its measures of the size of government pertain only to spending flows (e.g., government investment as a percentage of all investment), not stocks. This leads to the criticism that places such as Hong Kong are overrated because, for instance, the index misses that the Hong Kong government owns the housing stock. The coverage of the IMF dataset appeared to be exactly what would have been needed to serve this purpose. Murphy derived what EFW would have likely used as a variable (public capital divided by public plus private capital) for Hong Kong and became concerned when it did not correspond to how Hong Kong is generally portrayed. He then looked at the ratio of private to public investment across time in various countries and realized that much of the dataset was synthetic, upon finding the private investment proportion to be constant across time.

## Detailed exposition

Constructing capital stocks using the perpetual inventory method dates to at least the 1950s (Goldsmith 1951), but its application to public capital stocks is more recent (Ratner 1983; Costa et al. 1987; Aschauer 1989; Lynde and Richmond 1993). Robert Ford and Pierre Poret (1991) and Paul Evans and Georgios Karras (1994) study the productivity of public and private capital using data from the OECD “Flows and Stocks of Fixed Capital 1971–1996” dataset, which offered a panel of private and public capital stocks for 12 countries. But the early effort by the OECD to construct a panel of capital stocks was discontinued 1997 because of differences in how each series was constructed (Strum et al. 1998; Kamps 2006). So the IMF is not alone in relying on heroic assumptions to construct flawed datasets of capital stocks.

The starting point for the IMF dataset is Kamps (2006). He uses the perpetual inventory method to construct the first set of comparable public and private capital stocks for a substantial panel, covering 22 OECD countries from 1960 to 2001. Using the same assumptions and methodology, the IMF constructs a series of public and private capital stocks for 170 countries from 1960 to 2015. The perpetual inventory method measures the capital stock (public or private) in period  $t+1$ ,  $K_{t+1}$ , as the sum of the capital stock after depreciation ( $\delta$  is the annual rate of depreciation of the capital stock) and gross investment,  $I_t$ .

$$K_{t+1} = (1 - \delta)K_t + I_t \quad (1)$$

The capital stock in period  $t+1$  can be written as a weighted sum of past investment and the depreciated capital stock from period one,  $K_1$ , as described in Equation 2. Therefore, constructing a capital stock series requires a figure for the initial capital stock, a depreciation rate, and an investment series.

$$K_{t+1} = (1 - \delta)^t K_1 + \sum_{i=0}^{t-1} (1 - \delta)^i I_{t-i} \quad (2)$$

To estimate the initial public and private capital stock in 1960, Kamps (2006) and later Gupta et al. (2014) construct an investment series that starts in 1860 and grows at four percent per year, such that that series matches the observed level of investment in 1960. Kamps (2006) and the IMF assume that the capital stock was zero in 1860 and calculate the capital stock for each year from 1861 to 1960 using the investment series that grows at four percent per year to arrive at an estimate of the initial capital stock in 1960. The depreciation rates are assumed to change over time as described by Gupta et al. (2014), and new investment is assumed to be made mid-year. Iterative substitution yields the representation in Equation 3, which is used by Kamps (2006) as well as the IMF. Equation 3 is used to calculate both the public capital stock and the private capital stock, with the type of capital indexed by the superscript  $j$ .

$$K_{t+1}^j = (1 - \delta_t^j) K_t^j + \left(1 - \frac{\delta_t^j}{2}\right) I_t^j \quad (3)$$

The rationale found in Kamps (2006) for assuming an annual investment growth rate of four percent from 1860 to 1960 is that four percent matches the total gross investment growth rate in 22 OECD countries from 1960 to 2001. For more than a third of the countries in the IMF dataset, these assumptions are extended to the 1990s, when disaggregated investment data become available. The IMF applies the assumption about investment growth in OECD countries to developing and transition economies,<sup>3</sup> a questionable modeling decision given the variance in the efficiency of public sector investment (Pritchett 2000).<sup>4</sup> Even within OECD countries the positive relationship between public capital and output is

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3. Modest changes in the investment growth rate can lead to substantial changes in the initial capital stock. Though an inaccurate estimate of the initial capital stock will diminish over time, even 20 years after the initial period differences can be non-trivial.

4. Pritchett (1996; 2000) emphasizes the efficacy of public sector investment and quality of governance in determining the contribution of public investment to the public capital stock. Moreover, the assumptions made by the methodology and Pritchett's criticisms make the figures of time series relationships reported by the IMF (2017a), without reference to these glaring, known issues, all the more puzzling.

heterogeneous (De Jong et al. 2017). Gupta et al. (2014), for instance, when extending the methodology to 52 countries adjust public investment using a measure of the efficiency of public investment. In the IMF dataset, no adjustment for quality is attempted.

Kamps (2006) justifies the assumption of a constant investment growth rate in OECD countries by noting that even countries that experienced a large shock, such as war, are likely to reaccumulate capital quickly following the shock, such as postwar Japan and Germany (Davis and Weinstein 2002; Brakman et al. 2004). Perhaps the justification is reasonable enough for OECD countries with stable institutions, yet the rapid recoveries in Japan and Germany are the exception (Coyne 2007). Countries with weak or unstable institutions, such as those included in the IMF dataset, may not reaccumulate capital quickly, particularly in countries transitioning from central planning (O'Reilly 2015). But these concerns are not what we wish to emphasize.

In the IMF dataset, total investment is the sum of private and public investment, which are listed in separate columns in the dataset. That the dataset only lists public and private investment separately, without providing the total investment number that is used, contributes to the opaqueness of the dataset's assumptions.

Here, to our understanding, is how the IMF creates the dataset in question: The IMF first identifies the earliest year for which total investment data is available. For years prior to those for which historical data is available, the total investment data is constructed by shrinking the level of investment each year such that it corresponds to a four percent growth rate. Then, the earliest year where actual data for the private-public distinction is available is used to calculate a percentage of investment that is public and a percentage private for all previous years. For some years, that percentage may be applied to the observed total investment number. For others, the percentage may be applied to the total investment number corresponding to an investment growth rate of four percent. The assumption of a constant backward-looking public and private investment breakdown is our core criticism. The IMF applies this assumption to 39 percent of the data points in the dataset. We would characterize any of these estimations as being purely 'synthetic,' in contrast to the genuine observations in the dataset.<sup>5</sup>

For example, the earliest year where the public/private breakdown is available in Russia is 1994, a point in time in which private investment made up 86.6 percent of the total investment. For all previous periods, the percentage of investment that was private is assumed by the IMF to be 86.6 percent. An overall

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5. We do not characterize post-1960 data points constructed using the assumption of a four-percent investment growth rate as synthetic unless those data points were constructed with additional assumption about the proportion of public and private investment.

investment figure—without public/private breakdown—is available for Russia back to 1989. As for years prior to 1989, no investment figures were had. Overall investment was assumed to grow at four percent such that it achieves the actual investment total in Russia in 1989, and 86.6 percent of the investment each year being private investment. Both investment series are then fed into the perpetual inventory methodology to yield public and private capital stocks by year. The dataset thereby reports synthetic figures for both public investment and private investment for every year going back to 1960.

To assume that the breakdown between private and public investment in Russia was roughly constant over the period 1960 to 1994 is surely systematically wrong, as this is literally to assume that 86.6 percent of investment under communism was private. Public investment as percentage of all investment for all members of the Eastern Bloc, and the year that percentage actually corresponds to, are given in Table 1. The same issue applies to other countries which experienced communism, or socialism, besides members of the Eastern Bloc—conservatively, such as Vietnam, Laos, and Angola<sup>6</sup>—but we limit the list to the Eastern Bloc for the sake of simplification and exposition.

The post-transition proportions of private investment in Table 1 likely overstate the true proportion of private investment under central planning. Most of the genuine data points for the Eastern Bloc, from which the synthetic data points are derived, come from the early 1990s, with all besides Bulgaria beginning in 1989 or later. Georgia's is the latest, and corresponds to 2002. Macedonia and Turkmenistan are not in the dataset, but if the IMF's methodology were applied consistently, an even more recent data point may be used for them were they included in the future. A few of these figures (including those of Bulgaria) are somewhat believable for the more liberal eras and regions of the Eastern Bloc, such as they were, but nearly all of the synthetic data points seem to have no correspondence whatsoever with the histories of the countries or regions.

To our knowledge, the IMF has not made explicit any justification for the choices it made in generating the dataset. The IMF could argue that the years under communism have little weight for the most recent cross-sections, since the capital has been depreciated to essentially zero (whether it would have low weight is contingent on the depreciation rate). Second, much of the public capital stock was, somewhat infamously, privatized following the breakup of the Soviet Union.

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6. It is difficult to be certain which countries actually attempted to impose the collectivization of the means of production. Many of the countries that were nominally communist or socialist states were failed states that did not have the capacity to impose socialism (cf. Murphy 2018). It is even possible that high levels of 'private investment' for these countries is plausible if the informal economy is included. Two non-Eastern Bloc countries where data does peer back before communism was rolled back, Mongolia and China, do show very low levels of private investment, consistent with a state-run economy.

Suppose the private-public breakdown from 1994 roughly corresponds to the breakdown between factories (private capital) and bridges (public capital) after privatization. If so, the 1994 breakdown may very crudely function as a proxy, but why use this crude proxy in place of a single rough estimate of public and private investment for all formerly communist countries? The 1994 capital stock could then be used as an extremely rough starting point for the capital stock today, just as the earlier assumption of four percent investment growth functions as such.

**TABLE 1. Private investment as a percentage of total investment assumed by the IMF for Eastern Bloc countries during their communist years, and year to which the actual data corresponds (present-day country names used)**

Country	'Private investment'	Year
Albania	65.44%	1989
Armenia	71.49%	1994
Azerbaijan	90.52%	1992
Belarus	88.95%	1989
Bosnia	55.73%	1997
Bulgaria	64.45%	1982
Croatia	70.74%	1991
Czech Republic	85.81%	1994
Estonia	85.58%	1999
Georgia	78.36%	2002
Hungary	89.47%	1994
Kazakhstan	91.75%	1993
Kyrgyzstan	68.20%	1993
Latvia	89.55%	1994
Lithuania	84.79%	1992
Moldova	85.15%	1993
Montenegro	83.28%	1999
Poland	70.87%	1994
Romania	51.24%	1989
Russia	86.57%	1994
Serbia	95.69%	2001
Slovakia	86.29%	1992
Slovenia	84.57%	1994
Tajikistan	46.47%	1997
Ukraine	87.71%	1993
Uzbekistan	66.31%	1993

Lastly, one might argue for a conception whereby 'public capital' includes infrastructure and government buildings, while 'private capital' is only some more narrowly conceived means of production. Using the most recent data for 'public'



and ‘private’ investment would then be a crude proxy for that alternative conception of such variables. But such conceptions are not supported by any statement by the IMF in connection with this project. Moreover, the alternative conception fails to consider that various pieces of infrastructure in the developed world, including railways and airports, are now in the private sector and spending on them falls in the private investment portion of national accounts. That is to say, there are both factories that properly belong in ‘public capital’ and airports that belong in ‘private capital.’ Therefore, we do not find this interpretation to be useful, though perhaps something like it is what the IMF was thinking, if only inchoately.

The way the dataset is currently constructed gives the impression that there is genuine data specific to each country and year. But the data provided do not meaningfully constitute a ‘panel’ going back for any but a very select set of countries with rich data breaking down public and private investment extensively. The countries in question correspond to, more or less, what Kamps (2006) previously found. The degree to which Kamps (2006) could be further extended has seemingly already been explored by Florence Arestoff and Christophe Hurlin (2006) and Gupta et al. (2014); other recent literature such as De Jong et al. (2017) and Serkan Arslanalp et al. (2010) similarly employ the Kamps (2006) methodology with only a modest number of countries. Though the issues raised here have been framed in terms of post-communist countries, and the Eastern Bloc specifically, dramatic institutional change occurred throughout the world, as many countries either dabbled in socialism or, even if not, often nationalized entire industries. Without more research attempting to construct national accounts data for years and countries where historically it does not exist in its complete state, little can be gained by extending the methodology to countries not found in the analysis of Gupta et al. (2014). If such a high proportion of the data points that are unique to the IMF dataset are simply synthetic, the dataset as a whole may add negative value.

For countries in which it can be shown that the lack of early data for the breakdown between public/private investment does not materially matter, constructing a cross-section or short panel of disaggregated capital stock estimates may be useful. A cross-section corresponding to a recent year may in fact allow several former communist countries to reasonably appear in the dataset if the communist years have sufficiently low weight in the perpetual inventory method. But doing so would call for the project to dial back its ambitions. In any case, the IMF should know better than to produce datasets showing that most of the capital stock in the Soviet Union was private circa 1965.



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