The formula written for cell I7 can then be used for cells J7 and K7 as well:

$$
\begin{aligned}
\text{J7} = \text{INDEX}(\quad &\text{SplitScreenStrip!\$13 : \$23,} \\
&\text{MATCH(\$D7, SplitScreenStrip!\$D\$13 : \$D\$23, 0),} \\
&\text{MATCH(J\$4, SplitScreenStrip!\$12 : \$12, 0)} \\
&)
\end{aligned}
$$

The analyst can then copy cell I7 and paste it in cells J7 and K7. Cell L7 contains the formula that applies the law of motion:

$$
C_t = C_{t-1} + I_t - F_t
$$
$$
\underbrace{\text{L7}}_{AR_t} = \underbrace{\text{I7}}_{AR_{t-1}} + \underbrace{\text{J7}}_{S_t} + \underbrace{\text{K7}}_{-F_t^{ar}}
$$

The analyst can copy range I7:L7 and paste it in range I8:L17 (or drag the fill handle).

	C	I	-F	C₋₁	+I₀	-F₀	C₀	+I₁	-F₁	C₁	+I₂	-F₂	C₂	+I₃	-F₃	C₃	+I₄	-F₄	C₄	+I₅	-F₅	C₅
	$+AR$	$+S$	$-F^{ar}$	0	0	0	0	60,000	-45,205	14,795	66,000	-64,521	16,274	72,600	-70,973	17,901	79,860	-78,070	19,692	87,850	-107,542	0
	$+Inv$	$+\Delta Inv$	-0	0	3,750	0	3,750	375	0	4,125	413	0	4,538	454	0	4,991	499	0	5,491	-5,491	0	0
	$-AP^{ic}$	$-COP^{ic}$	$+F^{cp,ic}$	0	-3,750	0	-3,750	-15,375	3,750	-15,375	-16,913	15,375	-16,913	-18,604	16,913	-18,604	-20,464	18,604	-20,464	-16,472	36,936	0
	$-AP^{om}$	$-COP^{om}$	$+F^{cp,om}$	0	0	0	0	-9,000	0	-9,000	-9,900	9,000	-9,900	-10,890	9,900	-10,890	-11,979	10,890	-11,979	-13,178	25,157	0
	$-SWP^m$	$-LC^m$	$+F^{mp,m}$	0	0	0	0	-24,000	24,000	0	-26,400	26,400	0	-29,040	29,040	0	-31,944	31,944	0	-35,140	35,140	0
	$-SWP^{om}$	$-LC^{om}$	$+F^{mp,om}$	0	0	0	0	-6,000	6,000	0	-6,000	6,000	0	-6,000	6,000	0	-6,000	6,000	0	-6,000	6,000	0
	$+NFA$	$-Dep$	$-F^{nfa}$	0	0	20,000	20,000	-4,000	0	16,000	-4,000	0	12,000	-4,000	0	8,000	-4,000	0	4,000	-4,000	0	0
	$-TP$	$-T$	$+F^{tp}$	0	0	0	0	-494	494	0	-959	959	0	-1,414	1,414	0	-1,919	1,919	0	-2,478	2,478	0
	$+C^l$	$+I^l$	$-F^l$	0	0	-4,000	-4,000	-152	8,030	3,878	147	3,689	7,714	293	4,446	12,454	473	5,268	18,195	691	-18,887	0
	$+C^d$	$+I^d$	$-F^d$	0	0	10,000	10,000	200	-2,700	7,500	150	-2,650	5,000	100	-2,600	2,500	50	-2,550	0	0	0	0
	$+C^e$	$+I^e$	$-F^e$	0	0	6,000	6,000	1,154	-231	6,923	2,238	-448	8,713	3,299	-660	11,353	4,477	-895	14,934	5,783	-20,717	0

Parameters: $n = 5$; $\tau = 30\%$; $r^a = 15.00\%$; $i^l = 3.80\%$; $r^l = 1.00\%$; $i^d = 2.00\%$; $r^d = 3.00\%$; $\alpha = 20\%$.

Figure 38. Cell J13 contains the value that has the same row-label as SiglePeriod!D7 (+AR) and the same column-label as SiglePeriod!I4 C_0 ("SplitScreenStrip" sheet).

The realization of the matrix where CFS statement is illustrated is analogous to the one described above. The labels of the rows are in column F (column of cash-flow labels) and the labels of the columns are in row 19. The figures of the matrix are grabbed from the full-scale strip with the formulas:

$$
\begin{aligned}
\text{J22} = \text{INDEX}(\quad &\text{SplitScreenStrip!\$13 : \$23,} \\
&\text{MATCH(\$F22, SplitScreenStrip!\$F\$13 : \$F\$23, 0),} \\
&\text{MATCH(J\$19, SplitScreenStrip!\$12 : \$12, 0)} \\
&)
\end{aligned}
$$

$$
\begin{aligned}
\text{K22} = \text{INDEX}(\quad &\text{SplitScreenStrip!\$13 : \$23,} \\
&\text{MATCH(\$F22, SplitScreenStrip!\$F\$13 : \$F\$23, 0),} \\
&\text{MATCH(K\$19, SplitScreenStrip!\$12 : \$12, 0)} \\
&)
\end{aligned}
$$

$$
\begin{aligned}
\text{L22} = (-1) * \text{INDEX}(\quad &\text{SplitScreenStrip!\$13 : \$23,} \\
&\text{MATCH(\$F22, SplitScreenStrip!\$F\$13 : \$F\$23, 0),} \\
&\text{MATCH(K\$19, SplitScreenStrip!\$12 : \$12, 0)} \\
&)
\end{aligned}
$$

Cell I22 contains the formula that applies the law of motion:

$$
F_t = I_t + C_{t-1} - C_t
$$
$$
\underbrace{\text{L22}}_{F_t^{ar}} = \underbrace{\text{J22}}_{S_t} + \underbrace{\text{K22}}_{AR_{t-1}} + \underbrace{\text{L22}}_{-AR_t}
$$

The analyst can copy range I22:L22 and paste it in range I23:L32 (or drag the fill handle).

The analyst can build in the same way any preferred framing of the SSM, with higher or lower scale, depending on the objective of the analysis.

6. Module 6: Reshaping the Project Split-Screen Strip

The model's main purpose is to communicate the result of the numeric analysis: the recipients of the reports can include readers that are not familiar with the compact structure of the split-screen strip. The Transposed Matrix (Part I, Section 10.2) and a set of standard financial statements may be easily extracted from the split-screen strip.

6.1. Reshaping the Strip as a Transposed Matrix

The Transposed Matrix, presented in Part I, Section 10.2, is a compact form of the project strip which provides an intuitive picture of the whole project in terms of three submatrices, respectively reporting the book values (C_t), the incomes (I_t), and the cash flows (F_t), each one divided into the main four areas (operating, non-operating, debt, and equity) (see also Figure 39):

Symbol	Description
$+C^o$	+ Operating assets
$+C^l$	+ Liquid assets
$C^{\mathbf{inv}}$	**Investments**
$+C^d$	+ Debt
$+C^e$	+ Equity
$C^{\mathbf{fin}}$	**Financings**
$+I^o$	+ Operating income
$+I^l$	+ Interest income
$+I^{\mathbf{inv}}$	**Income from assets**
$+I^d$	+ Interest expenses
$+I^e$	+ Net Income
$I^{\mathbf{fin}}$	**Income to capital providers**
$+F^o$	+ CFO (cash flow from operations)
$+F^l$	+ CFL (cash flow from/to non-operating assets)
$F^{\mathbf{inv}}$	**Cash flow from assets**
$+F^d$	+ CFD (cash flow to debtholders)
$+F^e$	+ CFE (cash flow to equity)
$F^{\mathbf{fin}}$	**Cash flow to capital providers**

Figure 39. Structure of a column of the Transposed Matrix: capital amounts, incomes, and cash flows are in vertical format (symbol on the left, description on the right; see also Part I, Section 10.2).

CODE INSTRUCTIONS: STRUCTURE OF TRANSPOSED MATRIX

The analyst adds, in his workbook, a new worksheet—"TransMatrix"—and creates three ranges of cells representing the three submatrices presented in Part I, Equation (70) (see also Figure 40 below).

Each row of the Transposed Matrix contains the label of the corresponding row in the four-area matrix (SplitScreenStrip!D68:F71): columns D, E, and F report the labels that pertains, respectively, to capital, income and cash flow.

CODE INSTRUCTIONS: FILLING THE CAPITAL SUBMATRIX OF TRANSPOSED MATRIX

We employ again the INDEX and MATCH combination. The technique is like the one described in Section 2.2, used in the split-screen strip for picking the amounts from the "PreCalc" worksheet.

Figure 40. Structure of the Transposed Matrix ("TransMatrix" sheet).

The more external formula is:

$$\text{INDEX}(\text{FourAreaStrip}, \text{row\_num}, \text{column\_num})$$

where
"FourAreaStrip" is the range of cells where the four-area Matrix is located (i.e. the range SplitScreenStrip!$G$68:$Y$71);
"row_num" is the row-number of the range "FourAreaStrip" where the item that contains the sought value is located: it can be selected by matching the label of the row in the Transposed Matrix and the label in the split-screen strip, using the function MATCH;
"column_num" is the column-number of the range "FourAreaStrip" where the category (capital, income, or cash flow) and the period that contains the sought value are indicated: it can be selected by matching the label of the column in the Transposed Matrix and the labels in the split-screen strip, using the function MATCH. One starts from cell I6:

$$I6 = \text{INDEX}(\quad \text{SplitScreenStrip!}\$G\$68 : \$Y\$71,$$
$$\underbrace{\text{MATCH}(\$D6, \text{SplitScreenStrip!}\$D\$68 : \$D\$71, 0)}\quad,$$

the result of this formula is the number of the row in the four-area strip that has the same label as cell $\$D6$ (“$+C^o$”)

$$\underbrace{\text{MATCH}(I\$4, \text{SplitScreenStrip!}\$G\$67 : \$Y\$67, 0)}$$

the result of this formula is the number of the column in the four-area strip that has the same label as cell $I\$4$ (“C_0”)
$$)$$

The formula written for cell I6 can then be used for cells I7, I10, and I11 as well. Rows 8 and 12 contain the sums of the previous rows:

$$\underbrace{I8}_{C_0^{\text{inv}}} = \text{SUM}(\underbrace{I6 : I7}_{C_0^o + C_0^l}) \qquad \underbrace{I12}_{C_0^{\text{fin}}} = \text{SUM}(\underbrace{I10 : I11}_{C_0^d + C_0^e})$$

Hence, the analyst can copy the range of cells I6 : I12 and paste it in the range J6 : N12 (or, more simply, use the fill handle), see Figures 41 and 42.
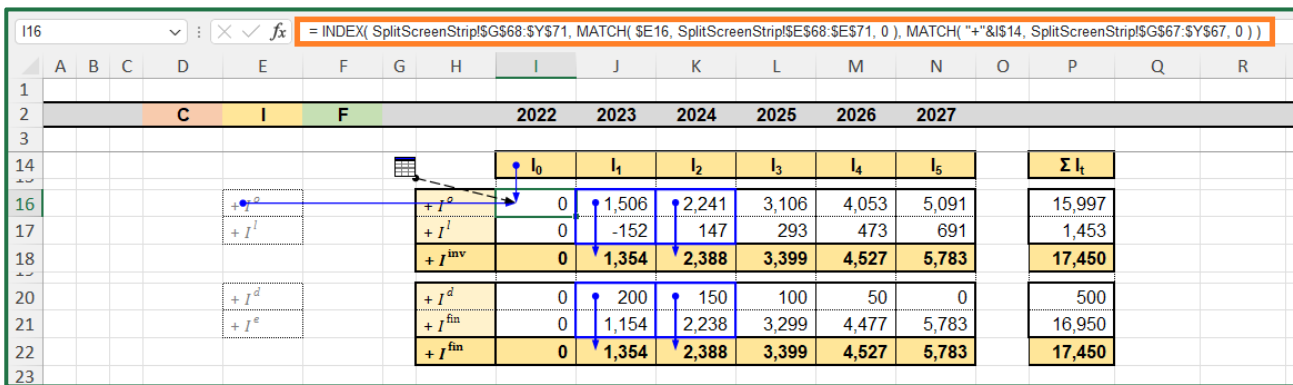

Figure 41. Cell I6 contains the formula for picking up the operating capital C^o as of period $t = 0$; cells I8:N8 and I12:N12 contain the sums of the two rows above ("TransMatrix" sheet).

Figure 42. Cell J68 contains the value that has the same row-label as TransMatrix!D6 ($+C_0$ and the same column-label as TransMatrix!I4 (C_0) ("SplitScreenStrip" sheet).

CODE INSTRUCTIONS: FILLING THE INCOME SUBMATRIX OF TRANSPOSED MATRIX

The technique useful for filling the cells of the income submatrix is the same employed for the capital submatrix. The only difference in the formula is in the column where the row-labels are reported: the column of incomes is E. Cell I16 is calculated as follows:

$$\text{I16} = \text{INDEX}(\quad \text{SplitScreenStrip!\$G\$68 : \$Y\$71,}$$
$$\underbrace{\text{MATCH(\$E16, SplitScreenStrip!\$E\$68 : \$E\$71, 0)}} \quad ,$$

the result of this formula is the number of the row in the four-area strip that has the same label as cell $\$E11$ ($"+I^o"$)

$$\underbrace{\text{MATCH("+"\&I\$14, SplitScreenStrip!\$G\$67 : \$Y\$67, 0)}}$$

the result of this formula is the number of the column in the four-area strip that has the same label (preceded by "+") as cell I\$14 ($"+I_0"$)

$$)$$

(see Figure 43).

Figure 43. Cell I16 contains the formula for picking the operating income I^o as of period $t = 0$; cells I18:N18 and I22:N22 contain the sums of the two rows above ("TransMatrix" sheet).

The operator "&" joins the text strings, so the formula "+"&I\$16 returns the symbol "+" alongside the content of cell I16, that is, it returns the value $+I_0$. This operation is necessary, because the labels in the "TransMatrix" sheet are "I_0", "I_1", "I_2", "I_3", "I_4", and "I_5", but the labels in the "SplitScreenStrip" sheet are "$+I_0$", "$+I_1$", "$+I_2$", "$+I_3$", "$+I_4$", and "$+I_5$".[9]

The formula written for cell I16 can be used for I17, I20, and I21 as well. Rows 18 and 22 contain the sums of the previous rows:

$$\underbrace{\text{I18}}_{I_0^{\text{inv}}} = \text{SUM}(\underbrace{\text{I16 : I17}}_{I_0^o + I_0^l}) \qquad \underbrace{\text{I22}}_{I_0^{\text{fin}}} = \text{SUM}(\underbrace{\text{I20 : I21}}_{I_0^d + I_0^e})$$

The analyst can then copy the cell range of cells I16 : I22 and paste it in the range J16 : N22 (or, more simply, use the fill handle. See Figure 43).

CODE INSTRUCTIONS: FILLING THE CASH-FLOW SUBMATRIX OF TRANSPOSED MATRIX

The technique useful for filling the cells of the cash-flow submatrix is the same employed for the capital submatrix and the income submatrix. The column where the row-labels are is column F. In the "TransMatrix" sheet, the rows of cash flows have positive sign; whereas, in the four-area matrix in the "SplitScreenStrip" sheet, they have negative sign. For this

reason, when we pick the value from the four-area Matrix, we must change it in sign (i.e., one multiplies by −1). One starts from the CFO, in cell I26:

$$\text{I26} = (-1) * \text{INDEX}(\quad \text{SplitScreenStrip!}\$G\$68 : \$Y\$71,$$
$$\underbrace{\text{MATCH}(\$F26, \text{SplitScreenStrip!}\$F\$68 : \$F\$71, 0)}_{\substack{\text{the result of this formula is the number of the row in the} \\ \text{four-area strip that has the same label as cell }\$F26\ (``{-}F^o")}},$$
$$\underbrace{\text{MATCH}(``{-}"\&\text{I}\$24, \text{SplitScreenStrip!}\$G\$67 : \$Y\$67, 0)}_{\substack{\text{the result of this formula is the number of the column} \\ \text{in the four-area strip that has the same label} \\ \text{(preceded by }``{-}") \text{ as cell I}\$24\ (``{-}F_0")}}$$
$$)$$

(see Figure 44).

Figure 44. Cell I26 contains the formula for picking the operating cash flow F^o as of the period $t = 0$; cells I28:N28 and I32:N32 contain the sums of the two rows above ("TransMatrix" sheet).

The operator "&" joins the text strings, so the formula "$-$"&I\$24 returns the symbol "$-$" alongside the content of the cell I24, i.e., it returns the value $-F_0$: this operation is necessary, because the labels in the "TransMatrix" sheet are "F_0", "F_1", "F_2", "F_3", "F_4", "F_5", but in the "SplitScreenStrip" sheet the labels are "$-F_0$", "$-F_1$", "$-F_2$", "$-F_3$", "$-F_4$", "$-F_5$".

The formula written for the cell I26 can be used for I27, I30, and I31 as well.

Rows 28 and 32 contain the sums of the previous rows:

$$\underbrace{\text{I28}}_{F_0^{\text{inv}}} = \text{SUM}(\underbrace{\text{I26} : \text{I27}}_{F_0^o + F_0^l}) \qquad \underbrace{\text{I32}}_{F_0^{\text{fin}}} = \text{SUM}(\underbrace{\text{I30} : \text{I31}}_{F_0^d + F_0^e})$$

The analyst can then copy the cell range I26 : I32 and paste it in the range J26 : N32 (or, more simply, use the fill handle).

FCFE AND CFL. The CFS in the Transposed Matrix enables the analyst to disclose an important piece of information: the Free Cash Flow to (or from) Equity (FCFE). It is obtained by consolidating the CFO and CFD row (i.e., $\text{FCFE}_t = F_t^o - F_t^d$). A positive FCFE indicates that the operations sustain the debt and leave some extra cash that may be distributed to shareholders or reinvested in liquid assets; a negative FCFE indicates that the operations cannot service the debt, so a financial deficit exists which must be covered either by equity or by liquid assets or by new borrowing (see Figure 45 below. See also Part I, Section 9). In both cases, it is necessary to make a decision on the CFL: if FCFE is positive, it is necessary to make a payout decision (how much will be retained in the firm and how much will be distributed to equityholders?); if FCFE is negative, it is necessary to make a

financing decisions (how much will be financed by cash withdrawals, by issuance of new shares, or by new borrowing?). In other words, CFE is a decision variable from $t = 0$ to $t = n - 1$ (at $t = n$, the project ends and the CFE is equal to the sum of the last FCFE and the end-of-period balance of liquid assets (see Part I, Equations (61) and (62)).

CODE INSTRUCTIONS: FILLING THE CFL STRIP
The FCFE matrix is simply a different representation of the data in the cash-flow submatrix of Transposed Matrix (see Part I, right matrix in Equation (63)). It can be placed in the "TransMatrix" sheet, rows 37:40, below the Transposed Matrix:

$$\underbrace{I38}_{\text{FCFE}_0} = \underbrace{I26}_{F_0^o} - \underbrace{I30}_{F_0^d}$$

$$\underbrace{I39}_{-F_0^e} = (-1) * \underbrace{I31}_{F_0^e}$$

$$\underbrace{I40}_{-F_0^l} = \underbrace{I38}_{\text{FCFE}_0} + \underbrace{I39}_{-F_0^e}$$

(see Figure 45).

Figure 45. The FCFE at time $t = 4$ (cell M38) is positive and equal to USD 6,164. Part of it is distributed to the firm's shareholders ($F_4^e = \text{USD}895$), the remaining part is retained by the firm and reinvested in liquid assets ($-F_4^l = \text{USD}5,268$). This figure is necessary for calculating C_4^l and, therefore, completing the BS as of period 4. The CFE at time $t = 5$, when the project ends, is $F_5^e = \text{USD}20,717$, equal to the FCFE (USD 1,830) plus the end-of-period balance of liquid assets (USD 18,887).

THE BENCHMARK TRANSPOSED MATRIX. It is convenient to build the Transposed Matrix for the benchmark as well (see Part I, Equation (87)).

It will turn out to be computationally helpful when appraising the project.

CODE INSTRUCTIONS: BUILDING THE BENCHMARK TRANSPOSED MATRIX
The analyst creates, in rows 45:73 of the "TransMatrix" sheet, a structure like the one created for the Transposed Matrix in rows 4:32. Each cell of this new structure contains the same formula as the corresponding cell of transposed matrix, but different in the strip where the amounts are picked up: the source of data of the project Transposed Matrix is the project strip (rows 68:71 of the "SplitScreenStrip" sheet), whereas the source of data of the

benchmark Transposed Matrix is the benchmark strip (rows 83:86 of "SplitScreenStrip" sheet). For example, the value V_0^o in cell I47:

$$I47 = \text{INDEX}(\quad \text{SplitScreenStrip!\$G\$83 : \$Y\$86,}$$
$$\underbrace{\text{MATCH(\$D47, SplitScreenStrip!\$D\$83 : \$D\$86, 0)},}$$

the result of this formula is the number of the row
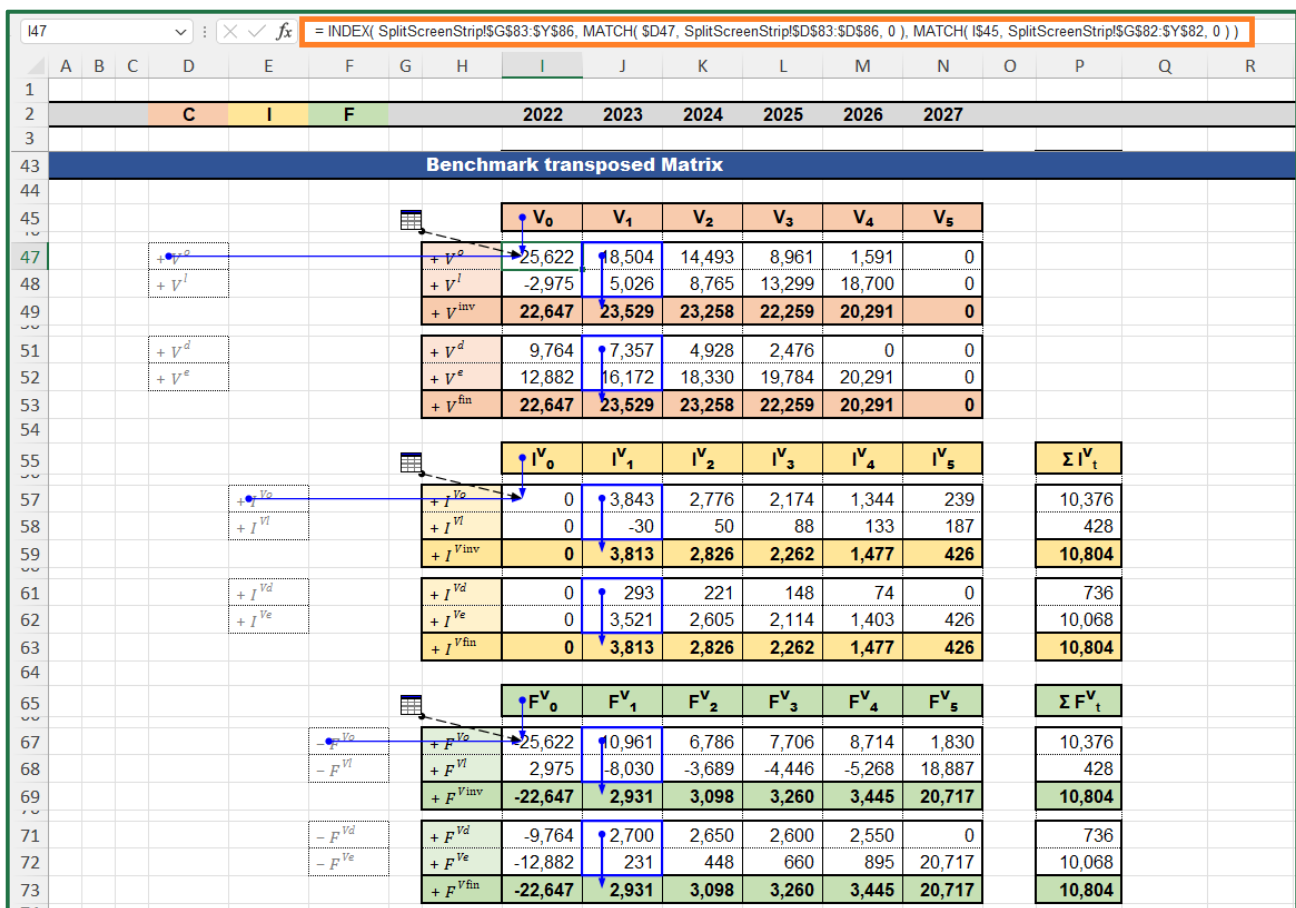in the benchmark four-area strip that has
the same label as cell \$D47 ("$+V^o$")

$$\underbrace{\text{MATCH(I\$45, SplitScreenStrip!\$G\$82 : \$Y\$82, 0)}}$$

the result of this formula is the number of the column
in the benchmark four-area strip that has
the same label as cell I\$45 ("V_0")

$$)$$

(see Figure 46).

Figure 46. Benchmark Transposed Matrix. Cell I47 contains the formula for picking up the economic value of operating assets V^o as of period $t = 0$ ("TransMatrix" sheet).

The formula written for the cell I47 can be used for I48, I51, and I52 as well. Rows 49 and 53 contain the sums of the previous rows:

$$\underbrace{I49}_{V_0^{inv}} = \text{SUM}(\underbrace{I47 : I48}_{V_0^o + V_0^l}) \qquad \underbrace{I53}_{V_0^{fin}} = \text{SUM}(\underbrace{I51 : I52}_{V_0^d + V_0^e})$$

The value I_0^{Vo} in cell I57 is obtained as

$$
\begin{aligned}
\text{I57} = \text{INDEX}(\quad & \text{SplitScreenStrip!\$G\$83 : \$Y\$86,} \\
& \text{MATCH(\$E57, SplitScreenStrip!\$D\$83 : \$D\$86, 0),} \\
& \text{MATCH("+"\&I\$55, SplitScreenStrip!\$G\$82 : \$Y\$82, 0)} \\
&)
\end{aligned}
$$

The formula written for cell I57 can be used for I58, I61, and I62 as well. Rows 59 and 63 contain the sums of the previous rows:

$$
\underbrace{\text{I59}}_{I_0^{V\text{inv}}} = \text{SUM}(\underbrace{\text{I57 : I58}}_{I_0^{Vo}+I_0^{Vl}}) \qquad \underbrace{\text{I63}}_{I_0^{V\text{fin}}} = \text{SUM}(\underbrace{\text{I61 : I62}}_{I_0^{Vd}+I_0^{Ve}})
$$

The value F_0^{Vo} in the cell I67 is obtained as

$$
\begin{aligned}
\text{I67} = (-1) * \text{INDEX}(\quad & \text{SplitScreenStrip!\$G\$83 : \$Y\$86,} \\
& \text{MATCH(\$F67, SplitScreenStrip!\$D\$83 : \$D\$86, 0),} \\
& \text{MATCH(" - "\&I\$65, SplitScreenStrip!\$G\$82 : \$Y\$82, 0)} \\
&)
\end{aligned}
$$

The formula written for cell I67 can be used for I68, I71, and I72 as well. Rows 69 and 73 contain the sums of the previous rows:

$$
\underbrace{\text{I69}}_{F_0^{V\text{inv}}} = \text{SUM}(\underbrace{\text{I67 : I68}}_{F_0^{Vo}+F_0^{Vl}}) \qquad \underbrace{\text{I73}}_{F_0^{V\text{fin}}} = \text{SUM}(\underbrace{\text{I71 : I72}}_{F_0^{Vd}+F_0^{Ve}})
$$

The Transposed Matrix makes it easy to calculate the sums of all the rows, which will be employed for computing the measures of worth in Module 7. The analyst uses column P in the "TransMatrix" sheet for calculating the sums of the rows. For example, one can calculate the sum of book values, C ($= \sum_{t=0}^{n} C_t$) in cell P6:

$$
\text{P6} = \text{SUM}(\underbrace{\underbrace{\text{I6 : N6}}_{C_0^o, C_1^o, ..., C_n^o}}_{\sum_{t=0}^{n} C_t^o})
$$

(see Figure 47).

The formula written for cell P6 can be used for P7, P8, P10, P11, and P12 as well. In the same way, the calculation of the sum of incomes and cash flows is possible in the other submatrices of the project (cells P16:P18, P20:P22, P26:P28, and P30:P32) and of the benchmark (cells P57:P59, P61:P63, P67:P69, and P71:P73).

Figure 47. Column P contains the sums of the rows ("TransMatrix" sheet).

6.2. Reshaping the Strip as a Set of Conventional Financial Statements

A different representation of the output is in the form of standard financial statements. Using report forms, the BS, IS, and CFS are laid out in report form (see also Part I, Figure 3).

CODE INSTRUCTIONS: STRUCTURE OF FINANCIAL STATEMENTS
The analyst creates, in his workbook, a new sheet — "ConventionalFinStat" — and sets up some ranges of cells to host the pro forma BSs, ISs, and CFs (Figures 48–50).

Each row contains a label in column D, E, or F: they are references of the values in the split-screen strip and report the capital amounts, incomes, and cash flows.

The standard pro forma financial statements are just a different way to show the results of the project. The analyst picks up the values for period 0 from the "SplitScreenStrip" sheet and feeds them into the conventional BS, IS, and CFS. Then, it suffices to copy and paste (or drag the fill handle) to fill the strip of all the project's BSs.

CODE INSTRUCTIONS: FILLING THE BALANCE SHEET
An effective technique for catching the figures from the split-screen strip is the use of the combinate functions INDEX and MATCH. The technique is the same described in the previous sections. For example, the AR are obtained as follows:

$$L11 = \text{INDEX}(\quad \text{SplitScreenStrip!}\$13 : \$23,$$
$$\underbrace{\text{MATCH}(\$D11, \text{SplitScreenStrip!}\$D\$13 : \$D\$23, 0)}, \quad ,$$

the result of this formula is the number of the row in the split-screen strip that has the same label as cell $D11 ("+AR")

$$\underbrace{\text{MATCH}(L\$7, \text{SplitScreenStrip!}\$12 : \$12, 0)}$$

the result of this formula is the number of the column in the split-screen strip that has the same label as cell L$7 ("$C_0$")

$$)$$

(see Figure 51).

	C	I	F	Financial Statements	UoM	2022	2023	2024	2025	2026	2027
						0	1	2	3	4	5
				Balance Sheet		C_0	C_1	C_2	C_3	C_4	C_5
$+ C^o$				**+ Operating Assets**	\$						
$+ NOWC$				+ Net Operating WC	\$						
$+ AR$	$+ AR$			+ AR	+ Accounts Receivable	\$						
$+ Inv$	$+ Inv$			+ Inv	+ Inventory	\$						
$- AP^m$	$- AP^m$			$- AP^m$	− Accounts Payable (manufacturing)	\$						
$- AP^{nm}$	$- AP^{nm}$			$- AP^{nm}$	− Accounts Payable (nonmanufacturing)	\$						
$- SWP^m$	$- SWP^m$			$- SWP^m$	− S&W Payable (manufacturing)	\$						
$- SWP^{nm}$	$- SWP^{nm}$			$- SWP^{nm}$	− S&W Payable (nonmanufacturing)	\$						
$- TP$	$- TP$			$- TP$	− Taxes Payable	\$						
$+ NFA$	$+ NFA$			$+ NFA$	+ (Net) Fixed Assets	\$						
$+ C^l$	$+ C^l$			$+ C^l$	+ Liquid Assets	\$						
$+ C^{inv}$				$+ C^{inv}$	Investments	\$						
$+ C^d$	$+ C^d$			$+ C^d$	+ Debt	\$						
$+ C^e$	$+ C^e$			$+ C^e$	+ Equity	\$						
$+ C^{fin}$				$+ C^{fin}$	Financings	\$						

Figure 48. Structure of the balance sheets in the spreadsheet ("ConventionalFinStat" sheet).

	C	I	F	Financial Statements	UoM	2022	2023	2024	2025	2026	2027
						0	1	2	3	4	5
				Income Statement		I_0	I_1	I_2	I_3	I_4	I_5
$+ S$				$+ S$	**+ Sales**	\$						
				(−) COGS	− Cost Of Goods Sold	\$						
$+ \Delta Inv$				$+ \Delta Inv$	+ Income from inventory (Δ Inventory)	\$						
$- COP^m$				$- COP^m$	− Cost of Purchases (manufacturing)	\$						
$- LC^m$				$- LC^m$	− Labor costs (manufacturing)	\$						
					Gross Profit	\$						
				(−) SGA	− Selling General and Administrative Expenses	\$						
$- COP^{nm}$				$- COP^{nm}$	− Cost of Purchases (nonmanufacturing)	\$						
$- LC^{nm}$				$- LC^{nm}$	− Labor costs (nonmanufacturing)	\$						
				EBITDA	**Earnings Before Interest, Taxes, Depreciation and Amortization**	\$						
$- Dep$				$- Dep$	− Depreciation	\$						
				EBIT	**Earnings Before Interest and Taxes**	\$						
$+ I^l$				$+ I^l$	+ Interest income	\$						
$+ I^d$				$- I^d$	+ Interest expenses	\$						
				EBT	**Earnings Before Taxes**	\$						
$- T$				$- T$	− Taxes	\$						
$+ I^e$				$+ I^e$	**Net Income**	\$						

Figure 49. Structure of the income statements in the spreadsheet ("ConventionalFinStat" sheet).

	C	I	F	Financial Statements	UoM	2022	2023	2024	2025	2026	2027
						0	1	2	3	4	5
				Statement of cash flows (Direct method)		F_0	F_1	F_2	F_3	F_4	F_5
		$- F^{ar}$		$+ F^{ar}$	+ Cash receipts from customers	\$						
	$+ I^l$			$+ I^l$	+ Interest income	\$						
	$- F^{ap,m}$			$- F^{ap,m}$	− Payments to suppliers (manufacturing)	\$						
	$+ F^{ap,nm}$			$- F^{ap,nm}$	− Payments to suppliers (nonmanufacturing)	\$						
	$+ F^{swp,m}$			$- F^{swp,m}$	− Payments to employees (manufacturing)	\$						
	$+ F^{swp,nm}$			$- F^{swp,nm}$	− Payments to employees (nonmanufacturing)	\$						
	$+ I^d$			$- I^d$	− Interest expenses	\$						
	$+ F^{tp}$			$- F^{tp}$	− Payments for income taxes	\$						
				(a)	**Cash flow from operating activities**	\$						
	$- F^{nfa}$			$+ F^{nfa}$	+ Asset disposal − Capital expenditures	\$						
				(b)	**Cash flow from investing activities**	\$						
$+ C^d$				$+ C^d$	+ Debt	\$						
				$+ \Delta C^d$	+ New borrowing − Principal repayments	\$						
	$- F^e$			$- F^e$	+ Issuance of New stock − Distributions to equityholders	\$						
				(c)	**Cash flow from financing activities**	\$						
				(a)+(b)+(c)	**Change in cash and cash equivalents (ΔC^l)**	\$						

Figure 50. Structure of the cash flow statements in the spreadsheet ("ConventionalFinStat" sheet).

Figure 51. Cell L11 contains the formula for picking the Account Receivables ($+$AR of period $t = 0$ from the split-screen strip ("ConventionalFinStat" sheet).

Every cell of the BS that contains a value calculated in the split-screen strip can be filled using the function INDEX-MATCH: the analyst can copy cell L11 and paste it in cells L12:L19 and L22:L23, as shown in Figure 51.

Other cells are partial sums of the values in the split-screen strip. An example is cell L10, which contains the value of the net operating working capital, NOWC:

$$\underbrace{\text{L10}}_{+\text{NOWC}_0} = \text{SUM}(\underbrace{\text{L11}:\text{L17}}_{+\text{AR}_0+\text{Inv}_0-\text{AP}_0^m-\text{AP}_0^{nm}-\text{SWP}_0^m-\text{SWP}_0^{nm}-\text{TP}_0})$$

or cells L9, L20, and L24:

$$\underbrace{\text{L9}}_{C_0^o} = \underbrace{\text{L10}}_{+\text{NOWC}_0} + \underbrace{\text{L18}}_{+\text{NFA}_0}$$

$$\underbrace{\text{L20}}_{C_0^{inv}} = \underbrace{\text{L9}}_{C_0^o} + \underbrace{\text{L19}}_{C_0^l}$$

$$\underbrace{\text{L24}}_{C_0^{fin}} = \underbrace{\text{L22}}_{C_0^d} + \underbrace{\text{L23}}_{C_0^e}$$

as represented in Figure 52.

Figure 52. Cell L20 contains the formula fur summarizing C^o and C^l, which determine C^{inv} ("ConventionalFinStat" sheet).

Once the BS for $t = 0$ has been completed, the analyst can copy the cell range L9 : L24 and paste it in the cell range M9 : Q24 (or, more simply, use the fill handle).

CODE INSTRUCTIONS: FILLING THE INCOME STATEMENT
The structure of the formula used for filling the BS can be used for filling the IS. An example of the formula is

$$L30 = \text{INDEX}(\quad \text{SplitScreenStrip!}\$13 : \$23,$$
$$\underbrace{\text{MATCH}(\$E30, \text{SplitScreenStrip!}\$E\$13 : \$E\$23, 0)}$$

the result of this formula is the number of the row in the split-screen strip that has the same label as cell \$E30 ("$+\Delta\text{Inv}$")

$$\underbrace{\text{MATCH}(\text{"+"}\&L\$26, \text{SplitScreenStrip!}\$12 : \$12, 0)}$$

the result of this formula is the number of the column in the split-screen strip that has the same label (preceded by $+$) as cell L\$26 ("I_0")
$$)$$

(see Figure 53).

Figure 53. Cell L30 contains the formula for picking the inventory variation, $+\Delta\text{Inv}$, of period $t = 0$ ("ConventionalFinStat" sheet).

I^d is a special case, in the sense that, while $+I^d$ is available in the split-screen strip, the value $-I^d = (-1) \cdot I^d$ is actually required in the IS scheme:

$$L41 = \quad (-1) * \text{INDEX}(\text{SplitScreenStrip!}\$13 : \$23,$$
$$\text{MATCH}(\$E41, \text{SplitScreenStrip!}\$E\$13 : \$E\$23, 0),$$
$$\text{MATCH}(\text{"+"}\&L\$26, \text{SplitScreenStrip!}\$12 : \$12, 0)$$
$$)$$

The intermediate components of the income statements are not in the split-screen strip, so the analyst must calculate them in this layout:

$$\underbrace{L29}_{-COGS_0} = SUM(\ \underbrace{L30:L32}_{+\Delta Inv_0 - COP_0^m - LC_0^m}\ )$$

$$\underbrace{L33}_{GrossProfit_0} = \underbrace{L28}_{+Sales_0} + \underbrace{L29}_{-COGS_0}$$

$$\underbrace{L34}_{-SGA_0} = SUM(\ \underbrace{L35:L36}_{-COP_0^{nm} - LC_0^{nm}}\ )$$

$$\underbrace{L37}_{EBITDA_0} = \underbrace{L33}_{GrossProfit_0} + \underbrace{L34}_{-SGA_0}$$

$$\underbrace{L39}_{EBIT_0} = SUM(\ \underbrace{L37:L38}_{+EBITDA_0 - Dep_0}\ )$$

$$\underbrace{L42}_{EBT_0} = SUM(\ \underbrace{L39:L41}_{+EBIT_0 + I_0^l - I_0^d}\ )$$

(see also Part I, Figure 5). The net income, I_t^e, is available in the split-screen strip as well. Of course, the analyst can pick it up and feed it into the conventional scheme (with the combined function INDEX-MATCH) or calculate it as

$$\underbrace{L44}_{I_0^e} = SUM(\underbrace{L42:L43}_{+EBT_0 - T_0}).$$

The analyst can now copy the range L28 : L44 and paste it in the cell range M28 : Q44 (or, more simply, use the fill handle).

CODE INSTRUCTIONS: FILLING THE CASH FLOW STATEMENT
The structure of the formula used for filling the BS and for the IS can be used for filling the Cash Flow Statement. An example of the formula is

$L48 = (-1) * INDEX(\ \ \text{SplitScreenStrip!\$13 : \$23,}$

$\underbrace{\text{MATCH(\$F48, SplitScreenStrip!\$F\$13 : \$F\$23, 0)}}\qquad ,$

the result of this formula is the number of the row in the
split-screen strip that has the same label as cell \$F48 ("$-F^{ar}$")

$\underbrace{\text{MATCH("$-$"\&L\$46, SplitScreenStrip!\$12 : \$12, 0)}}$

the result of this formula is the number of the column in the
split-screen strip that has the same label (preceded by $-$) as cell L\$46 ("$-F_0$")
$)$

(see Figure 54).

Figure 54. Cell L48 contains the formula for picking up the cash receipts from customers, $+F^{ar}$, of period $t = 0$ ("ConventionalFinStat" sheet).

The statement of cash flows contains values that the analyst can find in the cash-flow column of the split-screen strip (e.g., F^{ar}, $F^{ap,m}$, $F^{ap,nm}$), but it also contains values available in the income columns (I^l, I^d). For these figures, the analyst can use the same formula employed for the IS. An example of the formula is

$$
\begin{aligned}
L49 = \text{INDEX}(\quad & \text{SplitScreenStrip!}\$13 : \$23, \\
& \text{MATCH}(\$E49, \text{SplitScreenStrip!}\$F\$13 : \$F\$23, 0), \\
& \text{MATCH}(\text{"}-\text{"}\&L\$26, \text{SplitScreenStrip!}\$12 : \$12, 0) \\
&)
\end{aligned}
$$

ΔC^d is a special case because it is not available in the split-screen strip. However, the value C^d does appear in the strip, so the analyst can pick it up with the formula already used for the BS:

$$
\begin{aligned}
L61 = \text{INDEX}(\quad & \text{SplitScreenStrip!}\$13 : \$23, \\
& \text{MATCH}(\$D61, \text{SplitScreenStrip!}\$F\$13 : \$F\$23, 0), \\
& \text{MATCH}(L\$7, \text{SplitScreenStrip!}\$12 : \$12, 0) \\
&)
\end{aligned}
$$

The variation ΔC^d_t is $\Delta C^d_t = C^d_t - C^d_{t-1}$; in spreadsheet formula, this means, for period 0,

$$
\underbrace{L62}_{\Delta C^d_0} = \underbrace{L61}_{C^d_0} - \underbrace{K61}_{C^d_{-1}}
$$

(see Figure 55).

Figure 55. Cell L62 contains the formula for calculating the variation ΔC_0^d as the difference between values in row 61 ("ConventionalFinStat" sheet).

The three classes of cash flows of the standard CFS are obtained by summing the individual items:

$$\underbrace{\text{L56}}_{\substack{\text{Cash flow from operating activities}}} = \text{SUM}(\underbrace{\text{L48} : \text{L55}}_{\substack{+F_0^{ar}+I_0^l - F_0^{ap,m} - F_0^{ap,nm} - F_0^{swp,m} \\ -F_0^{swp,nm} - I_0^d - F_0^{tp}}})$$

$$\underbrace{\text{L59}}_{\substack{\text{Cash flow from investing activities}}} = \underbrace{\text{L58}}_{+F_0^{nfa}}$$

$$\underbrace{\text{L64}}_{\substack{\text{Cash flow from financing activities}}} = \text{SUM}(\underbrace{\text{L62} : \text{L63}}_{+\Delta C_t^d - F_t^e}).$$

The sum of the three components above is the change in cash and cash equivalents (ΔC^l):

$$\text{L66} = \text{L56} + \text{L59} + \text{L64}$$

The analyst can copy the range L48 : L66 and paste it in range M48 : Q66 (or, more simply, use the fill handle).

7. Module 7: Assessing Value Creation and Financial Efficiency

As we have seen, the NPVs can be found in the MVA matrix. This section is addressed to calculating some measures of economic profitability that provide different pieces of information from the NPV but are NPV-consistent and, therefore, reciprocally consistent. They offer an alternative, but logically equivalent, view on the project's value creation and financial efficiency (see Part I, Section 13). A new sheet for the presentation of the absolute and relative measures of worth must be created, called "ValueCreation". In it, we report the NPV and the economic residual income (ERI), which are absolute measures of worth, and, in addition, the rate of return (i) and the cash-flow return on capital (CFROC), along with the corresponding benchmark rates of return (respectively, ρ and CFROC^V), which are relative measures of worth.

7.1. Economic Residual Income (ERI)

The ERI informs about how value creation may be apportioned across the various periods, that is, how the project has contributed to increase shareholders' wealth in the

various periods. The total of such ERIs provide the overall value created (see Part I, Sections 12 and 13).

CODE INSTRUCTIONS: ERI TABLE
The analyst creates, in his workbook, a new sheet called "ValueCreation", where he prepares a range of cells that can contain the table of the ERIs (see Figure 56). Columns A and B contain the labels of the area (o, l, d, e, inv, and fin), and a header row (row 6) which contains the numbers of the periods. Each cell of this range contains the ERI of one area, $I_t^j - I_t^{Vj}$, $j = o, l, d, e$, inv, fin. These values are already available (changed in sign) in the MVA Matrix (SplitScreenStrip!98:101), so the analyst can pick them up with the following formulas:

$$C9 = (-1) * \text{INDEX}(\underbrace{\text{SplitScreenStrip!\$98:\$101}}_{\substack{\text{the MVA four-area Matrix} \\ \text{that contains the wanted values}}} ,$$

$$\underbrace{\text{MATCH(\$B9, SplitScreenStrip!\$B\$98:\$B\$101, 0)}}_{\substack{\text{the result of this formula is the number of the row in} \\ \text{MVA four-area Matrix that has the same label as cell \$B9 ("o")}} ,$$

$$\underbrace{\text{MATCH(C\$6, SplitScreenStrip!\$9:\$9, 0)}}_{\substack{\text{the result of this formula is the number of the first column in the} \\ \text{MVA four-area Matrix that has the same label as cell C\$6 ("0")}}$$

$$)$$

Then, the analyst copies and pastes the same formula for the whole strip C9:H12. The same table can also be framed in terms of investments vs. financings. For this purpose, it suffices to use the previous ERI strip. For example, for the ERI generated by the investments is calculated as

$$\underbrace{C14}_{\text{ERI}^{\text{inv}}} = \text{SUM}(\underbrace{C9 : C10}_{\text{ERI}^o + \text{ERI}^l})$$

The ERI informs that the project subtracts value for the firm's shareholders in the first two periods (-2367 and -367) but adds value in the remaining three periods (1185, 3074, and 5357). Overall, the Total ERI is positive and equal to 6882. It is calculated in column I as $\text{ERI} = \sum_{t=0}^{n} (I_t - I_t^V)$. In the spreadsheet,

$$I9 = \text{SUM}(C9:H9).$$

As shown in Part I, Equations (96) and (102), the Total ERI is equal to the NPV. Therefore, calculating the ERIs represent a way for decomposing the NPV by periods.

		0	1	2	3	4	5	
		$I_0 - I_0^V$	$I_1 - I_1^V$	$I_2 - I_2^V$	$I_3 - I_3^V$	$I_4 - I_4^V$	$I_5 - I_5^V$	Total ERI
9	o	0	-2,338	-535	932	2,709	4,853	5,622
10	l	0	-122	97	206	340	504	1,025
11	d	0	-93	-71	-48	-24	0	-236
12	e	0	-2,367	-367	1,185	3,074	5,357	6,882
14	inv	0	-2,460	-438	1,138	3,050	5,357	6,647
15	fin	0	-2,460	-438	1,138	3,050	5,357	6,647

Figure 56. Economic residual income ("ValueCreation" sheet).

7.2. Rate of Return, Average ERI, and Cash-Flow Return on Capital

Beside (the NPV and the) Total ERI, which are absolute measures of worth, some useful information is provided by the relative measures of worth, which can be extracted with simple formulas (see Part I, Section 13). The formulas of the measures employ either the sum of project book values or the sum of benchmark amounts. It is convenient to pick up such figures from the "TransMatrix" sheet, where they have already been calculated.

CODE INSTRUCTIONS: SUMS OF ROWS OF THE TRANSPOSED MATRICES
The analyst builds a table in the "ValueCreation" sheet and reports all the sums calculated in the "TransMatrix" sheet (see Figure 57). For example:

$$E20 = \text{TransMatrix!P6}$$
$$G20 = \text{TransMatrix!P16}$$
$$I20 = \text{TransMatrix!P26}$$
$$K20 = \text{TransMatrix!P57}$$
$$M20 = \text{TransMatrix!P67}$$

These values are used for assessing the project's economic profitability (see the code instructions below).

Figure 57. The table in the rows 18:26 contains the sums of the Transposed Matrices rows ("ValueCreation" sheet).

CODE INSTRUCTIONS: ABSOLUTE AND RELATIVE MEASURES OF ECONOMIC PROFITABILITY
The analyst sets up a range of cells that can host the values of the (absolute and relative) measures of worth, and the benchmark rate of return (see Figure 58).
NPV (COLUMN D). As noted in Section 7, the NPV is equal to the MVA at $t = 0$, which can be picked up from the MVA Matrix (rows 98:101 of the "SplitScreenStrip" sheet). For example, the NPV generated by the operations is obtained as

$$D31 = \text{SplitScreenStrip!J98}$$

(as we already know, this output is also equal to the operating Total ERI in cell I9). The analyst can then copy cell D31 and paste it in cells D32, D35, and D36. The NPV of the investment and financing areas are the sums of the previous rows. For example, the investment NPV is calculated as

$$\underbrace{D33}_{\text{NPV}^{\text{inv}}} = \text{SUM}(\underbrace{D31 : D32}_{\text{NPV}^o + \text{NPV}^l})$$

AERI (COLUMN F). The Average Economic Residual Income (AERI) is the ratio of Total ERI and the project's lifespan:

$$\underbrace{F31}_{AERI^o} = \underbrace{I9}_{totalERI^o} / \underbrace{Assumptions!\$H\$5}_{n}$$

The analyst can copy cell F31 and paste it in cells F32, F35, and F36. The AERI of the investment and financing areas are the sums of the previous rows. For example, the investment AERI is:

$$\underbrace{F33}_{AERI^{inv}} = SUM(\ \underbrace{F31:F32}_{AERI^o + AERI^l}\ )$$

CFROC (COLUMN H). The Cash-flow return on capital (CFROC) is the ratio of the sum of cash-flows, $F\ (=\sum_{t=0}^{n} F_t)$, and the sum of book values, $C\ (=\sum_{t=0}^{n} C_t)$:

$$CFROC = \frac{\sum_{t=0}^{n} F_t}{\sum_{t=0}^{n} C_t}$$

The analyst can pick up the values of F and C from the table in rows 18:26:

$$\underbrace{H31}_{CFROC^o} = \underbrace{I20}_{\sum_{t=0}^{n} F_t^o} / \underbrace{E20}_{\sum_{t=0}^{n} C_t^o}$$

The analyst can then copy cell H31 and paste it in ranges H32:H33 and H35:H37.

RATE OF RETURN (COLUMN J). The rate of return of the project, i, is the ratio of the sum of project incomes, $I\ (=\sum_{t=0}^{n} I_t)$ and the sum of the project book values, C:

$$i = \frac{\sum_{t=0}^{n} I_t}{\sum_{t=0}^{n} C_t}.$$

The analyst can grab the values of I and C from the table in rows 18:26:

$$\underbrace{J31}_{i^o} = \underbrace{G20}_{\sum_{t=0}^{n} I_t^o} / \underbrace{E20}_{\sum_{t=0}^{n} C_t^o}.$$

As explained in Part I, Section 13, i and CFROC must coincide, so J31 = H31, as we expect. The analyst can then copy cell J31 and paste it in ranges J32:J33 and J35:J37. These rates of return refer to all the areas of the project. They are, respectively, the average ROI, average ROL, average ROA, average ROD, and average ROE, while cells J33 and J37 contain the average ROA (see Table 4 in Part I).

CFROC^V (COLUMN L). The cash-flow return on capital of the benchmark, CFROC^V, is the cutoff rate associated with CFROC which signal value creation (i.e., project acceptance) or value destruction (i.e., project rejection): it is the ratio of the sum of the cash flows generated by the benchmark $\left(\sum_{t=0}^{n} F_t^V\right)$ and the sum of the book values, C.

$$CFROC^V = \frac{\sum_{t=0}^{n} F_t^V}{\sum_{t=0}^{n} C_t}$$

The analyst can grab the values of F^V and C from the table in rows 18:26:

$$\underbrace{L31}_{CFROC^{Vo}} = \underbrace{M20}_{\sum_{t=0}^{n} F_t^{Vo}} / \underbrace{E20}_{\sum_{t=0}^{n} C_t^o}$$

The analyst can then copy the cell L31 and paste it in ranges L32:L33 and L35:L37.

BENCHMARK RATE OF RETURN (COLUMN N). The benchmark rate of return ρ, associated with i, is the ratio of the sum of benchmark profits $I^V\left(=\sum_{t=1}^{n} I_t^V\right)$, and the sum of book values, C :

$$\rho = \frac{\sum_{t=0}^{n} I_t^V}{\sum_{t=0}^{n} C_t}$$

The analyst can grab the values of I^V and C from the table in rows 18:26:

$$\underbrace{N31}_{\rho^o} = \underbrace{K20}_{\sum_{t=0}^{n} I_t^{Vo}} / \underbrace{E20}_{\sum_{t=0}^{n} C_t^o}$$

The analyst can then copy the cell N31 and paste it in ranges N32:N33 and N35:N37. As explained in Part I, Section 13, CFROC^V must coincide with ρ, so L31 = N31 (same for the other ones), as we expect.

		NPV		AERI		CFROC		project rate of return		CFROC^V		MARR	
		$V_0 - C_0$		$\frac{\text{Total ERI}}{n}$		$\frac{\sum_{t=0}^{n} F_t}{\sum_{t=0}^{n} C_t}$		$\frac{\sum_{t=0}^{n} I_t}{\sum_{t=0}^{n} C_t}$		$\frac{\sum_{t=0}^{n} F_t^V}{\sum_{t=0}^{n} C_t}$		$\frac{\sum_{t=0}^{n} I_t^V}{\sum_{t=0}^{n} C_t}$	
	NPV^o	5,622	AERI^o	1,124	CFROC^o	46.1%	i^o average ROI	46.1%	CFROC^{Vo}	29.9%	ρ^o operating MARR	29.9%
	NPV^l	1,025	AERI^l	205	CFROC^l	3.8%	i^l average ROL	3.8%	CFROC^{Vl}	1.1%	ρ^l non-operating MARR	1.1%
	NPV^{inv}	6,647	AERI^{inv}	1,329	CFROC^{inv}	23.9%	i^{inv} average ROA	23.9%	CFROC^{Vinv}	14.8%	ρ^{inv} project MARR	14.8%
	NPV^d	-236	AERI^d	-47	CFROC^d	2.0%	i^d average ROD	2.0%	CFROC^{Vd}	2.9%	ρ^d debt MARR	2.9%
	NPV^e	6,882	AERI^e	1,376	CFROC^e	35.4%	i^e average ROE	35.4%	CFROC^{Ve}	21.0%	ρ^e equity MARR	21.0%
	NPV^{fin}	6,647	AERI^{fin}	1,329	CFROC^{fin}	23.9%	i^{fin} average ROA	23.9%	CFROC^{Vfin}	14.8%	ρ^{fin} project MARR	14.8%

Figure 58. Measures of economic profitability ("ValueCreation" sheet).

As the reader can see, areas D31:D32 and D35:D36 of the "ValueCreation" sheet show the NPV for the various areas: NPV^o = 5,622 (value created by the project's operations), NPV^l = 1,025 (value created by the reinvestment in liquid assets), NPV^d = −236 (value lost by the debtholders at the expense of the firm's shareholders), and NPV^e = 6,882 (value created for the firm's shareholders). Cells D33 and D37 report the project NPV: the value created by the project is NPV = 6,647, part of which is generated by the liquid assets (because assumptions 21 and 24 imply that $i^l > r^l$, that is, the interest rate on liquid assets is greater than the required return on them). However, the equity NPV (USD 6,882) is greater than USD 6,647 because part of it (USD 236) is lost by the debtholders. This occurs because assumptions 19 and 25 imply $i^d < r^d$, that is, the interest rate on debt is smaller than the required return on debt (i.e., the maximum attractive financing rate for the firm).

7.3. The Product Structure

An alternative way of calculating the NPV consists in computing the product of the total invested capital (C) and the financial efficiency of the investment, which is equal to the difference between the rate of return and the benchmark rate of return ($i − \rho$). This

represents an explicit link between the capital, the rate of return and the MARR (see Part I, Equation (103), and the code instructions below).

CODE INSTRUCTIONS: ALTERNATIVE WAY OF CALCULATING THE NPV
The analyst sets up a range of cells that can host the alternative way of calculating the NPV.

TOTAL CAPITAL. Cells D42:D48 contain the total capital of the project ($\sum_{t=0}^{n} C_t$), grabbed from the Transposed Matrix. The analyst starts from

$$\underbrace{\text{D42}}_{\substack{\text{total investment}\\\text{in operating assets}}} = \text{TransMatrix!P6}$$

and then copies cell D42 and pastes it in ranges D43:D44 and D46:D48.

FINANCIAL EFFICIENCY. Cells F42:F48 contain the financial efficiency of the investment $(i - \rho)$, obtained from the values already calculated in the table above. The analyst starts from

$$\underbrace{\text{F42}}_{\substack{\text{financial efficiency}\\\text{of the operating assets}}} = \underbrace{\text{J31}}_{i^o} - \underbrace{\text{N31}}_{\rho^o}$$

and then copies the cell F42 and pastes it in ranges F43:F44 and F46:F48.

NPV. Cells H42:H48 contains the NPV as products of investment scale and financial efficiency. Starting from

$$\underbrace{\text{H42}}_{\text{NPV}^o} = \underbrace{\text{D42}}_{\substack{\text{total investment}\\\text{in operating assets}}} * \underbrace{\text{F42}}_{\substack{\text{financial efficiency}\\\text{of the operating assets}}}$$

the analyst can then copy the cell H42 and paste it in the ranges H43:H44 and H46:H48 (see Figure 59).

In particular, the total capital invested in the project is $C =$ USD 72,923 at an above-normal rate of return of $i - \rho = 9.1\%$, which makes a USD 6,647 gain. The total capital borrowed is $C^d =$ USD 25,000 at a rate of return which is lower than the benchmark rate of return by $\left| i^d - \rho^d \right| = 0.9\%$, so the debt NPV is slightly negative and equal to NPV$^d = -$USD236. The total capital invested by shareholders is $C^e =$ USD 47,923, invested at an above-normal rate of return of $i^e - \rho^e = 14.4\%$, which makes a USD 6,882 increase in wealth (see also Part I, Equation (103)).

	total capital		financial efficiency		NPV	
			Measuring value creation and financial efficiency			
Σc^o		34,681	$i^o - \rho^o$	16.2%	NPV^o	5,622
Σc^l		38,242	$i^l - \rho^l$	2.7%	NPV^l	1,025
Σc^{inv}		72,923	$i^{inv} - \rho^{inv}$	9.1%	NPV^{inv}	6,647
Σc^d		25,000	$i^d - \rho^d$	-0.9%	NPV^d	-236
Σc^e		47,923	$i^e - \rho^e$	14.4%	NPV^e	6,882
Σc^{fin}		72,923	$i^{fin} - \rho^{fin}$	9.1%	NPV^{fin}	6,647

Figure 59. The product structure: an alternative way of calculating the NPV ("ValueCreation" sheet). (The red lines represent equality).

8. Conclusions

This paper provides practitioners with a guide to innovative financial modeling. Specifically, it implements the accounting-and-finance engineering system (AFES) described in

Magni (2020, 2023) on spreadsheet software. The AFES is based on the split-screen approach, and we guide the modeler step by step, showing how to build a frugal, transparent, and easy-to-use model for performing a detailed financial analysis of a capital asset project. The AFES articulation is such that it acts as a diagnostic tool, spotting modeling errors and internal inconsistencies. In particular, if numbers in rows and columns do not match, there is some inconsistencies in the calculation. Furthermore, if the absolute measures of worth are not reciprocally consistent, then some problems arise in some parts of the model (either in the evaluation process or, earlier, in processing the accounting and financial magnitudes).

We start from the verbal description of the project, then carry out preliminary calculation and use them to obtain the split-screen strip, whereby the pro forma financial statements are chronologically chained. We divide the model into seven modules with seven associated worksheets and make the corresponding file available for downloading at the following address: https://morespace.economia.unimore.it/carloalbertomagni/spreadsheet-modeling/ (accessed 18 February 2023) (the file can also be requested at magni@unimo.it or d.baschieri@grafspa.it)

Symbols and Abbreviations

AERI	average economic residual income
AFES	Accounting and Finance Engineering System
AP_t	accounts payable
AP_t^m	accounts payable (manufacturing)
AP_t^{nm}	accounts payable (nonmanufacturing)
AR_t	accounts receivable
C_t^d	debt capital
C_t^e	equity capital
C_t^{fin}	capital raised from capital providers (claimholders)
C_t^{inv}	capital invested in the project
C_t^l	liquid assets
C_t^o	operating assets
CFD	cash flow to debt
CFE	cash flow to equity
CFL	cash flow from/to liquid assets
CFO	cash flow from operations
CFROC	project's cash-flow return on capital
$CFROC^V$	benchmark's cash-flow return on capital
$COGS_t$	cost of goods sold
COP_t	cost of purchases
COP_t^m	cost of purchases (manufacturing)
COP_t^{nm}	cost of purchases (nonmanufacturing)
Dep_t	depreciation

EBIT_t	earnings before interest and taxes
EBITDA_t	earnings before interest, taxes, depreciation, and amortization
EBT_t	earnings before taxes
F_t^{ap}	payments to suppliers
$F_t^{ap,m}$	payments to suppliers (manufacturing)
$F_t^{ap,nm}$	payments to suppliers (nonmanufacturing)
$F_t^{swp,m}$	payments to employees (manufacturing)
$F_t^{swp,nm}$	payments to employees (nonmanufacturing)
F_t^{ar}	cash receipts from customers
F_t^{cogs}	payments for COGS
F_t^{d}	cash flow to debt
F_t^{e}	cash flow to equity
F_t^{fin}	cash flow to capital providers (claimholders)
F_t^{inv}	cash flow from project's assets
F_t^{Inv}	cash flow from inventory $(= 0)$
F_t^{l}	cash flow from liquid assets (net of deposits)
F_t^{nfa}	asset disposal (net of capital expenditures)
F_t^{o}	cash flow from operations
F_t^{swp}	payments to employees
F_t^{tp}	payments for income taxes
F_t^{V}	benchmark's cash flow
F_t^{Vd}	cash flow of the benchmark portfolio replicating the project's CFD
F_t^{Ve}	cash flow of the benchmark portfolio replicating the project's CFE
F_t^{Vl}	cash flow of the benchmark portfolio replicating the project's CFL
F_t^{Vo}	cash flow of the benchmark portfolio replicating the project's CFD
FCFE	free cash flow to equity
I_t^{d}	interest expenses
I_t^{e}	net income
I_t^{fin}	income from the project's assets
I_t^{inv}	income to capital providers
I_t^{l}	interest income
I_t^{o}	operating income
I_t^{V}	benchmark profit
I_t^{Vd}	profit of the benchmark portfolio replicating the project's CFD
I_t^{Ve}	profit of the benchmark portfolio replicating the project's CFE
I_t^{Vl}	profit of the benchmark portfolio replicating the project's CFL
I_t^{Vo}	profit of the benchmark portfolio replicating the project's CFO
i^{d}	return on debt (loan interest rate)
i^{l}	return on non-operating assets (interest rate on liquid assets)
Inv_t	inventory
ΔInv_t	income from inventory (change in inventory)
LC_t	labor costs
LC_t^{m}	labor costs (manufacturing)
LC_t^{nm}	labor costs (nonmanufacturing)
MARR	minimum attractive rate of return
NFA_t	net fixed assets
NOL	net operating liabilities
NOL_t^{m}	net operating liabilities (manufacturing)
NOL_t^{nm}	net operating liabilities (nonmanufacturing)
NOWC_t	net operating working capital
NPV	net present value
r	project cost of capital (required return on assets)
r^{d}	cost of debt (required return on debt)
r^{l}	cost of non-operating assets (required return on non-operating assets)
r^{o}	cost of operating assets, pre-tax WACC (required return on operating assets)
ρ	MARR for the project

ρ^d	MARR for the debt
ρ^e	MARR for the equity
ρ^l	MARR for liquid assets
ρ^o	MARR for the operating assets
ROA	Return On Assets
ROD	Return On Debt
ROE	Return On Equity
ROL	Return On Liquid Assets
S_t	sales
SGA_t	selling, general, and administrative expenses
SSM	Split-Screen Matrix
SWP_t	salaries and wages payable
SWP_t^m	salaries and wages payable (manufacturing)
SWP_t^{nm}	salaries and wages payable (nonmanufacturing)
T_t	taxes
TP_t	taxes payable
T_t	income taxes
V_t	project's economic value
V_t^d	economic value of debt
V_t^e	economic value of equity
V_t^l	economic value of non-operating assets
V_t^o	economic value of operating assets
WACC	weighted average cost of capital

Appendix A. Alternative Schemes for CFE Calculation

In this paper, we have described the case where the firm applies a payout ratio to the net income for determining the CFE. In real-life applications, many different schemes may be employed. In this Appendix, we illustrate two alternative schemes, based on FCFE.

Let us assume that the firm determines the CFE by applying the payout ratio (20%) to the FCFE (instead of the net income). This implies that Table 7 turns to Table A1.

Table A1. Breakdown of CFE (payout ratio: 20% of FCFE).

	TIME	0	1	2	3	4	5
CASH FLOW TO EQUITY (F_t^e)	Shareholders' investment	−6,000	0	0	0	0	0
	Interim payout (20% of FCFE)	0	$0.2 \cdot FCFE_1$	$0.2 \cdot FCFE_2$	$0.2 \cdot FCFE_3$	$0.2 \cdot FCFE_4$	0
	Liquidation dividend	0	0	0	0	0	$C_4^e + I_5^e$

The difference between Tables 7 and A1 lies in the "Interim payout" row.

CODE INSTRUCTIONS: CASH FLOW TO EQUITY CALCULATED AS A FRACTION OF FCFE

Section 2.2.3 contains the formula used for filling the cells $-F_t^e$ of the full-scale matrix. The spreadsheet code for the cell I23 ($-F_0^e$) is:

$$\underbrace{I23}_{-F_0^e} = IF(\underbrace{I9}_{period} = 0, \underbrace{\text{Assumptions! \$H\$21}}_{\text{case } t=0}, \underbrace{IF(\underbrace{I9}_{period} < \underbrace{\$D\$2}_{n}, \underbrace{-\underbrace{H23}_{I_0^e} * \underbrace{\$D\$6}_{20\%}}_{\text{case } 0<t<n}, \underbrace{-(G23 + H23)}_{\text{case } t=n}))}_{\text{case } t \neq 0}$$

(over the interim payout term: "interim payout (20% of net income)"; over the last term: "liquidation dividend")

Assuming FCFE is the calculation base for the CFE, one only needs change the part of the formula that calculates the interim payout ("−H23 ∗ \$D\$6" in the example above).

Specifically, net income ($-$H23) must be replaced by FCFE. The latter is equal to the difference between CFO and CFD (FCFE$_t = F_t^o - F_t^d$) and the CFO is equal to

$$F_t^o = F_t^{ar} - F_t^{ap,m} - F_t^{ap,nm} - F_t^{swp,m} - F_t^{swp,nm} + F_t^{nfa} - F_t^{tp}.$$

The new spreadsheet code for I23 is then

$$\overset{-F_0^e}{\overbrace{\text{I23}}} = \text{IF}(\overset{\text{period}}{\overbrace{\text{I9}}} = 0,$$

$$\underbrace{\overset{\text{equity financing}}{\overbrace{\text{Assumptions! }\$H\$21}}}_{\text{case } t=0},$$

$$\text{IF}(\overset{\text{period}}{\overbrace{\text{I9}}} < \overset{n}{\overbrace{\$D\$2}}, \underbrace{-(-\overset{\overset{\text{interim payout}}{\text{(20\% of}}}{\overset{\text{FCFE)}}{\overbrace{\overset{\text{FCFE}}{\overbrace{\overset{-F_0^{ar}-0}{\underset{=\text{CFO}_0}{\overset{+F_0^{ap,m}+F_0^{ap,nm}}{\overset{+F_0^{swp,m}+F_0^{swp,nm}}{-F_0^{nfa}+F_0^{tp}}}}}{\text{SUM(I13:I20)}}}}} + \overset{}{\overbrace{\text{I22}}}) * \overset{20\%}{\overbrace{\$D\$6}}, \overset{\text{liquidation dividend}}{\overbrace{-(\text{G23}+\text{H23})}}))}_{\text{case } 0<t<n \qquad\qquad \text{case } t=n}}_{\text{case } t\ne 0}$$

At https://morespace.economia.unimore.it/carloalbertomagni/spreadsheet-modeling (accessed 18 February 2023), two Excel files are available, one where the payout ratio is applied to net income and another one where the payout ratio is applied to the FCFE.

Other ways to determine the distribution policy are possible and one just has to replace the nested formula that calculates the interim payout. For example, the payout to equity holders might be calculated as the minimum value between net income and FCFE:

$$\text{interim payout (period 0)} = -\overset{\text{MIN}(I_0^e, \text{ FCFE}_0)}{\overbrace{\text{MIN}(\overset{I_0^e}{\overbrace{\text{H23}}}, \overset{\text{FCFE}_0}{\overbrace{(-\overset{\text{CFO}_0}{\overbrace{\text{SUM(I13:I20)}}} + \overset{-F_0^d}{\overbrace{\text{I22}}})}}))} * \overset{20\%}{\overbrace{\$D\$6}}$$

More generally, a firm may not be willing (or may not be allowed) to distribute cash to its shareholders if either the net income or the FCFE is negative. In this case, the previous formula changes to

$$\text{interim payout (period 0)} = -\text{MAX}(\overset{\text{MIN}(I_0^e, \text{ FCFE}_0)}{\overbrace{\text{MIN}(\overset{I_0^e}{\overbrace{\text{H23}}}, \overset{\text{FCFE}_0}{\overbrace{(-\text{SUM(I13:I20)} + \text{I22})}})}}, 0) * \overset{20\%}{\overbrace{\$D\$6}}$$

which implies that the firm will pay the minimum between net income and FCFE only if both are positive (if one of them is zero or negative, then MIN(H23, $-$SUM(I13 : I20) + I22), 0) $\le$ 0 and MAX($\le$ 0, 0) = 0).
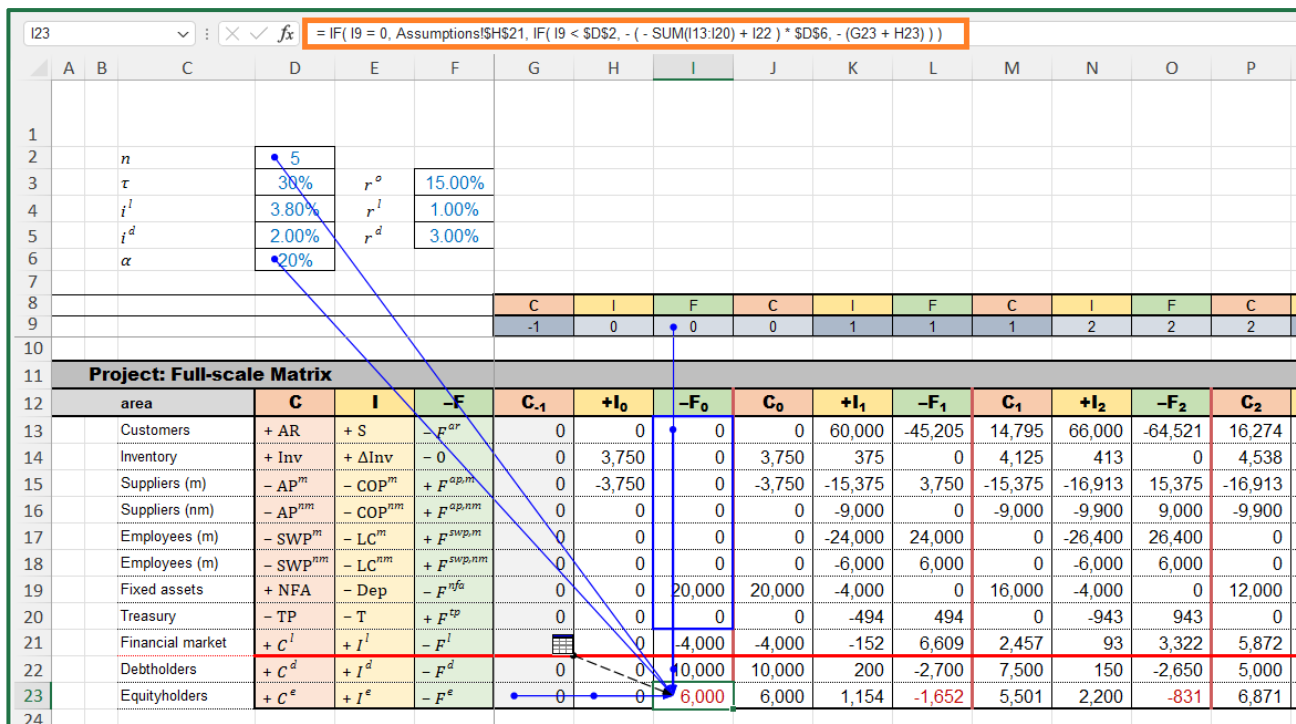
Figure A1. An alternative way to determine the Cash Flow to Equity in cell I23 ("SplitScreenStrip" sheet).

Notes

[1] We assume the reader is already familiar with Magni (2023). If not, we recommend reading it before tackling this applicative part.

[2] Some graphs are included in the spreadsheet file as well, conveying information in a visual form.

[3] In principle, the & operator is not even necessary if one uses homogeneous labels (see Section 4).

[4] For simplicity, we will refer to Magni (2023) as "Part I".

[5] The COGS are computed as $\text{COGS}_t = \text{COP}_t^m + \text{LC}_t^m - \Delta\text{Inv}_t..$ However, the relation between material used and manufacturing COP is as follows: material used in $t = \text{COP}_t^m - \Delta\text{Inv}_t$; material used in t is an estimated figure, based on the projection of units produced (equal to units sold by assumption). Material used in t = units sold in $t \cdot$ unit cost. Hence, COP_t^m = units sold in t · unit cost + ΔInv_t and we can also write

$$\text{COGS}_t = \text{units sold in t} \cdot \text{unit cost} + \text{LC}_t^m.$$

The latter equality may be used for checking consistency of COGS calculation in the model.

[6] The vertical bar in Figure 6 is now in Indian red. As explained in Part I, its meaning changes as follows: for each row, the sum of the three elements preceding the bar ($C_{t-1} + I_t - F_t$) is equal to the element following the bar (C_t).

[7] We note, again, that column D describes a statement of capital amounts (equality of investments and financings), column E describes a statement of incomes (equality of income from investments and income to capital providers), column F describes a statement of cash flows (equality of cash flow from investments and cash flow distributed to capital providers).

[8] Those unfamiliar with these functions may turn to Avon (2021, Ch. 11) or to any guide to spreadsheets.

[9] In principle, labels in the "TransMatrix" sheet may be adjusted with the addition of "+" so that the "&" operator is not necessary.

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