

Data Appendix

“The Brazilian Depression of 1980s and 1990s”

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Original Data: Description

- O1. Nominal Gross National Product, 1947-1998 (R\$ hundreds)
- O2. Nominal Private Consumption, 1947-1998 (R\$ hundreds)
- O3. Nominal Government Consumption, 1947-1998 (R\$ hundreds)
- O4. Nominal Gross Fixed Capital Formation, 1947-1998 (R\$ hundreds)
- O5. Nominal Gross Fixed Capital Formation, Structures, 1947-1998 (R\$ hundreds)
- O6. Nominal Gross Fixed Cap. Form, Machinery and Equipment, 1947-1998 (R\$ hundreds)
- O7. Nominal Inventory Changes, 1947-1987: 1990-1998 (R\$ hundreds)
- O8. Nominal Gross Capital Formation, 1947-1998 (R\$ hundreds)
- O9. Nominal Private Gross Fixed Capital Formation, 1970-1998 (R\$ hundreds)
- O10. Nominal Government Gross Fixed Capital Formation, 1970-1998 (R\$ hundreds)
- O11. Nominal Exports, 1947-1998 (R\$ hundreds)
- O12. Nominal Imports, 1947-1998 (R\$ hundreds)
- O13. Implicit price deflator of GDP (changes, %)
- O14. Brazilian per capita GDP relative to USA, 1950-1998 (as a share)
- O15. Industrial capacity utilization (average, %), 1970-1998
- O16. Tax share on GDP (%), 1947-2001
- O17. IPA-DI, general, 1970-2000 (price index, 1998 = 100)
- O18. IPA-DI, machines, vehicles, and equipment, 1970-2000 (price index, 1998 = 100)
- O19. IPA-DI, construction equipment, 1970-2000 (price index, 1998 = 100)
- O20. IPA-DI, consumption – durables, 1970-2000 (price index, 1998=100)
- O21. IPA-DI, consumption – nondurables, 1970-2000 (price index, 1998=100)

Original Data: Source

- O1. Nt.Ac., IBGE.
- O2. Nt.Ac., IBGE.
- O3. Nt.Ac., IBGE.
- O4. Nt.Ac., IBGE.
- O5. Nt.Ac., IBGE.
- O6. Nt.Ac., IBGE.
- O7. Nt.Ac., IBGE.

- O8. Nt.Ac., IBGE.
- O9. Nt.Ac., IBGE.
- O10. Nt.Ac., IBGE.
- O11. Nt.Ac., IBGE.
- O12. Nt.Ac., IBGE.
- O13. Nt.Ac., IBGE.
- O14. Penn World Table 6, <http://pwt.econ.upenn.edu/>.
- O15. FGV, also at <http://www.ipeadata.gov.br/> as “utilização da capacidade – indústria – média”.
- O16. Nt.Ac., IBGE.
- O17. FGV, Conjuntura Econômica, also at <http://www.ipeadata.gov.br/> as “IPA-DI - producer price index domestic supply”.
- O18. FGV, Conjuntura Econômica, also at <http://www.ipeadata.gov.br/> as “IPA-DI - machine, vehicles and equipments”.
- O19. FGV, Conjuntura Econômica, also at <http://www.ipeadata.gov.br/> as “IPA-DI - building materials”.
- O20. FGV, Conjuntura Econômica, also at <http://www.ipeadata.gov.br/> as “IPA-DI - durables goods”.
- O21. FGV, Conjuntura Econômica, also at <http://www.ipeadata.gov.br/> as “IPA-DI - nondurables goods”.

Notes:

- (a) IBGE denotes the Brazilian Institute for Geography and Statistics (Instituto Brasileiro de Geografia e Estatística, <http://www.ibge.gov.br/>).
- (b) Nt.Ac., IBGE, denotes the National Accounts Statistics publish by IBGE. National Accounts came from two sources: National Accounts System publications (several years and volumes) and Anuário Estatístico Brasileiro (several years and volumes).
- (c) IPEA denotes the Institute for Applied Economic Research (Instituto de Pesquisa Econômica e Aplicada), Ministry of Planning, Brazilian Federal Government (<http://www.ipea.gov.br/>).
- (d) FGV refers to Fundação Getúlio Vargas, <http://www.fgv.br/>.

Description of key raw series

1. *Gross Fixed Capital Formation (1947-1998)*: composed by investments in three categories, namely *building construction, machinery and equipments* and *others*. The item *machinery and equipments* is computed as the total volume invested in machineries, including transportation and installation, of all machineries produced in Brazil minus the export of those capital products plus the total value of imported machineries. The item *others* include investment in planted forests, new permanent cultures and the value of breeding animals.

2. *IPA-DI*: wholesale price index covering the entire economy (general) and specifics sectors of manufactures (machines, vehicles, and equipment; and construction equipment).¹

Constructed Series: Description

- C1. Real Gross National Product, 1947 – 1998 (thousands of 1998 Reais), 100*O1/C15
- C2. Real Private Consumption, 1947 – 1998 (thousands of 1998 Reais), 100*O2/C15
- C3. Real Consumption of Durables Goods, 1970 – 1998 (thousands of 1998 Reais), 100*O3/C15
- C4. Real Consumption of Non-Durables Goods, 1970 – 1998 (thousands of 1998 Reais), 100*O4/C15
- C5. Real Government Consumption, 1947 – 1998 (thousands of 1998 Reais), 100*O5/C15
- C6. Real Gross Fixed Capital Formation, 1947 – 1998 (thousands of 1998 Reais), 100*O6/C15
- C7. Real Gross Fixed Capital Formation, Structures, 1947-1998 (thousands of 1998 Reais), 100*O7/C15
- C8. Real Gross Fixed Capital Formation, Machinery and Equipment, 1947-1998 (thousands of 1998 Reais), 100*O8/C15
- C9. Real Inventories Changes, 1947-1998 (thousands of 1998 Reais), 100*O9/C15
- C10. Real Gross Capital Formation, 1947 – 1998 (thousands of 1998 Reais), 100*O10/C15
- C11. Real Private Gross Fixed Capital Formation, 1970 – 1998 (thousands of 1998 Reais), 100*O11/C15
- C12. Real Government Gross Fixed capital Formation, 1970 – 1998 (thousands of 1998 Reais), 100*O12/C15
- C13. Real Exports, 1947 – 1998 (thousands of 1998 Reais), 100*O13/C15
- C14. Real Imports, 1947 – 1998 (thousands of 1998 Reais), 100*O14/C15
- C15. Implicit Price Index of GDP, 1947 – 1998 (1998 = 100)
- C16. Real Capital Stock, 1970 – 1998 (thousands of 1998 Reais)
- C17. Working age population, 10–69 years, 1950 – 1998
- C18. Economically Active Population, 1950-1998
- C19. Employment, 1950 – 1998
- C20. Average weekly worked hours, 1970 – 1998
- C21. Hours worked, 1970 – 1998
- C22. GNP per Working Age Population, C1/C17
- C23. Capital Stock per Working Age Population, C16/C17
- C24. Private Consumption per Working Age Population, C2/C17
- C25. Consumption of Durables Goods per Working Age Population, C3/C17
- C26. Consumption of Non-Durables Goods per Working Age Population, C4/C17
- C27. Government Consumption per Working Age Population, C5/C17
- C28. Gross Fixed Capital Formation per Working Age Population, C6/C17

¹ For a good description of price index, see Muendler (2003).

- C29. Gross Fixed Capital Formation per Working Age Population, Construction, C7/C17
- C30. Gross Fixed Capital Formation per Working Age Population, Machinery and Equipment, C8/C17
- C31. Gross Capital Formation per Working Age Population, C9/C17
- C32. Private Gross Fixed Capital Formation per Working Age Population, C10/C17
- C33. Government Gross Fixed Capital Formation per Working Age Population, C11/C17
- C34. Exports per Working Age Population, C12/C17
- C35. Imports per Working Age Population, C13/C17
- C36. Total factor productivity, 1970 – 1998
- C37. Relative Price Corrected Gross Fixed Capital Formation, Construction, $100 \cdot O5/O19$
- C38. Relative Price Corrected Gross Fixed Capital Formation, Machinery and Equipment, $100 \cdot O6/O18$
- C39. Relative Price Corrected Consumption of Durables Goods, $100 \cdot (C3 \cdot C15)/O20$
- C40. Relative Price Corrected Investment, $C37 + C38 + C39$
- C41. Relative Price Corrected Capital Stock

Construction of series

1. *Real Series (C1-C16)*: To transform the nominal series into real series we used the GDP implicit deflator to construct a price index taking 1998 as the base-year. While this method does not account for changes in relative prices due to the Brazilian hyperinflation (late 1980s), the use of a single price index keeps the consistence between the various components of the national expenditure. Unless one can use an implicit deflator for each series, this consistency would be compromised by the use of a different price index for each series.

2. *Real Consumption of Durables Goods and Non-durables (C3 and C4)*: These series are from Ellery, Gomes and Sachsida (2002). The Brazilian National Account System provides information about the final consumption of goods classified by sector of activity for 1970, 1975, 1980, 1985 and 1990. The consumption of non-durable goods for these years is calculated as the sum of the demand for final consumption of each sector classified as a producer of a non-durable good. Following the adopted methodology, the share of non-durable consumption in total consumption was computed for each of those years. Then a linear interpolation of these shares was made in order to determine the share of non-durable consumption for the missing years between 1970 and 1990. To calculate the consumption of non-durable goods in the years with missing data the share calculated above is multiplied by the total consumption. The result is added to a random variable. The random variable is calculated so that the relative volatility of the generated data matches the relative volatility of the actual data. For the period 1990-1998 the necessary information is directly available in the New National Account System (SNA-93).

3. *Capital Stock (C16)*: capital stock series (K_t) were computed using the Perpetual Inventory method. Gross Fixed Capital Formation (*GFCE*) consists of three components, namely investments in construction

structures (S_t), machineries and equipments (ME_t), and others (O_t). Gross Capital Formation (GCF_t) is in turn obtained adding the inventory changes (IC_t). Total investment flow is then computed including to this gross capital formation the consumption of durable goods (CD_t). The depreciation rate was taken as $\delta_{ME}=15\%$ for capital stock of machineries and equipments (KME_t) and $\delta_{KS}=3.5\%$ for capital stock of structures (KS_t) taken from the WPN, whereas the depreciation rate for other capital stock (KO_t) was taken as $\delta_{KO}=15\%$ as well. i.e.

$$K_{t+1} = GFCF_t + IC_t + CD_t + (1 - \delta_{ME})KME_t + (1 - \delta_{KS})KS_t + (1 - \delta_{KO})KO_t$$

To compute the initial capital stock K_{1970} , the capital labor ratio computed by IPEA $(K/Y)_{1970}=1.33$ was used. Therefore, $K_{1970} = 1.33 Y_{1970}$.

4. *Working-age population (C17)*: the 10 to 69 years-old population was taken as the Brazilian working-age population instead of the commonly used interval 15-64 due to the existence of child labor as well as the limited social security coverage in the country. The National Census data for 1950, 1960, 1970, 1980 and 1991 and the Population Account of 1996 were taken and linear interpolation techniques were applied in order to obtain the series up to 1996. The average growth rate of this working-age population for the period 1991-1996 was taken in turn to linearly project the corresponding data for 1997 and 1998.

5. *Average weekly worked hours (C18)*: the Brazilian National Census data and the PNAD data, both published by IBGE, were used to compute this series. Yet the missing data for 1974, 1975, 1991 and 1994 were supplied by means of a linear interpolation of the series. The raw data presents the weekly worked hours by intervals of hours worked and, also variation of the considered sample of workers. Therefore, these raw data were treated using the methodology proposed by McGrattan and Rogerson (1998) in order to obtain a consistent average value for the average weekly worked hours.

6. *Economically active population (C19)*: The Brazilian census give the data on the economically active population for 1950, 1960, 1970, 1980 and 1991. For the missing years between 1950 and 1970 we used a linear interpolation. For the missing years between 1970 and 1998 we used the values given by the Annual Household Survey (PNAD), except for 1974, 1975, 1992 and 1994. In this years PNAD were not carried on by the government. Again, we used linear interpolation to get the corresponding values.

7. *Employment (C20)*: The Brazilian census estimates the employment for 1950, 1960, 1970 and 1980. Between 1990-1998 employment is computed in the National Account (IBGE). For the missing values between 1950 and 1990 we get employment data using linear interpolation.

8. *Hours Worked (C21)*: (employment) x (average weekly worked hours) x (number of weeks per year).

9. *Total Factor Productivity (C36)*: For computation of total factor productivity we use the Cobb-Douglas

production function: $A = \frac{Y}{K^\theta L^{1-\theta}}$, where Y is the GNP per working age person, K is the capital stock per

working age person, H is the total hours worked, A is the total factor productivity, θ is the capital share and t is the time subscript.

Notes:

- (a) IPEA denotes the Institute for Applied Economic Research (Instituto de Pesquisa Econômica e Aplicada), Ministry of Planning, Brazilian Federal Government.
- (b) Nt.Cn., IBGE, refers to the Brazilian National Census conducted by IBGE every 10 years approximately: 1950, 1960, 1970, 1980 and 1991.
- (c) PNAD, IBGE (Pesquisa Nacional de Amostragem Domiciliar) refers to the Brazilian Households National Survey conducted by IBGE, for the period 1970-1998 but 1974, 1975, 1991 and 1994.
- (d) Pop.Acc., IBGE (Contagem da População) refers to the statistics obtained by IBGE in 1996 regarding the structure and characteristics of the Brazilian population.

Detrending

All series were detrended according to

$$y_t^d = \frac{y_t}{(1 + g)^{t-1980} \cdot y_{1980}}$$

where y_t^d denotes the detrended series, y_t is the undetrended series, g is the trend, and t is the time period, for $t = \{1980, \dots, 1998\}$.

Data for growth accounting

The data for growth accounting are the capital input, the labor input, the total factor productivity and the Gross National Product. The capital input (K) corresponds to the Capital Stock (C16); the labor input (L) is hours worked (C21). The total factor productivity (A) is calculated as described in the paper, i.e.:

$$A = \frac{Y}{K^\theta L^{1-\theta}}, \text{ where } Y \text{ represents the GNP and } \theta \text{ the capital share.}$$

Figures and Tables

Figure 1: Detrended GNP per Working age Person, 10-69 years (1980-1998), C22 detrended.

Figure 2: Detrended Output, Hours, and Capital Series, C22 detrended, C23 detrended and C21.

Figure 3: Detrended TFP, C36 detrended.

Figure 4: Detrended Aggregate Output Dynamics, Data and Artificial Series, C22 detrended and artificial data.

Figure 5: Data and Model Dynamics. (a) Consumption, C26 detrended; (b) Investment, C31 detrended; (c) Capital, C23 detrended; (d) Hours, C21/C17. Dashed line is the model data.

Figure 6: Relative Price of Investment and Consumption Goods. (a) Relative Price of Structures, O19/O17; (b) Relative Price of Machines and Equipment, O18/O17; (c) Relative Price of Durables Consumption Goods, O20/O17; (d) Relative Price of Non-Durables Consumption Goods, O21/O17.

Figure 7: Detrended Investment Series Dynamics, Corrected Data and Model with Corrected Data. Data: C31 detrended; Corrected data: C40 detrended.

Figure 8: Capital Stock Series, Brazil (1980-1998) Data, Corrected Data and Model with Corrected Data. Data: C23 detrended; Corrected Data: C41. See the description above on construction of capital stock.

Table 1: Detrended Per Working Age Person Output and Components. C22, C25, C26, C31, C32, C33, C27, C35, C34, all series detrended.

Table 2: Composition of output (as shares of GDP). C24/C22, C31/C22, C27/C22, C35/C22, C34/C22.

Table 3: Aggregate output and inputs. C22 detrended, C23 detrended, C23/C22, C21, C18, C22/C21, O15.

Table 4: Growth accounting. C22, C36, C23/C22, C21/C17.

Table 5: Model growth accounting (artificial data).

References

Ellery Jr., Roberto, Victor Gomes and Adolfo Sachsida (2002), "Business cycle fluctuations in Brazil", *Revista Brasileira de Economia* (Brazilian Economic Review), 56 (2), pp. 269-308.

McGrattan, Ellen R. and Richard Rogerson (1998), "Changes in hours worked since 1950", *Federal Reserve Bank of Minneapolis Quarterly Review*, 22 (1), pp. 2-19.

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