APENDICE 4

Algoritmo de interpolación multifractal que modela la volatilidad del IPC, escrito en el lenguaje del programa *Mathematica 6*.

```
Clear[Arr, Nes, Par]

F1[x_] := ( 0.0398876404494382    0 ) .x + ( 0 )
          (-0.0253247191011236  .042)    ( 0.87178)

F2[x_] := ( 0.06573033707865168     0 ) .x + ( 0.71 )
          (-0.028227528089887634 0.055)    ( 0.76995)

F3[x_] := ( 0.04719101123595507     0 ) .x + ( 1.88 )
          (-0.012331460674157307 0.050)    ( 0.7445)

F4[x_] := ( 0.05674157303370785     0 ) .x + ( 2.72 )
          (-0.012561797752808985 0.040)    ( .9636)

F5[x_] := ( 0.06348314606741574     0 ) .x + ( 3.73 )
          (-0.00865112359550562 0.061)    ( 1.06449)

F6[x_] := ( 0.040449438202247175    0 ) .x + ( 4.86 )
          (-0.03674831460674158 0.068)    ( 1.42812)

F7[x_] := ( 0.04101123595505615     0 ) .x + ( 5.58 )
          ( 0.021270224719101134 -0.079)    ( 1.49189)

F8[x_] := ( 0.05000000000000003  0 ) .x + ( 6.31 )
          (-0.0201685393258427  .1)    ( 1.029)

F9[x_] := ( 0.05505617977528087    0 ) .x + ( 7.2 )
          (-0.04596123595505619 .129)    ( 1.50261)

F10[x_] := ( 0.030337078651685445    0 ) .x + ( 8.18 )
           (-0.05017415730337078 0.090)    ( 1.8281)

F11[x_] := ( 0.052247191011235934    0 ) .x + ( 8.72 )
           (-0.0388370786516854  0.070)    ( 1.7263)

F12[x_] := ( 0.10505617977528085    0 ) .x + ( 9.65 )
           (-0.03750505617977529 .101)    ( 1.60809)

F13[x_] := ( 0.09943820224719098    0 ) .x + ( 11.52 )
           ( 0.03409550561797752 0.090)    ( 1.8181)


F14[x_] := ( 0.04550561797752812    0 ) .x + ( 13.29 )
           (-0.012288764044943817 .086)    ( 3.20174)

F15[x_] := ( 0.038202247191011215  0 ) .x + ( 14.1 )
           ( 0.04047752808988766  .05)    ( 3.7545)

F16[x_] := ( 0.019101123595505608    0 ) .x + ( 14.78 )
           ( 0.023623595505617954 0.05)    ( 4.9045)

F17[x_] := ( 0.02752808988764046    0 ) .x + ( 15.12 )
           (-0.10652808988764043 0.18)    ( 5.6362)

F18[x_] := ( 0.028651685393258516  0 ) .x + ( 15.61 )
           ( 0.06106179775280895  .09)    ( 5.3681)

F19[x_] := ( 0.021348314606741515  0 ) .x + ( 16.12 )
           ( 0.02319101123595508  .08)    ( 7.2372)

F20[x_] := ( 0.03258426966292125    0 ) .x + ( 16.5 )
           (-0.040761235955056194 .145)    ( 8.27805)

F21[x_] := ( 0.010112359550561981  0 ) .x + ( 17.08 )
           ( 0.047550561797752786 .04)    ( 8.8936)

F22[x_] := ( 0.007865168539325675  0 ) .x + ( 17.26 )
           (-0.03799999999999998 -.04)    ( 10.1564)

F23[x_] := ( 0.02247191011235967    0 ) .x + ( 17.4 )
           ( 0.11030224719101125 -.182)    ( 9.26562)

FS1[x_] := ( 0.04113557358053302    0 ) .x + ( 0 )
           ( 0.02413383545770567 -.055)    ( 0.96005)

FS2[x_] := ( 0.06778679026651216     0 ) .x + ( 0.71 )
           (-0.048695249130938575 0.088)    ( 0.73992)

FS3[x_] := ( 0.04866743916570106     0 ) .x + ( 1.88 )
           ( 0.04098146002317496 -0.054)    ( 0.83914)

FS4[x_] := ( 0.058516801853997664    0 ) .x + ( 2.72 )
           (-0.018126882966396283 0.047)    ( 0.95723)
```

$$FS5[x\_] := \begin{pmatrix} 0.06546929316338355 & 0 \\ 0.09293974507531864 & -0.134 \end{pmatrix}.x + \begin{pmatrix} 3.73 \\ 1.24194 \end{pmatrix};$$

$$FS6[x\_] := \begin{pmatrix} 0.04171494785631516 & 0 \\ -0.037139049826187716 & 0.062 \end{pmatrix}.x + \begin{pmatrix} 4.86 \\ 1.43358 \end{pmatrix};$$

$$FS7[x\_] := \begin{pmatrix} 0.04229432213209731 & 0 \\ 0.050920046349942065 & -0.128 \end{pmatrix}.x + \begin{pmatrix} 5.58 \\ 1.53648 \end{pmatrix};$$

$$FS8[x\_] := \begin{pmatrix} 0.05156431054461185 & 0 \\ -0.003047508690614136 & 0.06 \end{pmatrix}.x + \begin{pmatrix} 6.31 \\ 1.0654 \end{pmatrix};$$

$$FS9[x\_] := \begin{pmatrix} 0.05677867902665119 & 0 \\ 0.06055735805330242 & -0.082 \end{pmatrix}.x + \begin{pmatrix} 7.2 \\ 1.69462 \end{pmatrix};$$

$$FS10[x\_] := \begin{pmatrix} 0.03128621089223644 & 0 \\ -0.04003592120509848 & 0.062 \end{pmatrix}.x + \begin{pmatrix} 8.18 \\ 1.85358 \end{pmatrix};$$

$$FS11[x\_] := \begin{pmatrix} 0.05388180764774042 & 0 \\ 0.025734646581691768 & -0.058 \end{pmatrix}.x + \begin{pmatrix} 8.72 \\ 1.84278 \end{pmatrix};$$

$$FS12[x\_] := \begin{pmatrix} 0.10834298957126298 & 0 \\ -0.01669351100811124 & 0.053 \end{pmatrix}.x + \begin{pmatrix} 9.65 \\ 1.65177 \end{pmatrix};$$

$$FS13[x\_] := \begin{pmatrix} 0.10254924681344145 & 0 \\ 0.09916338354577056 & -0.036 \end{pmatrix}.x + \begin{pmatrix} 11.52 \\ 1.93276 \end{pmatrix};$$

$$FS14[x\_] := \begin{pmatrix} 0.0469293163383546 & 0 \\ 0.01678736964078795 & 0.025 \end{pmatrix}.x + \begin{pmatrix} 13.29 \\ 3.25725 \end{pmatrix};$$

$$FS15[x\_] := \begin{pmatrix} 0.03939745075318654 & 0 \\ 0.08263615295480883 & -0.03 \end{pmatrix}.x + \begin{pmatrix} 14.1 \\ 3.8273 \end{pmatrix};$$

$$FS16[x\_] := \begin{pmatrix} 0.01969872537659327 & 0 \\ 0.0321714947856315 & 0.032 \end{pmatrix}.x + \begin{pmatrix} 14.78 \\ 4.92088 \end{pmatrix};$$

$$FS17[x\_] := \begin{pmatrix} 0.028389339513325618 & 0 \\ 0.01493974507531868 & -0.066 \end{pmatrix}.x + \begin{pmatrix} 15.12 \\ 5.86006 \end{pmatrix};$$

$$FS18[x\_] := \begin{pmatrix} 0.029548088064890007 & 0 \\ 0.08054982618771724 & 0.051 \end{pmatrix}.x + \begin{pmatrix} 15.61 \\ 5.40359 \end{pmatrix};$$

$$FS19[x\_] := \begin{pmatrix} 0.02201622247972184 & 0 \\ 0.09521378910776362 & -0.059 \end{pmatrix}.x + \begin{pmatrix} 16.12 \\ 7.36369 \end{pmatrix};$$

$$FS20[x\_] := \begin{pmatrix} 0.033603707995364905 & 0 \\ 0.010917728852838912 & 0.036 \end{pmatrix}.x + \begin{pmatrix} 16.5 \\ 8.37724 \end{pmatrix};$$

$$FS21[x\_] := \begin{pmatrix} 0.010428736964078984 & 0 \\ 0.08655446118192349 & -0.033 \end{pmatrix}.x + \begin{pmatrix} 17.08 \\ 8.96003 \end{pmatrix};$$

$$FT1[x\_] := \begin{pmatrix} 0.056133056133056226 & 0 \\ 0.03644282744282745 & -0.062 \end{pmatrix}.x + \begin{pmatrix} 7.720831600831602 \\ 1.7303176715176714 \end{pmatrix};$$

$$FT2[x\_] := \begin{pmatrix} 0.09667359667359664 & 0 \\ -0.05511642411642412 & 0.058 \end{pmatrix}.x + \begin{pmatrix} 7.92920997920998 \\ 2.1300723492723495 \end{pmatrix};$$

$$FT3[x\_] := \begin{pmatrix} 0.1943866943866943 & 0 \\ 0.0626060291060291 & -0.053 \end{pmatrix}.x + \begin{pmatrix} 8.059916839916841 \\ 1.2891126819126821 \end{pmatrix};$$

$$FT4[x\_] := \begin{pmatrix} 0.18399168399168395 & 0 \\ 0.11504781704781702 & 0.036 \end{pmatrix}.x + \begin{pmatrix} 10.014948024948026 \\ 0.8901488565488568 \end{pmatrix};$$

$$FT5[x\_] := \begin{pmatrix} 0.08419958419958425 & 0 \\ 0.07377858627858627 & -0.025 \end{pmatrix}.x + \begin{pmatrix} 12.601247401247399 \\ 2.724241164241165 \end{pmatrix};$$

$$FT6[x\_] := \begin{pmatrix} 0.07068607068607065 & 0 \\ 0.09587318087318092 & 0.03 \end{pmatrix}.x + \begin{pmatrix} 13.52178794178794 \\ 2.9584573804573804 \end{pmatrix};$$

$$FT7[x\_] := \begin{pmatrix} 0.035343035343035324 & 0 \\ 0.11360498960498955 & -0.032 \end{pmatrix}.x + \begin{pmatrix} 14.49089397089397 \\ 4.081831185031187 \end{pmatrix};$$

$$FT8[x\_] := \begin{pmatrix} 0.05093555093555095 & 0 \\ -0.08845530145530142 & 0.066 \end{pmatrix}.x + \begin{pmatrix} 14.703347193347195 \\ 6.397504365904365 \end{pmatrix};$$

$$FT9[x\_] := \begin{pmatrix} 0.05301455301455317 & 0 \\ 0.233585239085239 & -0.051 \end{pmatrix}.x + \begin{pmatrix} 15.176340956340955 \\ 3.636682744282745 \end{pmatrix};$$

$$FT10[x\_] := \begin{pmatrix} 0.03950103950103939 & 0 \\ 0.06779521829521834 & 0.059 \end{pmatrix}.x + \begin{pmatrix} 15.7968814968815 \\ 6.642745114345113 \end{pmatrix};$$

$$FT11[x\_] := \begin{pmatrix} 0.06029106029106011 & 0 \\ 0.08245738045738041 & -0.036 \end{pmatrix}.x + \begin{pmatrix} 16.006819126819128 \\ 7.804258627858628 \end{pmatrix};$$

$$FT12[x\_] := \begin{pmatrix} 0.01871101871101905 & 0 \\ 0.0976642411642411 & 0.033 \end{pmatrix}.x + \begin{pmatrix} 16.926943866943866 \\ 8.068076507276508 \end{pmatrix};$$

$$FT13[x\_] := \begin{pmatrix} 0.014553014553014242 & 0 \\ -0.07210291060291055 & -0.043 \end{pmatrix}.x + \begin{pmatrix} 17.140956340956347 \\ 10.791931808731809 \end{pmatrix};$$

$$FT14[x\_] := \begin{pmatrix} 0.0415800415800418 & 0 \\ -0.006547817047817005 & 0.061 \end{pmatrix}.x + \begin{pmatrix} 17.059875259875255 \\ 9.037051143451142 \end{pmatrix};$$

```
FU1[x_] := {{0.06163194444444444, 0}, {-0.012539062500000007, .055}}.x + {0, 0.85995};
FU2[x_] := {{0.10156249999999999, 0}, {0.004958333333333339, -0.088}}.x + {0.71, 0.90008};
FU3[x_] := {{0.07291666666666669, 0}, {0.013588541666666665, 0.054}}.x + {1.88, 0.74086};
FU4[x_] := {{0.08767361111111109, 0}, {0.014455729166666674, -0.047}}.x + {2.72, 1.04277};
FU5[x_] := {{0.0980902777777778, 0}, {0.020602430555555547, 0.134}}.x + {3.73, 0.99806};
FU6[x_] := {{0.06249999999999998, 0}, {-0.0007482638888888947, -0.062}}.x + {4.86, 1.54642};
FU7[x_] := {{0.06336805555555551, 0}, {-0.037041666666666646, 0.128}}.x + {5.58, 1.30352};
FU8[x_] := {{0.07725694444444449, 0}, {0.04855902777777778, -0.06}}.x + {6.31, 1.1746};
FU9[x_] := {{0.0850694444444444, 0}, {0.018126736111111097, 0.082}}.x + {7.2, 1.54538};
FU10[x_] := {{0.046875000000000076, 0}, {-0.005088541666666656, -0.062}}.x + {8.18, 1.96642};
FU11[x_] := {{0.08072916666666664, 0}, {-0.012796875000000006, 0.058}}.x + {8.72, 1.73722};
FU12[x_] := {{0.1623263888888888, 0}, {0.021915798611111103, -0.053}}.x + {9.65, 1.74823};

FV1[x_] := {{0.28184713375796167, 0}, {0.17617834394904452, 0.036}}.x + {8.273121019108281, -0.19797452229299273};
FV2[x_] := {{0.12898089171974528, 0}, {0.1130573248407643, -0.025}}.x + {11.804140127388532, 2.025079617834395};
FV3[x_] := {{0.10828025477707, 0}, {0.14681528662420384, 0.03}}.x + {12.852611464968152, 2.0516878980891713};
FV4[x_] := {{0.054140127388535, 0}, {0.174076433121019, -0.032}}.x + {14.156305732484078, 3.005439490445861};
FV5[x_] := {{0.07802547770700638, 0}, {-0.1356050955414012, 0.066}}.x + {14.22114649681529, 7.23677070063694};
FV6[x_] := {{0.08121019108280278, 0}, {0.3578980891719743, -0.051}}.x + {14.67445859872611, 1.4239140127388557};
FV7[x_] := {{0.060509554140127216, 0}, {0.10375796178343956, 0.059}}.x + {15.422929936305737, 6.002608280254774};
FV8[x_] := {{0.09235668789808887, 0}, {0.12636942675159224, -0.036}}.x + {15.436050955414009, 7.022624203821656};
FV9[x_] := {{0.02866242038216612, 0}, {0.1495541401273884, 0.033}}.x + {16.749808917197445, 7.144436305732485};
FV10[x_] := {{0.022292993630572768, 0}, {-0.11038216560509546, -0.043}}.x + {17.003184713375806, 11.473302547770698};
FV11[x_] := {{0.06369426751592389, 0}, {-0.010127388535031784, 0.061}}.x + {16.66624203821655, 9.100767515923563};


Par[x_] := Partition[Flatten[x], 2]


Clear[T];
T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS1, FU1}[[Random[Integer, {1, 25}]]][
    x[[1]]]] /;
         0 ≤ x[[1, 1]] ≤ 0.71
T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS2, FU2}[[Random[Integer, {1, 25}]]][
    x[[1]]]] /;
         0.71 < x[[1, 1]] < 1.88
T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS3, FU3}[[Random[Integer, {1, 25}]]][
    x[[1]]]] /;
         1.88 ≤ x[[1, 1]] ≤ 2.72
```

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T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS4, FU4}[[Random[Integer, {1, 25}]]][
    x[[1]]] /;
         2.72 < x[[1, 1]] < 3.73
T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS5, FU5}[[Random[Integer, {1, 25}]]][
    x[[1]]] /;
         3.73 ≤ x[[1, 1]] ≤ 4.86
T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS6, FU6}[[Random[Integer, {1, 25}]]][
    x[[1]]] /;
         4.86 < x[[1, 1]] < 5.58

T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS7, FU7}[[Random[Integer, {1, 25}]]][
    x[[1]]] /;
         5.58 ≤ x[[1, 1]] ≤ 6.31
T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS8, FU8}[[Random[Integer, {1, 25}]]][
    x[[1]]] /;
         6.31 < x[[1, 1]] < 7.2
T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS9, FU9}[[Random[Integer, {1, 25}]]][
    x[[1]]] /;
        7.2 ≤ x[[1, 1]] ≤ 8.18

T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS10, FU10, FT1}[[
     Random[Integer, {1, 26}]]][x[[1]]] /;
         8.18 < x[[1, 1]] < 8.72
T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS11, FU11, FT2}[[
     Random[Integer, {1, 26}]]][x[[1]]] /;
         8.72 ≤ x[[1, 1]] ≤ 9.65
T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS12, FU12, FT3}[[
     Random[Integer, {1, 26}]]][x[[1]]] /;
         9.65 < x[[1, 1]] < 11.52
T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS13, FV1, FT4}[[
     Random[Integer, {1, 26}]]][x[[1]]] /;
         11.52 ≤ x[[1, 1]] ≤ 13.29
```

```
T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS14, FV2, FT5}[[
     Random[Integer, {1, 26}]]][x[[1]]] /;
         13.29 < x[[1, 1]] < 14.10
T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS15, FV3, FT6}[[
     Random[Integer, {1, 26}]]][x[[1]]] /;
         14.10 ≤ x[[1, 1]] ≤ 14.78
T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS16, FV4, FT7}[[
     Random[Integer, {1, 26}]]][x[[1]]] /;
         14.78 < x[[1, 1]] < 15.12
T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS17, FV5, FT8}[[
     Random[Integer, {1, 26}]]][x[[1]]] /;
         15.12 ≤ x[[1, 1]] ≤ 15.61

T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS18, FV6, FT9}[[
     Random[Integer, {1, 26}]]][x[[1]]] /;
         15.61 < x[[1, 1]] < 16.12
T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS19, FV7, FT10}[[
     Random[Integer, {1, 26}]]][x[[1]]] /;
         16.12 ≤ x[[1, 1]] ≤ 16.50
T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS20, FV8, FT11}[[
     Random[Integer, {1, 26}]]][x[[1]]] /;
         16.50 < x[[1, 1]] < 17.08
T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FS21, FV9, FT12}[[
     Random[Integer, {1, 26}]]][x[[1]]] /;
         17.08 ≤ x[[1, 1]] ≤ 17.26
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```
T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FV10, FT13}[[Random[Integer, {1, 25}]]][
    x[[1]]]] /;
        17.26 < x[[1, 1]] < 17.40
T[x_] :=
 Par[
   {F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16,
      F17, F18, F19, F20, F21, F22, F23, FV11, FT14}[[Random[Integer, {1, 25}]]][
    x[[1]]]] /;
        17.40 ≤ x[[1, 1]] ≤ 17.8


NesT = NestList[T,
        {{0., 0.8}}, 200];
LT = Par[NesT];
SLT = Sort[LT];
ListPlot[SLT, PlotStyle -> PointSize[.005], Joined → True]
Clear[f0];
f0[x_, y_] := N[x / (1 + Abs[y])]
Clear[Lp];
Lp[L_] := Table[
  {i, f0[L[[i + 1, 2]] - L[[i, 2]], 2 + Abs[L[[i, 2]]]]}, {i, 1, Length[L] - 1}]
ListPlot[Lp[SLT], PlotStyle -> PointSize[.005], Joined → True,
 PlotRange → {-.20, .20}]
```