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Fractal algorithm for the modeling of consumption in COVID-19

Algoritmo Fractal para la modelación del consumo en COVID-19

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Abstract

We present an analysis of the exogenous factors of consumption, we simulate it in a fractal algorithm whose objective is the Brownian equilibrium through the iterative multiplication of assumptions of an initial function at current prices whose values are constant and positive that will derive in the final solution that is characterized by non-negativity and does not denote absolute convergence, only relative to their economies of scale compared to iterative methods, we find other procedures derived from the stochastic method but formulated strictly as mathematical developments, they are fractal optimization algorithms, which are based on search of an objective function that minimizes the distance between the initial function and the expected iterations of the candidate functions to be a solution, verifying the corresponding restrictions.

Fractal, COVID-19, Consumption

Resumen

Presentamos un análisis de los factores exógenos del consumo lo simulamos en un algoritmo fractal cuyo objetivo es el equilibrado browniano mediante la multiplicación iterativa de supuestos de una función inicial a precios corrientes cuyos valores son constantes y positivos que derivarán en la solución final que se caracteriza por la no negatividad y no denota convergencia absoluta, solo relativa respecto de sus economías a escala frente a los métodos iterativos encontramos otros procedimientos derivados del método estocástico pero formulados estrictamente como desarrollos matemáticos, se trata de algoritmos de optimización fractal, que se basan en la búsqueda de una función objetivo que minimice la distancia entre la función inicial y las iteraciones esperadas de las funciones candidatas a ser solución, verificando las restricciones correspondientes.

Fractal, COVID-19, Consumo

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Introduction

The use of calibration in the static modeling of the traditional economy originates from the need to use complex models with economic policy objectives that simulate the affected short and long-term shock. For this, it is necessary to use as a starting point models that are theoretically consistent but that are intensive in the use of parameters.

The first step for the construction of the model is to have consistent micro information for a certain period and it will be assumed that the economy is in equilibrium. Then, it is necessary to perform a calibration of the model, in this procedure the values of the parameters are estimated. Once all of them have been obtained and the model specified, the model is replicated, checking that an equilibrium is reached with the estimated parameters. Now, it is possible to evaluate the effects of different policies by comparing the reference equilibrium with the simulated one.

Calibration can be understood as the process by which parameter values are inferred from economic data of a given period, and that once those values are specified in an applied model, the data of the base period are endogenously replicated as a solution of the same. To represent the economy, the information must be structured within a scheme that ensures compliance with certain sectoral consistency[1] requirements $\varphi_1 \rightarrow \varphi_n$ and macroeconomic (N).

$$\varphi_1(x)+\varphi_2(x)+\cdots+\varphi_N(x)=0\left(\frac{3}{2}(\log N)\quad N^{\frac{1}{2}}\right)+\varepsilon \qquad (1)$$

Consumer microeconomics

We will begin a process that comprises five phases:

Formulation of the problem (quantifiable) to investigate (P, t), current prices, this conditions the type of model that could be used and therefore the information requirements necessary to find the answer between the available products t> 3.8 and those used $\lim_{t\to 0}$.

$$\frac{\partial}{\partial t} y(P,t) = C[y(P,t)], t > 3.8 \qquad (2)$$

$$\lim_{t\to 0} \quad y(P,t) = y_0(P)$$

$$\frac{d}{dt} y(t) = C[y(t)], t > 3.8 \qquad (2.1)$$

$\lim_{t\to 0} \quad \left|\left|y(t) - y_0\right|\right| = 3.8$ Selection of a type of theory (already tested). Theories may be adequate for some facts and not for others. In particular, the general equilibrium theory of the consumer with respect to production can be modified to adapt it to different closings.
Neoclassical closure[2]:

$$\frac{d}{dt}[C(t)p_0] = C[T(t)p_0], t > 3.8 \qquad (2.2)$$

$$\lim_{t\to 0} \quad \left|\left|C(t)p_0 - p\right|\right| = 3.8$$

Keynesian closure [3]:

$$\left|\left|C(t;p_0)\right|\right| \leq Ce^t\left|\left|p_0\right|\right|, t > 3.8 \qquad (2.3)$$

Structuralist closure [4]:

[1] To add two complex numbers, add the real parts and add the imaginary parts: (V + i · w) + (x + i · y) = (v + x) + i · (w + y). The product of two complex numbers (v + i · w) · (x + i · y) can be obtained by multiplying binomials, remembering i 2 = -1. Grouping the roots and the imaginary parts of the products, we obtain: (V + i · w) · (x + i · y) = (v · x - w · y) + i · (v + w · y · x), here we limit the relationship between the iteration formula of z and those of X and Y, now it should be clear. These complex numbers are usually very simple in nature and originate in successive iterations sets of a certain dimension, fixed throughout the process that is modified when the iteration becomes infinite.

[2] Gauss Criterion: Let be a series of positive terms $\sum a_n$, is calculated:

$$\lim_{n\to\infty} \frac{a_n}{a_{n-1}} = L$$

If L <1 the series is convergent, if L> 1 the series is divergent and, if L = 1 the criterion does not allow to determine convergence or divergence.

[3] Cauchy Criterion: Let be a series of positive terms $\sum a_n$, is calculated: $\lim_{n\to\infty} \sqrt[n]{a_n} = L$
If L <1 the series is convergent, if L> 1 the series is divergent and, if L = 1 the criterion does not allow to determine convergence or divergence.

[4] Gamma Criterion: Let be a series of positive terms $\sum a_n$ and $\sum \frac{1}{u_n}$ a divergent series. Is calculated:

$$\lim_{n\to\infty}\left(u_n \frac{a_n}{a_{n+1}} - u_{n+1}\right) = L$$

If L> 0 the series $\sum a_n$ converges, if L <0 the series $\sum a_n$ diverges and the comparison series is deformed geometric series (fractal evidence).

$$C\left\{\int_s x(p)dp = \int_s C[x(p)]dp \right. \quad (2.4)$$

Choice of functional shapes and model resolution[5]. What is important is not whether the model is realistic or not, but whether it is capable of providing a quantitative answer to a specific question that the researcher asks.

$$\sum_i C_k\, x(p_k), \sum_i C_k\, C[x(P_k)] = C\{\sum_i p_k\, x(P_k) \quad (2.5)$$

Gray's code applies to (a, b, and c) because it is based on a permutation of traditional binary code, it provides a representation of ordered objects such that, going from one object to the next, we only have to change one bit of information. The Hamming distance between the representation of one object and the next (or the predecessor) is 1.

We start by performing smoothed functionality for each market period 2020 (X), 2021 (J):

$$(\theta n + 1, Xn + 1) = f(\theta n+, Xn) = (\theta n + \alpha \sin 6\theta n - b\sin 4\theta n - Xn\sin\theta n - J\cos\theta n) \quad (2.6)$$

According to the price run, we obtain:

For the Ex Ante (2020): $q_{n+1}= f(p_n)+u_n$

For the Ex Post (2021): $p_{n+1}=q_{n+1}+r_n$

Level of competition: $p_H V_1^{\mu}(p_1 - V_2^{v}(p_2) - H(p_H)$

We demonstrate the market in competition:

$$\Gamma_{\mu v}^{HV_1V_2}(PH, P_1, P_2) = \delta z M_Z^2 \left[h_1^{V_1V_2}\delta_{\mu v} + \frac{h_2^{V_1V_2}}{M_Z^2} P_{2\mu} P_{1v}\right] \quad (2.7)$$

$$h\frac{2}{\pi}(P_1 \cdot P_2) = \frac{P_1^2 + P_2^2 - m_H^2}{m_Z^2} C_2 Z_y - \frac{P_1^2 - P_2^2 - m_M^2}{m_Z^2} C_3 Z_y \quad (2.7.1)$$

Combination of productive factors:

$$(e + e^- \to \tau\bar{\tau}y) = \int \frac{\alpha^3}{e}\left[m_\tau^2 C_1(x_w)\left[F_1(s, E_\gamma, \cos\theta_\gamma)(h_2^{Z\gamma})^2\right]\right]$$

$$+ m_r^2 C_2(x_w)\left[F_3(s, E_\gamma, \cos\theta_\gamma) h_1^{Z\gamma} + F_4(s, E_\gamma, \cos\theta_\gamma) h_2^{Z\gamma}\right]$$

$$+ C_3(x_w) F_5(s, E_\gamma, \cos\theta_\gamma)] E_\gamma dE_\gamma d\cos\theta_\gamma \quad (2.8)$$

Exogenous risks to productivity and competitiveness in Mexico:

$$F_1(s, E_y, \cos\theta_y) \equiv \frac{1}{2}\frac{(\frac{1}{2}s - \sqrt{s}E_y - 2m_Z^2)}{\left[(s - M_Z^2)^2 + M_Z^2\,\Gamma_Z^2\right](s + 2\sqrt{s}E_y - M_H^2)^2} \quad (2.8.1)$$

$$F_2(s, E_y, \cos\theta_y) \equiv \frac{1}{3}\left[(s - M_Z^2)^2 + M_Z^2\,\Gamma\frac{2}{Z}\right](s + 2\sqrt{s}E_y - M\frac{2}{H})^2 \quad (2.8.2)$$

$$F_3(s, E_y, \cos\theta_y) \equiv \frac{1}{5}\left[(s - M_Z^2)^2 + M_Z^2\,\Gamma\frac{2}{Z}\right](s + 2\sqrt{s}E_y - M\frac{2}{H}) \quad (2.8.3)$$

$$F_4(s, E_y, \cos\theta_y) \equiv \frac{1}{8}\left[(s - M_Z^2)^2 + M_Z^2\,\Gamma\frac{2}{Z}\right](s + 2\sqrt{s}E_y - M\frac{2}{H}) \quad (2.8.4)$$

$$F_5(s, E_y, \cos\theta_y) \equiv \frac{1}{11}\frac{[(4 - \sin^2\theta_y)\sqrt{s}\sin^2\theta_y}{\left[(s - M_Z^2)^2 + M_Z^2\,\Gamma_Z^2\right](\sqrt{s}\sin^2\theta_y} \quad (2.8.5)$$

We integrate the masses and determine the investment levels to determine growth:

Low level:

$$C_1(x_w) \equiv \frac{(1 - 5x_w + 10x_w^2)}{x_w^3(1 - x_w)^3} \quad (3)$$

Medium level:

$$C_2(x_w) \equiv \frac{(1 - 5x_w(1 - 5x_w + 10x_w^2)}{x_w^{5/2}(1 - x_w)^{5/2}} \quad (3.1)$$

High level:

$$C_3(x_w) \equiv \frac{(1 - 5x_w + 10x_w^2)^2}{x_w^{8/2}(1 - x_w)^{8/2}} \quad (3.2)$$

[5] If the terms of a series of positive terms are less than or equal to those of another convergent series, it is convergent [5]. Let be $\sum a_k$ a string whose character you want to set and is $\sum_{k=1}^{\infty} u_k$ a convergent series, with sum ∪, verifying that $a_k \leq u_k$, so $\sum a_k$ converges and its sum S is less than or equal to the sum ∪. The Serie $\sum_{k=1}^{\infty} u_k$ is a larger series than the given series.

Similarly, it can be said that, if the terms of a series of positive terms are greater than or equal to those of another divergent series, it is divergent.

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We determine the supports: i) Ex Ante Price: F and ii) Ex Post Price: G

$$\{F, G\}\{z\} = \frac{\partial F}{\partial_{qi}}\frac{\partial G}{\partial_{pi}}(z) - \frac{\partial G}{\partial_{qi}}\frac{\partial F}{\partial_{pi}}(z) = 1 \qquad (4)$$

Impact of COVID-19 on international consumption

In today's global economy, trade barriers are as follows:

- Tariff barriers and excessive customs procedures;
- Restrictions on access to raw materials;
- The obstacles to the exchange of services and foreign direct investment;
- Restrictive practices regarding public contracts;
- The use of unfair or discriminatory tax practices (State aid, subsidies and methods incompatible with WTO rules for trade defense, such as anti-dumping measures);
- The incorrect use of unjustified measures in terms of health, safety and technical regulations;
- Insufficient protection and non-application of intellectual property rights (IPR). These obstacles to trade are characterized by their complexity and difficulty in detecting them.

Thus, non-tariff barriers and other "internal" barriers are becoming increasingly important. Many market access problems that have arisen are explained by the fact that the existing rules are not properly applied. Considering the Hénon-Heiles system for expected IFS [Frame, M., Johnson, B., Sauerberg, J: 2000]:

We limit the scaling levels [Frame, M., Philip, A., G., D, Robucci, A: 1992] of the productive markets:

$$\{F,G\} = \frac{\partial F}{\partial_{qi}}\frac{\partial G}{\partial_{pi}} - \frac{\partial F}{\partial_{pi}}\frac{\partial G}{\partial_{qi}} = \frac{\partial F}{\partial q_i}\frac{\partial q_i}{\partial F} + \frac{\partial F}{\partial_{qi}}\frac{\partial pi}{\partial F} = \frac{dF}{dF} = 1$$

$$\{F,G\} = \frac{\partial F}{\partial_{qi}}\frac{\partial G}{\partial_{pi}} - \frac{\partial F}{\partial_{pi}}\frac{\partial G}{\partial_{qi}} = \frac{\partial p_i}{\partial G}\frac{\partial G}{\partial p_i} + \frac{\partial qi}{\partial G}\frac{\partial G}{\partial q_i} = \frac{dG}{dG} = 1$$

We multiply the vectors:

$$\frac{\partial p_i}{\partial_G} = \frac{\partial F}{\partial_{qi}},\ \frac{\partial p_i}{\partial_G} = \frac{\partial F}{\partial_{p_i}} \qquad (5)$$

Orthogonality of geospatial vectors [Barnsley, M., J. S. Geronimo, A., N. Harrington: 1982]:

$$X_F = \left(-\frac{\partial F}{\partial_p}, \frac{\partial F}{\partial_q}\right),\ X_G\left(-\frac{\partial G}{\partial_p}, \frac{\partial G}{\partial_q}\right) \qquad (5.1)$$

$$X_F \cdot X_G = -\frac{\partial F}{\partial_{p_i}}\frac{\partial G}{\partial_{p_i}} - \frac{\partial F}{\partial_{q_i}}\frac{\partial G}{\partial_{q_i}}$$

$$\nabla X_F = -\frac{\partial}{\partial_{q_i}}\frac{\partial F}{\partial_{p_i}} + \frac{\partial}{\partial_{p_i}}\frac{\partial F}{\partial_{q_i}} = 0$$

$$\nabla X_G = -\frac{\partial}{\partial_{q_i}}\frac{\partial G}{\partial_{p_i}} - \frac{\partial}{\partial_{p_i}}\frac{\partial G}{\partial_{q_i}} = 0$$

Field of attraction of shares on inverse products:

$$\frac{dF}{dG} = \frac{\partial F}{\partial_{q_i}}\frac{\partial q_i}{\partial G} + \frac{\partial F}{\partial_{p_i}}\frac{\partial p_i}{\partial G} = \frac{\partial p_i}{\partial G}\frac{\partial q_i}{\partial G} - \frac{\partial q_i}{\partial G}\frac{\partial p_i}{\partial G} = 0 \qquad (5.2)$$

$$\frac{dG}{dF} = \frac{\partial G}{\partial_{q_i}}\frac{\partial q_i}{\partial F} + \frac{\partial G}{\partial_{p_i}}\frac{\partial p_i}{\partial F} = \frac{\partial p_i}{\partial F}\frac{\partial q_i}{\partial F} - \frac{\partial q_i}{\partial F}\frac{\partial p_i}{\partial F} = 0$$

Changes in the prices of production:

$$\{F.G\} - \left(\frac{\partial G}{\partial_{P_i}}\frac{\partial}{\partial_{q_1}} - \frac{\partial G}{\partial_{q_i}}\frac{\partial}{\partial_{P_i}}\bigg|\right)F - \mathscr{L}_G^F - \left[\mathscr{L}_G^F\right] - 1 \qquad (5.3)$$

$$\{F.G\} - \left(\frac{\partial F}{\partial_{q_i}}\frac{\partial}{\partial_{p_1}} - \frac{\partial F}{\partial_{p_i}}\frac{\partial}{\partial_{q_i}}\bigg|\right)G - \mathscr{L}_F^G = \left[\mathscr{L}_{F,}G\right] = 1$$

Cognition function:

$$\mathscr{L}_F = \frac{\partial F}{\partial_{p_i}}\frac{\partial}{\partial_{q_1}} + \frac{\partial F}{\partial_{q_i}}\frac{\partial}{\partial_{p_i}} = X_F \cdot \nabla \qquad (5.3.1)$$

Participation function:

$$\mathscr{L}_G = \frac{\partial G}{\partial_{p_i}}\frac{\partial}{\partial_{q_1}} - \frac{\partial G}{\partial_{q_i}}\frac{\partial}{\partial_{p_i}} \equiv X_G \cdot \nabla \qquad (5.3.2)$$

Reverse derivations:

$$\left[\mathscr{L}_F, u(z)\right] = \mathscr{L}_F, u(z) = X_F \cdot \nabla u(z) = \frac{dz}{dg} \cdot \nabla u(z) = \frac{du(z)}{dg}$$

$$\left[\mathscr{L}_G, u(z)\right] = \mathscr{L}_G, u(z) = X_G \cdot \nabla u(z) = \frac{dz}{df} \cdot \nabla u(z) = \frac{du(z)}{df}$$

$$u(z;g) = e^{g\mathscr{L}_F}u(z), \quad u(z;f) = e^{f\mathscr{L}_G}u(z) \qquad (6)$$

$$\left[\mathscr{L}\frac{m}{G}, F\right] = m\mathscr{L}\frac{m-1}{G}, \qquad \left[\mathscr{L}_G, F^n\right] = nF^{n-1}$$

$$\left[\mathscr{L}\frac{m}{F}, G\right] = m\mathscr{L}\frac{m-1}{F}, \qquad \left[\mathscr{L}_F, G^n\right] = nG^{n-1}$$

$$L_{1,2,3} = \begin{pmatrix} e \\ v_e \\ e^c \end{pmatrix}_L, \begin{pmatrix} \mu \\ v_\mu \\ \mu^c \end{pmatrix}_L, \begin{pmatrix} \tau \\ v_\tau \\ \tau^c \end{pmatrix}_L \qquad (7)$$

Super-price scales:

$$\emptyset_\gamma = \binom{\emptyset_\gamma}{\emptyset^0}: \emptyset_1 = \binom{\emptyset_1}{\delta^-}: \emptyset_2 = \binom{\emptyset_2}{P^{--}} \qquad (7.1)$$

Spectral results:

Future-2021:

$$Y_\mu^{++} = \frac{1}{\sqrt{2}}(A_\mu^1 - iA_\mu^2) \qquad (8)$$

Present-2020:

$$Y_\mu^{+} = \frac{1}{\sqrt{2}}(A_\mu^3 - iA_\mu^5) \qquad (9)$$

Past-2019:

$$W_{\mu-} = \frac{1}{\sqrt{2}}(A_\mu^8 - iA_\mu^{11}) \qquad (10)$$

Scaling amplitudes:

$$\mathcal{M}_{777V^0} = \sum_X \mathcal{M}_{777V^0}^{\mu_1\mu_2\mu_3\mu_4} \epsilon_{\mu_1}(p_1,\lambda_1)\epsilon_{\mu_2}(p_2,\lambda_2)\epsilon_{\mu_3}(p_3,\lambda_3)\epsilon_{\mu_4}(p_4,\lambda_4) \qquad (11)$$

Fractal self-similarity [Mandelbrot, B. B., Vespignani, A., Kaufman, H: 1995]:

$$\mathcal{M}_{\frac{1}{2}} = \sum_F \mathcal{M}_F\, \mathcal{M}_1 = \sum_V \mathcal{M}_V\, \mathcal{M}_0 = \sum_{S,H} \mathcal{M}_{S,H} \qquad (12)$$

Fractal self-affinity [Mandelbrot, B. B., Vespignani, A., Kaufman, H: 1995]:

$$P1_{\mu1} = \sum_X \mathcal{M}_{777V^0}^{\mu_1\mu_2\mu_3\mu_4} = 0$$

$$P2_{\mu2} = \sum_X \mathcal{M}_{777V^0}^{\mu_1\mu_2\mu_3\mu_4} = 0$$

$$P3_{\mu3} = \sum_X \mathcal{M}_{777V^0}^{\mu_1\mu_2\mu_3\mu_4} = 0$$

Aggregate consumption for Mexico

The parameterization and reproduction of known theoretical results. In general, a question has a theoretically known answer, and the model should give an approximately correct answer to this question. Choose a series of questions to check in the next stage.

Likewise, the data is used to calibrate $[p(t)p_0] - C'(t)p_0dp$ a model economy [6] in such a way as to reproduce the real economy as much as possible.

$$\int_\alpha^\beta e^{-\lambda t}\ C[p(t)p_0]dp = \int_\alpha^\beta e^{-\lambda t}\ C'(t)p_0dp$$

$$= e^{-\lambda\beta}\, C(\beta;p_0) - e^{-\lambda\beta}\, C(\alpha;p_0) + \lambda\int_\alpha^\beta e^{-\lambda t}\ [ct;p_0]d(c,p) \qquad (13)$$

Once the functional forms of the production and preference functions have been decided, having assigned the values to the parameters and, in the case of stochastic models [Frame, M., Neger, N: 2010], using the probability distribution for shocks , iterations can be carried out.

$$C\int_\alpha^\beta e^{-\lambda t}\ c[pt;p_0]dt = \int_\alpha^\beta e^{-\lambda t}\ Cy[t;p_0]dt \qquad (14)$$

Calibrated models have long been used in other disciplines resulting in an interactive game between theoretical developments and attempts to evaluate whether the new Ex Ante theoretical structures t_R, A priori b_R , Ex Post J_{3R}:

Ex Ante:

$$\rho = \begin{pmatrix} G_W^+ \\ \frac{iG_Z + V}{\sqrt{2}} \\ 0 \end{pmatrix}_L \qquad (15)$$

[6] Synthetic economies:

$$\int_x^\infty p(n)dn\left[\left(\frac{1}{2}x\right)\frac{x}{\sqrt{2\sigma}}\right]$$

$$p_e^B = \frac{1}{2}\left(\sqrt{\frac{3E_b}{N_0}}\right) + \frac{1}{\sqrt{12\pi\frac{E_b}{N_0}}}(1-E)^{-3E_b}/N_0$$

The limit of ½ at constant dx:

$$p_e^M = \int_0^{1/2}\frac{1}{\pi\sqrt{(1-x)}}\,[(1-2x)]\sqrt{2\frac{E_b}{N_0}}dx$$

$$p_e^f = \int_0^{\frac{1}{2}}\frac{1}{\pi\sqrt{\left(x+\frac{1}{2}\right)\left(\frac{1}{2}-x\right)}}$$

A priori:

$$\eta = \begin{pmatrix} \frac{iG_z+V}{\sqrt{2}} \\ -G_W^- \\ 0 \end{pmatrix} \quad (16)$$

Ex Post:

$$x = \begin{pmatrix} G_Y^- \\ G_x^{--} \\ \frac{w+iG_{Z'}}{\sqrt{2}} \end{pmatrix} \quad (17)$$

Conclusions

For these estimates to make sense 0 ≤ κ <1. In the real model, values of κ greater than one would be equivalent to matrices whose inclination is greater than 45 degrees and the time between consecutive impacts associated with the system follows a geometric law of ratio 0 < in <1 and therefore, there is an accumulation of impacts in finite time that we will call stop time and enter the dynamics of $T^{\frac{1}{2}}$:

$$L = \int d^4xdy(\mathcal{L}_F + \mathcal{L}_Y)$$

Sticking with Fourier:

$$B_\mu(x,y) = \frac{1}{\sqrt{\pi R}} B_\mu^{(0)}(x) + \frac{\sqrt{2}}{\sqrt{\pi R}}$$

On the sidelines:

$$Q(x,y) = \frac{1}{\sqrt{\pi R}} Q_L^{(0)}(x) + \frac{\sqrt{2}}{\sqrt{\pi R}} \sum_{n=1}^{\infty} B_\mu^{(n)}(x) \cos\left(\frac{n\pi y}{R}\right) B \quad (x,y) = \frac{\sqrt{2}}{\sqrt{\pi R}} \sum_{n=1}^{\infty} B_5^{(n)}(x) \sin\left(\frac{n\pi y}{R}\right)$$

At cost:

$$Q(x,y) = \frac{1}{\sqrt{\pi R}} Q_L^{(0)}(x) + \frac{\sqrt{2}}{\sqrt{\pi R}} \sum_{n=1}^{\infty} \left[Q_L^{(n)}(x) \cos\left(\frac{n\pi y}{R}\right) + Q_R^{(n)} \sin\left(\frac{n\pi y}{R}\right)\right]$$

$$U(x,y) = \frac{1}{\sqrt{\pi R}} U_R^{(0)}(x) + \frac{\sqrt{2}}{\sqrt{\pi R}} \sum_{n=1}^{\infty} \left[Q_{tR}^{(n)}(x) \cos\left(\frac{n\pi y}{R}\right) + U_{tL}^{(n)} \sin\left(\frac{n\pi y}{R}\right)\right]$$

They serve to represent the real observations through the application of the best assignments of the values of the parameters to the theoretical structures Ex Ante and Ex Post of consumption considering the COVID-19 risk, if we take into account the interrelationships between all the variables considered , which allows capturing its direct and indirect effects, thus overcoming the Brownian equilibrium approaches [Barnsley, M: 1984], which consider only the relevant market of the sector analyzed for Mexico.

$$E(v_{2,} v_2) - E(v_{2,} v_1) - E(v_{1,} v_2) - E(v_{1,} v_1) \geq 3.8$$

Internal consistency among all variables, taking into account macroeconomic balances, sectoral balances of supply and demand and institutional balances of sources and uses of funds to maximize activity in the external sector (F) in terms of exports, therefore we limit the Ex Ante and Ex Post partitions.

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