

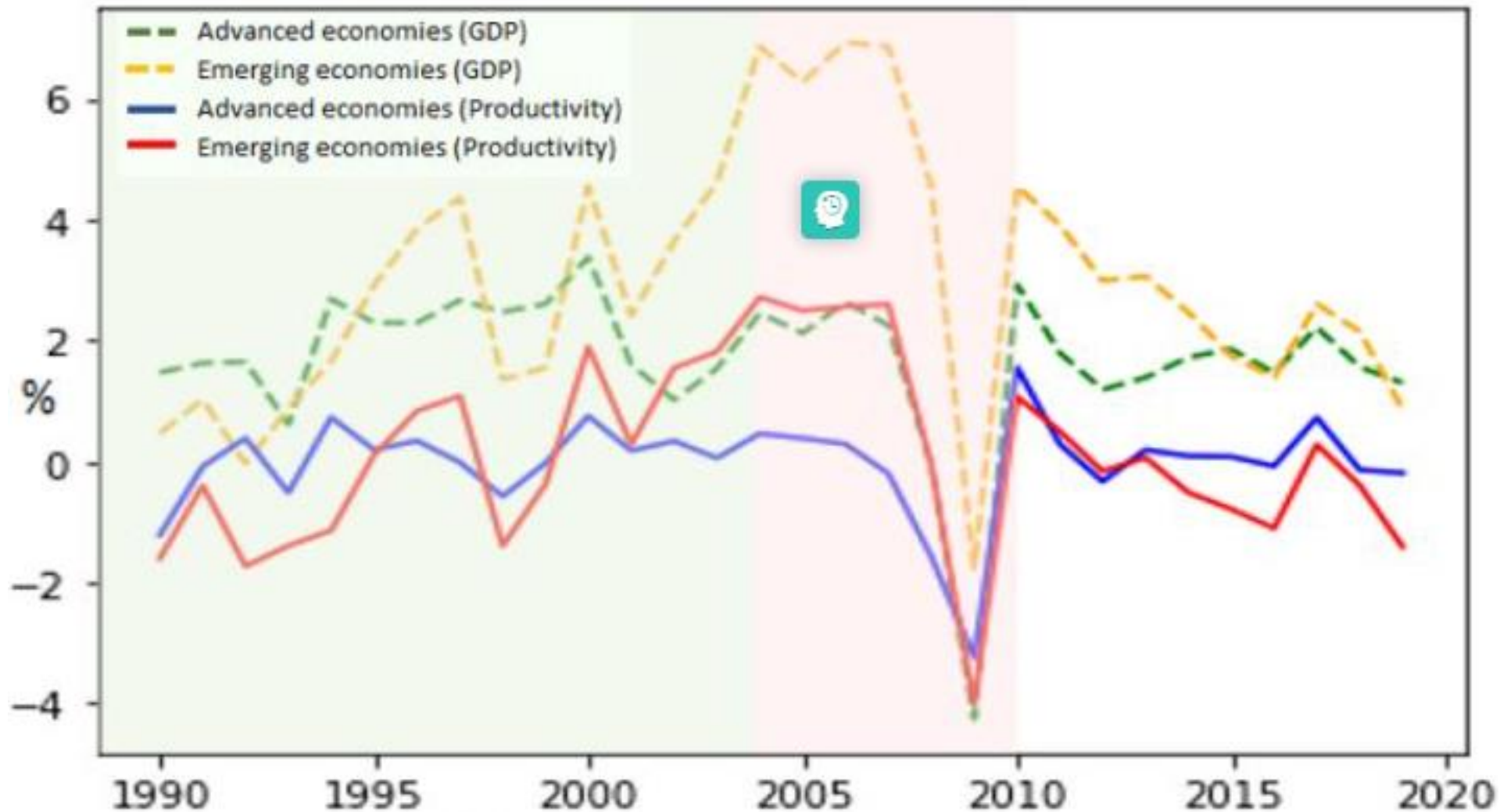
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2021**

The productivity of the agricultural sector and its effects on economic growth: a CGE analysis

- Motivation
- Global, Latin American and Colombian TFP landscape
- Literature review
- Could AI improve the modeling on CGE models?
- CGE for productivity analysis in the agricultural sector
- Results & final considerations

Productivity is at the heart of medium and long-term economic growth in any economy, and ensuring its sustained increase is undoubtedly one of the most important challenges for economic policymakers in alleviating poverty and meeting the growing aspirations of the world's citizens.

Contribution of TFP to economic growth in emerging and advanced economies, 1990-2019

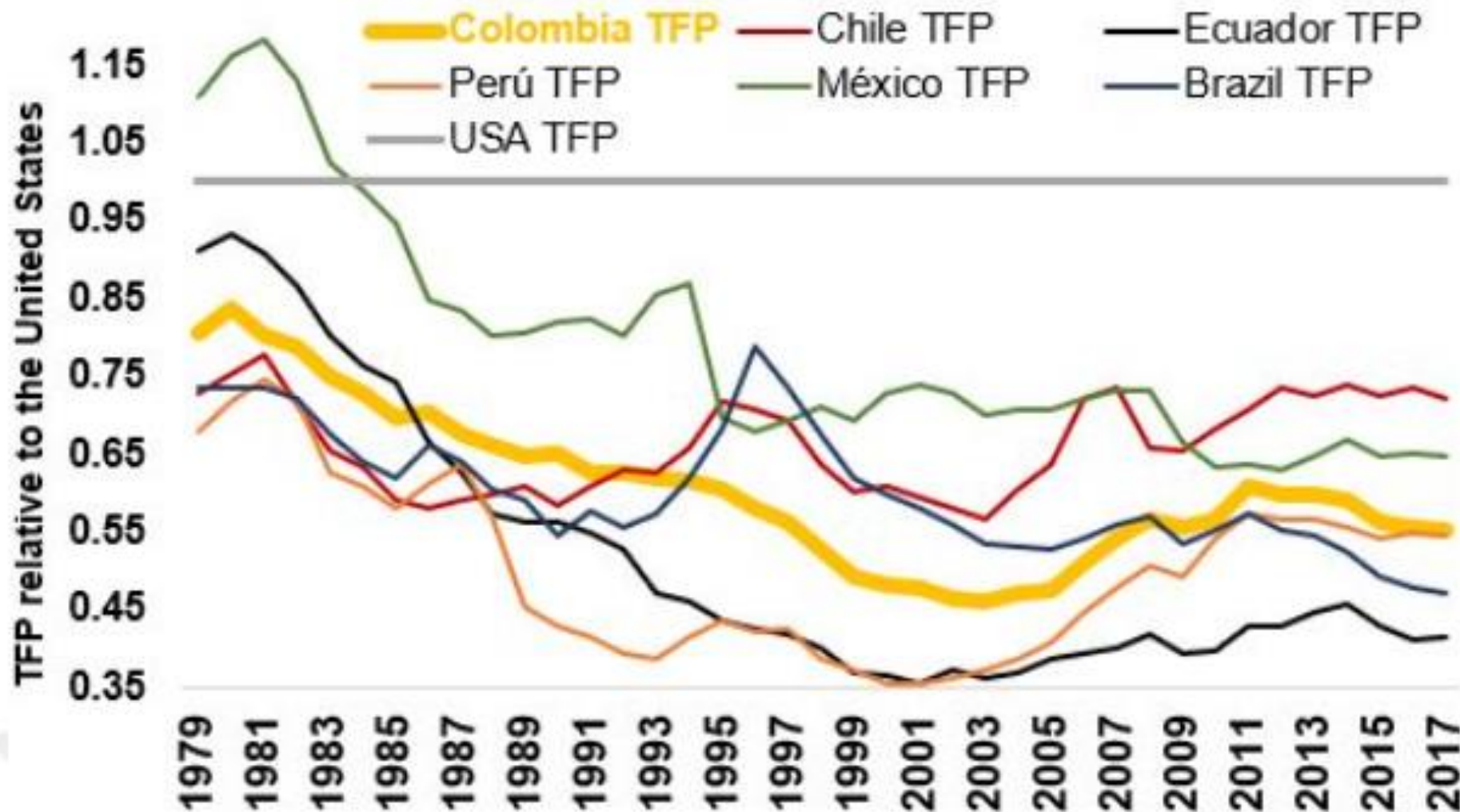


Source: Own elaboration and calculations with data from the Conference Board in Python

Contribution of TFP to economic growth in emerging and advanced economies, 1990-2019

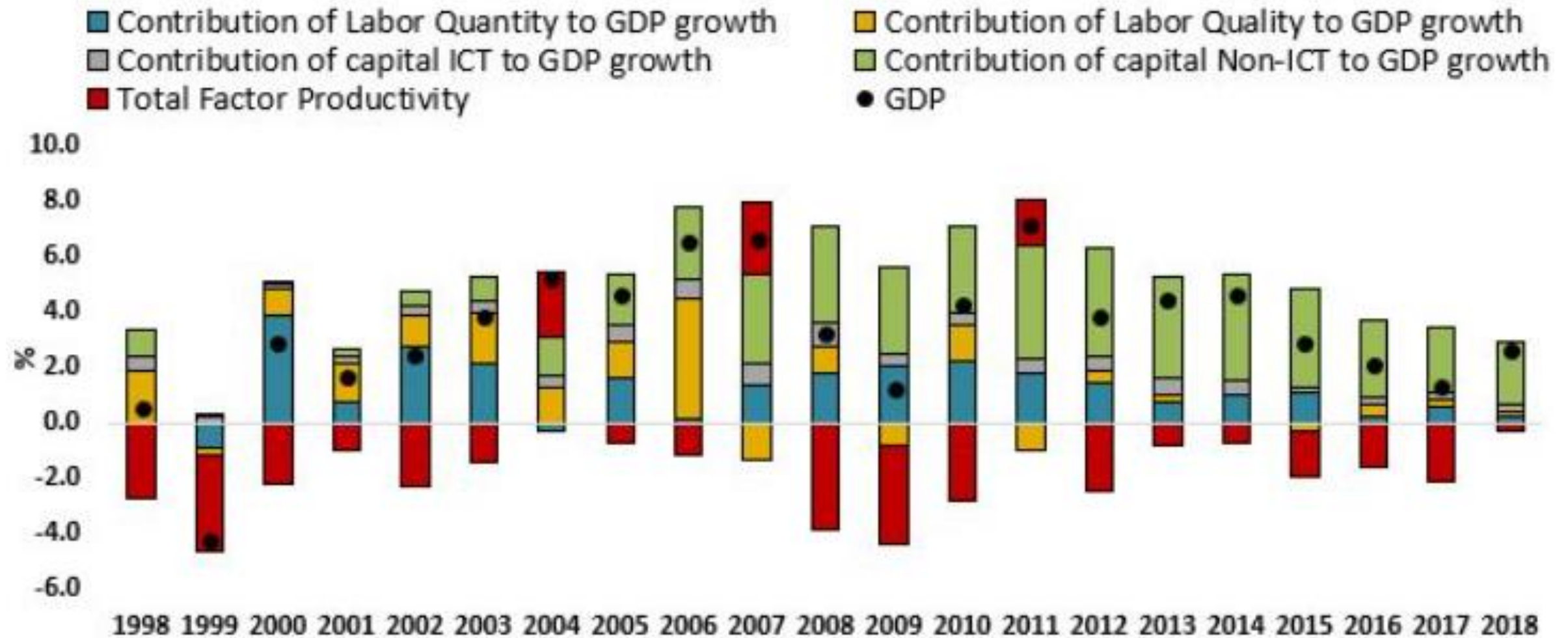
- Economic growth averaged 2.95% in emerging economies, with productivity contributing 0.11% to GDP growth between 1990-2019.
- Advanced economies had lower records of 1.68% and -0.04% respectively.
- The contribution of productivity to growth in 2009-2019 for emerging economies experienced a contraction of -0.59% and stagnation for advanced economies with a TFP change of -0.09%.

Evolution of Productivity (TFP) in Colombia and a set of economies in the region in 1977-2017



Source: Own elaboration with data from Penn World Table version 9.1 (2020)

Contribution of TFP to economic growth in Colombia 1998-2018



Source: Own elaboration with data from the Total Economy Database of the Conference Board.

Contribution of TFP to economic growth in Colombia 1998-2018

The economy has grown by an average of 3.3% between 1999 and 2019, but this growth incorporates a 0.6% reduction in the productivity contribution.

For the last ten years, the picture does not improve, with GDP growth averaging 3.4% between 2009-2019, and in this case the growth incorporates a 0.2% reduction in the productivity contribution.



TFP as proxy for productivity (Olley & Pakes, 1992)

Investment demand as proxy (Levinson & Petrin, 1999)

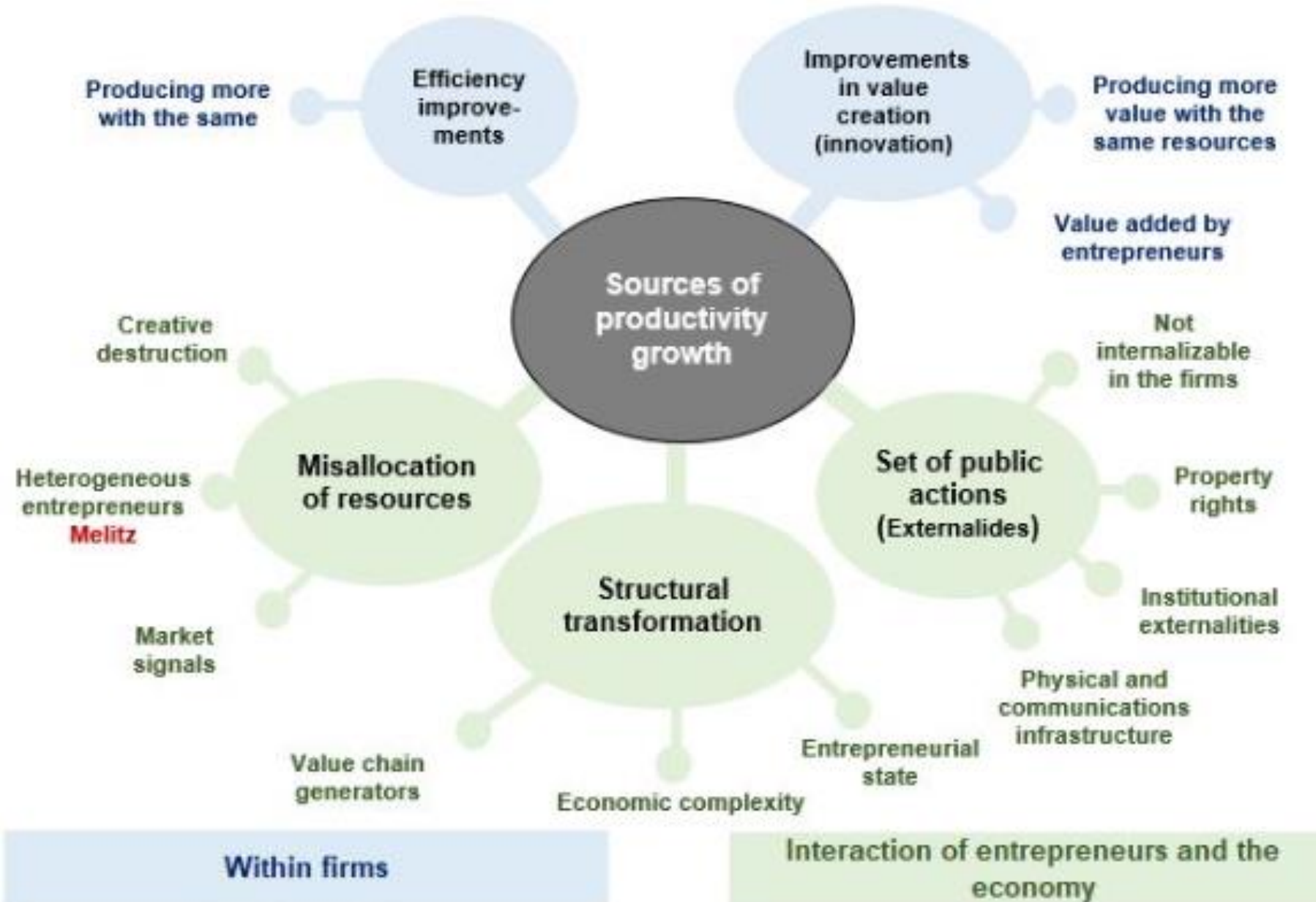
Semi-parametric estimators with GMMs (Wooldridge, 2009)

Semi-parametric estimation techniques (De Loecker, 2011)

Estimation of the work coefficient (Akerberg et al., 2015)

- Entrepreneurial status (Mazzucato, 2011).
- Economic complexity (Hidalgo and Hausmann, 2009).
- Productivity policy (McMillan and Rodrik, 2011).
- Misallocation of resources (Hsieh & Klenow, 2009);
(Restuccia & Rogerson, 2013); heterogeneity (Restuccia
& Santaella-Llopis, 2017); (Badaee & Farhi, 2020) y (Bils et al., 2020)
- World Bank Productivity Project (Cirera & Maloney, 2017);
(Cusolito y Maloney, 2018) y (Grover et al., 2019)

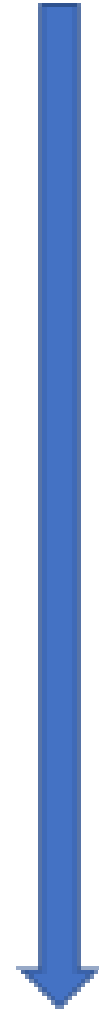
Conceptual approach to productivity



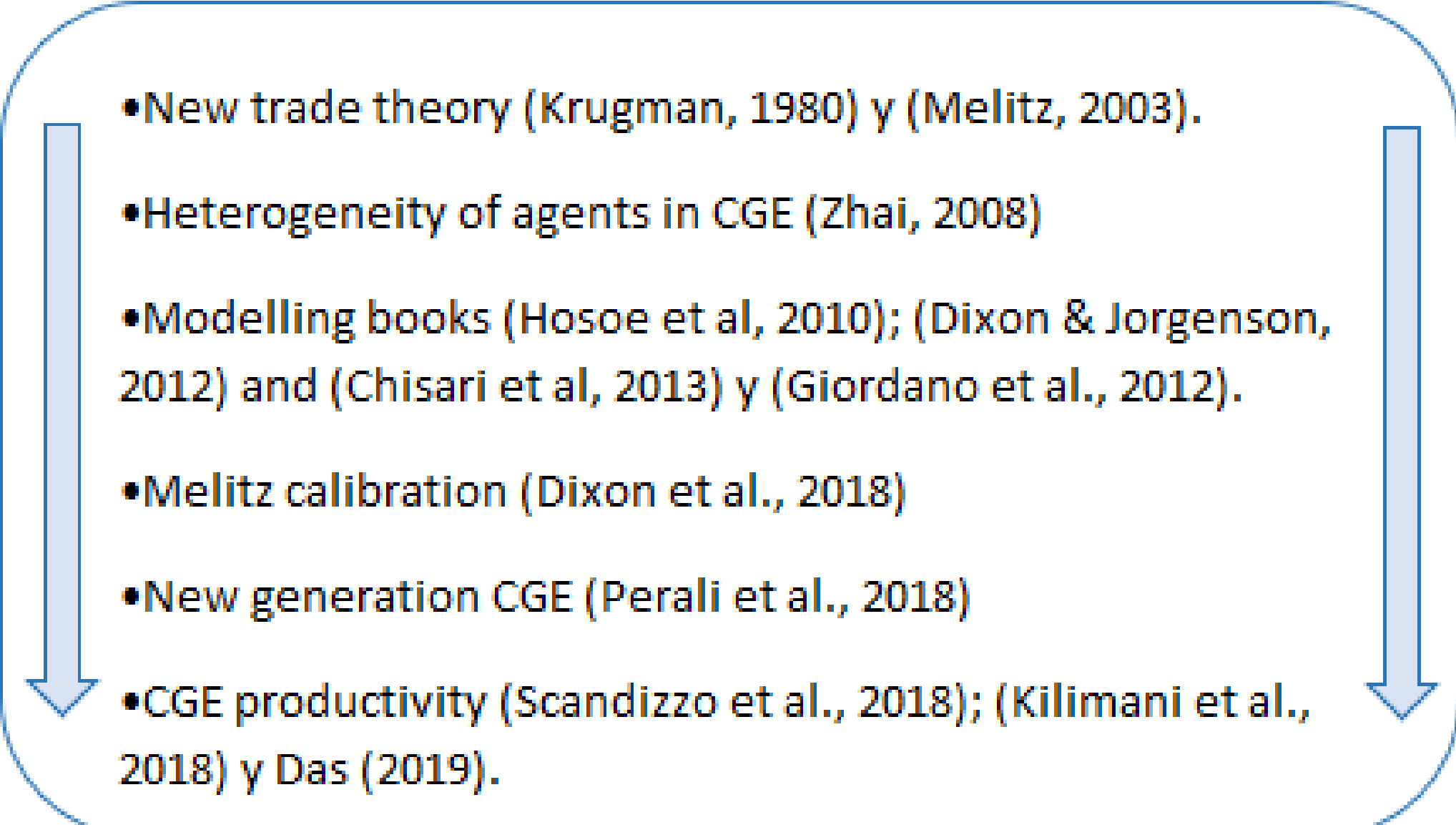
Source: Own elaboration according to the systematic review of the literature.

Literature review productivity Colombia

- Multifactor productivity in Colombia fell at an average rate of -0.2% per year in the period 1950-2002 (Clavijo, 2003).
- Multifactor productivity grew in Colombia in the 1980s and 1990s, in the case of industry (Echavarria et al., 2006)
- Productivity has been stagnating over the last decades in Colombia. Oligopolistic power (high Herfindahl) negatively affects total factor productivity growth. (Echavarria et al., 2019)
- Colombia has a high concentration of small enterprises compared to other countries. (Eslava & Haltiwanger, 2020); (Becerra et al, 2019)



Literature review productivity modelling

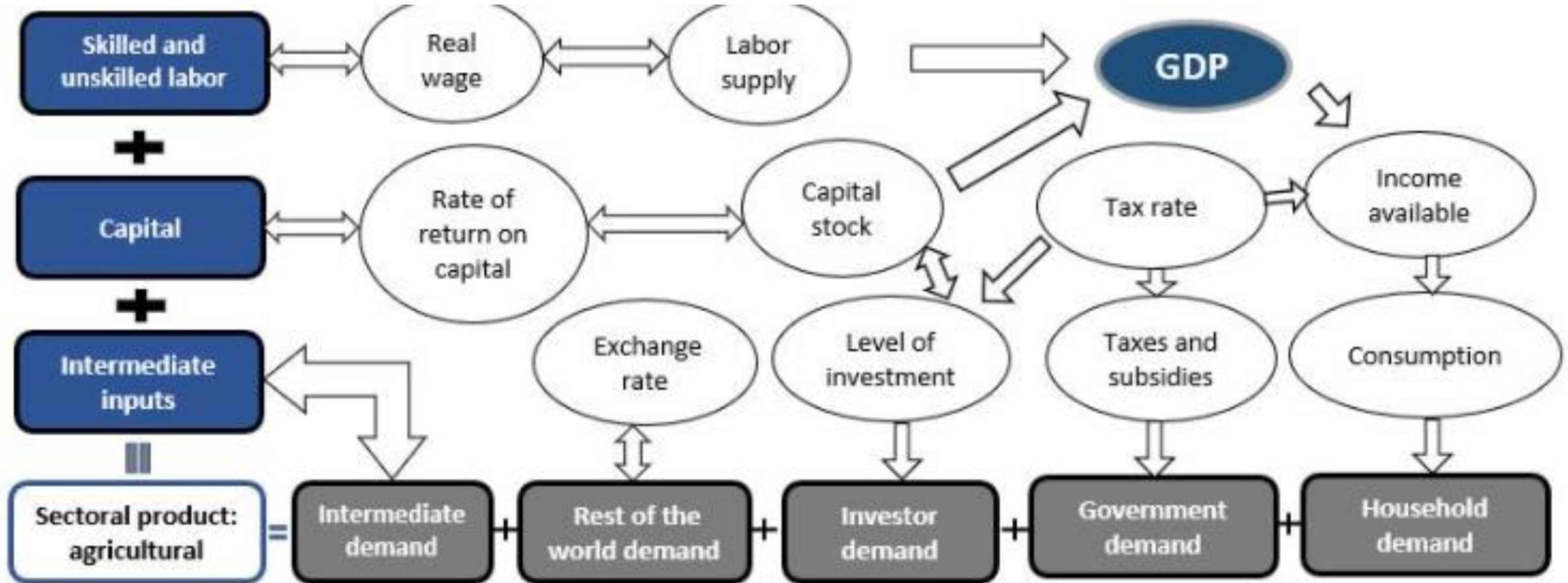
- 
- New trade theory (Krugman, 1980) y (Melitz, 2003).
 - Heterogeneity of agents in CGE (Zhai, 2008)
 - Modelling books (Hosoe et al, 2010); (Dixon & Jorgenson, 2012) and (Chisari et al, 2013) y (Giordano et al., 2012).
 - Melitz calibration (Dixon et al., 2018)
 - New generation CGE (Perali et al., 2018)
 - CGE productivity (Scandizzo et al., 2018); (Kilimani et al., 2018) y Das (2019).

- Use of Melitz-type modelling to "endogenize" productivity growth.
- An analysis that goes beyond the traditional exogenous shocks of TFP in general equilibrium models and in the analysis of productivity in Colombia with scenarios for the next decade.
- Simulation of scenarios that already includes the possible economic effects of the pandemic, as well as

Distinctive new feature compared to LR

- It is worth adding that it will have a robust and consistent nature, due to multiple advantages such as the creation of a module that replicates the fiscal rule and an inclusion of 20 types of households that allows quantifying distributional effects for Colombia.
- A first step in integrating the field of artificial intelligence with computable general equilibrium models I have called "AICGE", which could be the future in macro modelling.

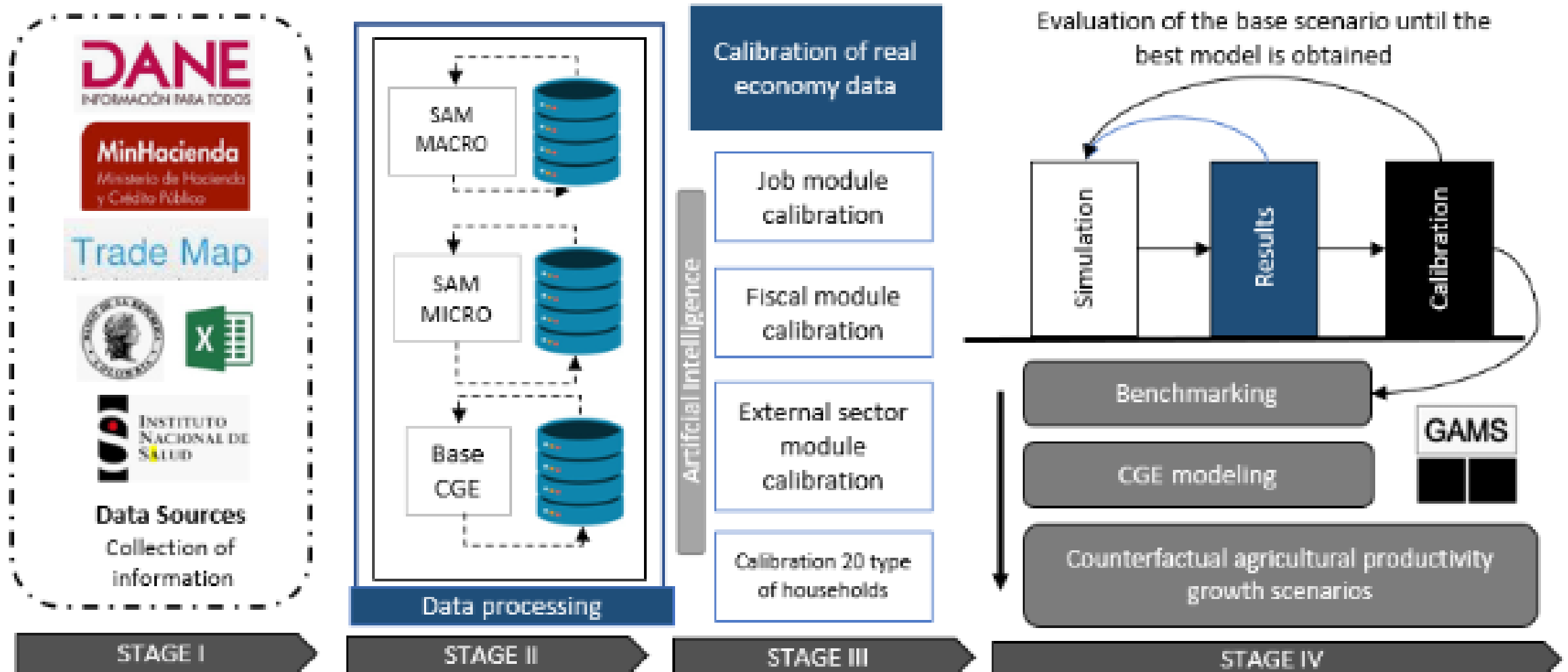
Description of CGE model



Source: Own elaboration adapted from Hosoe et al. (2010) and Dixon and Jorgenson (2012)

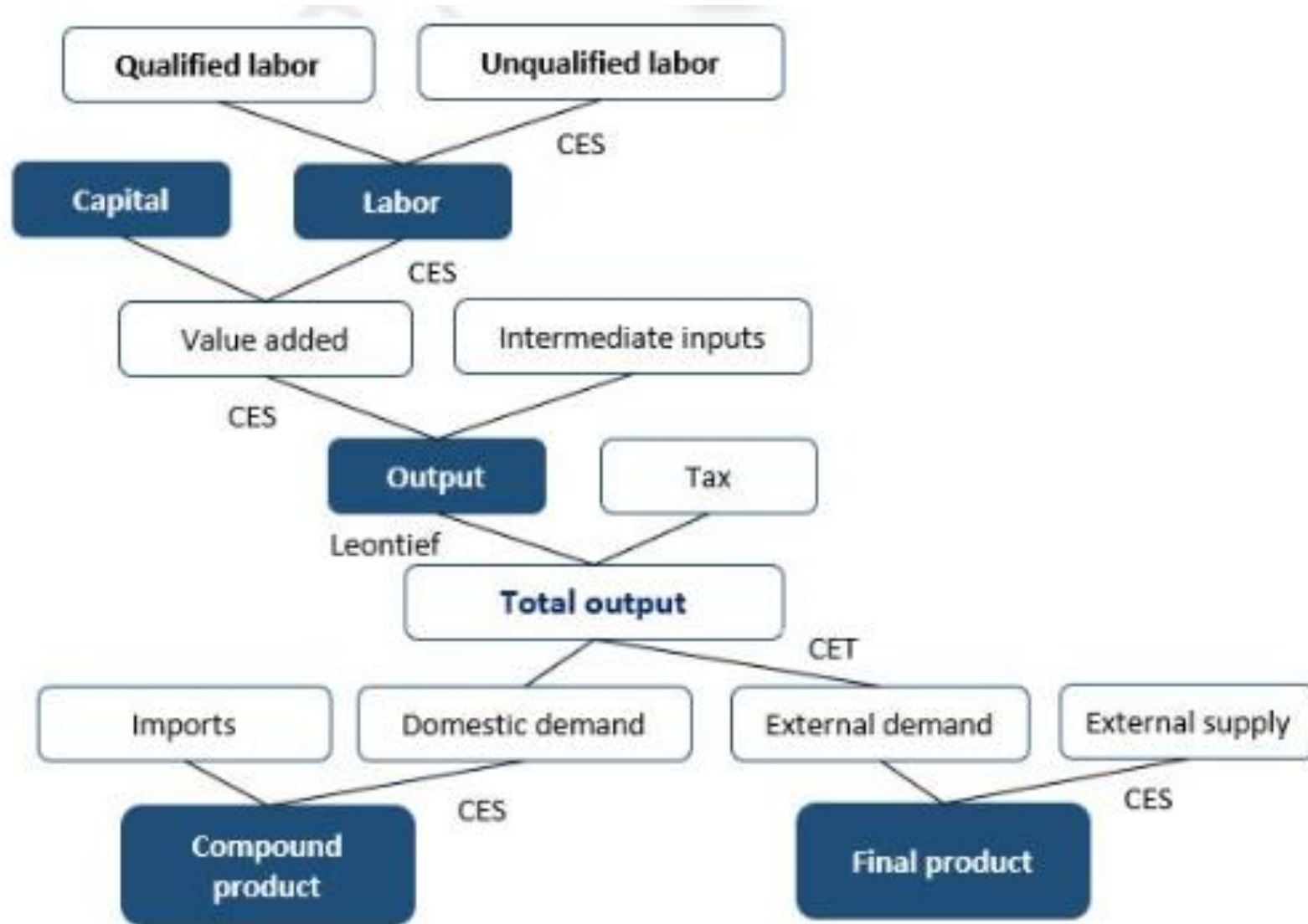
Simplified diagram of the construction of the CGE for the analysis of agricultural productivity

Data and construction process of the CGE model for the analysis of agricultural productivity growth in Colombia



Source: Own elaboration

Simplified CGE scheme for Colombia



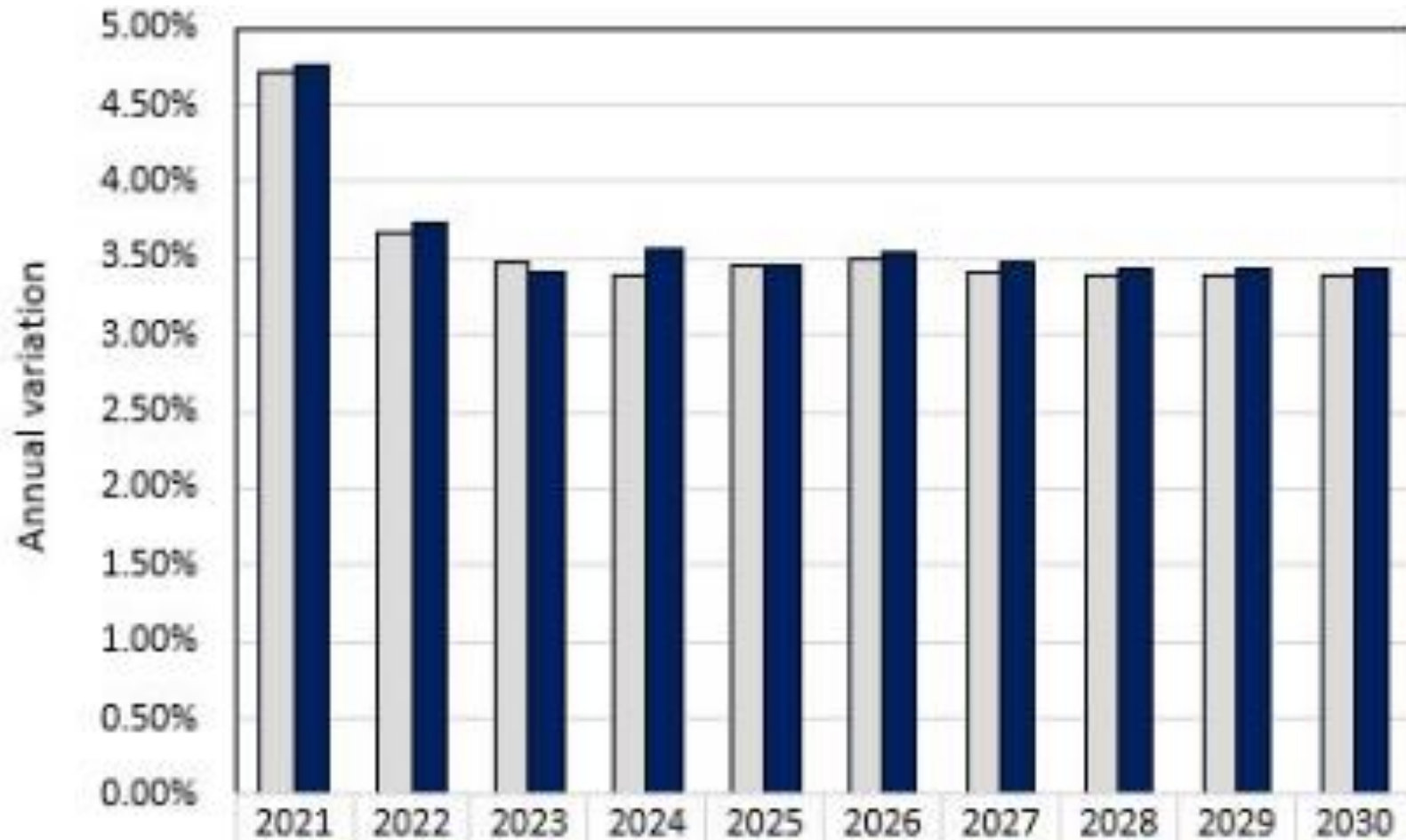
Source: Authors' elaboration based on [Perfetti et al. \(2017\)](#) y [García et al. \(2020\)](#).

Base scenario that considers Covid-19 as a transitory supply shock that triggers demand effects. To this is added simultaneously the oil shock in the price of quantities, a fall in FDI, remittances, increased public spending, among others.

Variable	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
GDP growth	3.30%	-7.68%	4.71%	3.66%	3.47%	3.39%	3.46%	3.49%	3.42%	3.38%
Unemployment rate	9.21%	15.78%	12.15%	12.23%	12.21%	12.20%	12.12%	12.05%	11.99%	11.92%
Fiscal deficit	-2.52%	-6.71%	-4.63%	-3.94%	-3.62%	-3.27%	-2.80%	-2.35%	-1.93%	-1.54%

Source: Calculations with the CGE model in GAMS.

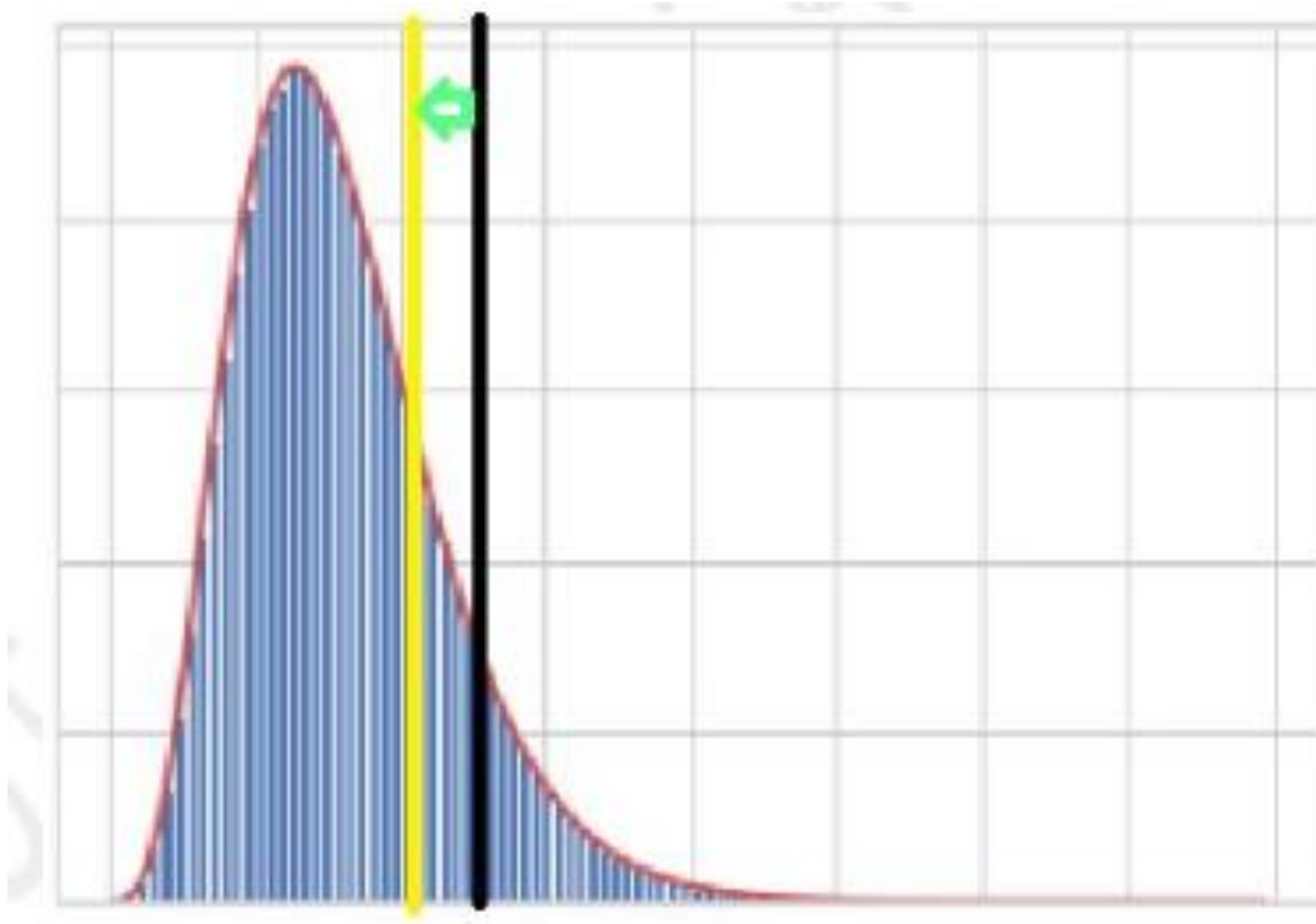
Agricultural productivity growth scenarios (TFP) by sector in the Colombian economy 2019-2030.



□ Base scenario (includes covid-19)	4.71%	3.66%	3.47%	3.39%	3.46%	3.49%	3.42%	3.38%	3.38%	3.38%
■ Productivity growth in the agricultural sector	4.75%	3.74%	3.41%	3.56%	3.46%	3.53%	3.47%	3.43%	3.43%	3.44%

Pareto probability distribution of productive enterprises

Melitz model



Source: Own elaboration adapted from [Melitz \(2003\)](#).

This document provided a more global and relevant vision for the achievement of the objective and scenario analyses, considering current and future challenges and proposals, which were mostly inspired by a framework of heterogeneous actors and imperfect competition.

Allowing the entry of Colombian companies that have not yet been able to export while avoiding cost barriers has an endogenous effect on the country's productivity, since it allows the insertion in the international market in sectors with higher profitability and technology.



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Another point to highlight is that the CGE model improves significantly with the calibration of the parameters and exogenous macro series integrated with Machine Learning, which suggests that machine learning techniques could be an important part of the macro forecasting toolkit for emerging countries and an excellent complement to computable models.



Thank you
very much
for your
attention!

