

Is there cross-fertilisation possible in macroeconomics?

DSGE confronted to MABM models

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- **A linear standard narrative from early Equilibrium Business Cycles (EBC) until the New synthesis (DSGE- Dynamic Stochastic General Equilibrium)**
 - A progressive integration of Keynesian elements (frictions, monetary policy rules...)
 - An economic conjuncture which seems to support these general models' message ("Great Moderation")
 - So, from early EBC models (Lucas, 1972) , to RBC and finally DSGE (Woodford, 2003): an interpretation of this episode in the history of macro as characterized by a continuous progress
- **Despite early critics** - and not only from the opposite "side" for instance, Hansen and Heckman (1995) or Caballero (2010) – **no "sound" alternative seemed to emerge.**
- **On the early 2000s, a new (and soon growing) literature was nevertheless emerging**

For the last two decades, **A**gents-based **C**omputational Economics models (ACE) and after, Macro agent-based models (**MABM**) developed.

Those models need numerical simulations and were considered as extremely versatile because any possible behaviours, rules, interactionsetc. can be considered.

In short : the number of parameters and explicit or implicit choices of behavioural rules is so large that the results of the model may appear unreliable and arbitrary.

After the Crisis, a new context

- After the turmoil of the first global crises of the XXI° century which were unannounced and misconstrued, the context seemed to change:
 - DSGE models' ability in explaining empirical evidences has been increasingly questioned.
 - An increasing number of papers using agents-based methodology have been published
- In addition, after the crisis, both approaches seem to be in different situations
 - While theoretical critics had been already addressed to DSGE, a (new) criticism developed attacking their lack of transparency (calibration/identification) ...
 - ... there were also progresses made by MABM to control better the outcome of the model (traceability). There was then a larger interest not only from academics but **also from policy makers** (cf. Trichet (2010)) who are now interested in such an approach (European Central Bank, Bank of England ...)
- Without being considered as complete surveys, those debates culminated in 2018 with two consecutive special issues: *Oxford Review of Economic Policy* (2018) versus *JEP* (2018)

The objective of the paper /presentation

In that new context, macroeconomics has seen

- the increasing **importance (?)** of **M**acro **A**gents-**B**ased **M**odels (**MABM**)
- and what seems to be an increasing **variety (?)** of DSGE models.

Questions:

Shall we interpret this as a **transformation (?)** of DSGE models under the pressure of MABM literature? What sort of transformation did occur? (or is still occurring?)

Are **MABM** influenced in their building process by DSGE models standards?

Can we draw finally some preliminary conclusions about the possible consequence(s) (specialization, diversification, fragmentation) for research in macroeconomics? (Davis 2018, Rodrik 2015, Hamermesh 2013)

A remark:

A project, still at a preliminary stage which came to know a recent development in cooperation with **Sienna University** (**Alberto Baccini, Martina Cioni, Eugenio Petrovich - BCP**) in order to incorporate quantitative elements.

Part I – The autonomy of MABMs' research program.

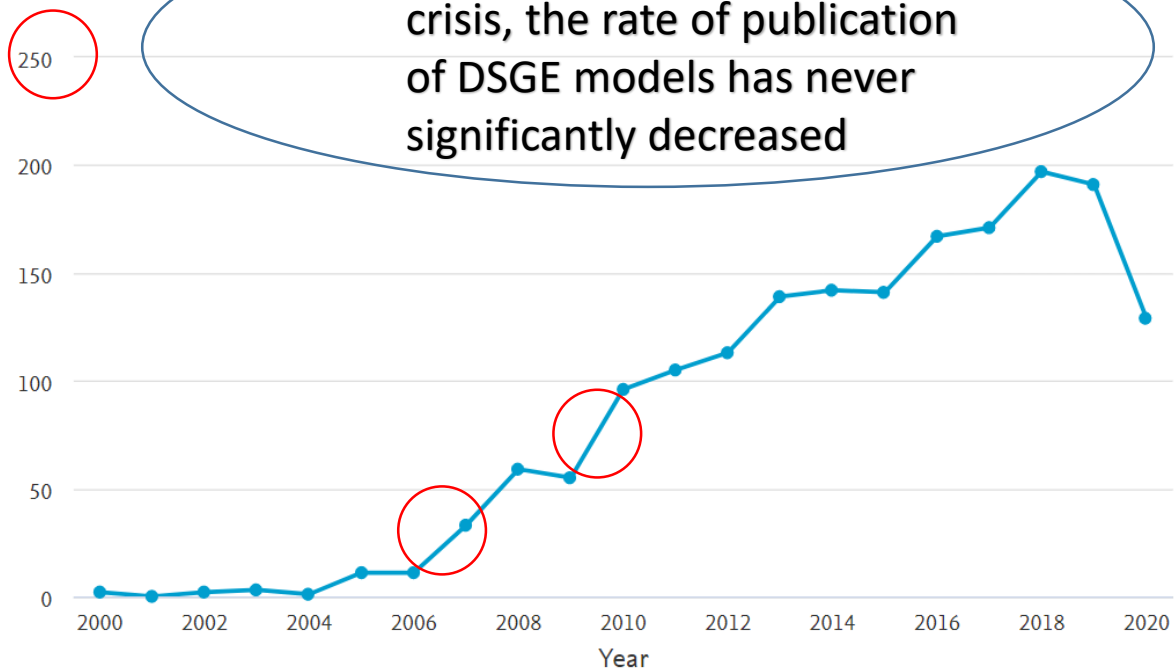
Did MABMs develop independently from the crisis ? Independently from DSGE models' trajectory?

Databasis: scopus
Keyword analysis
Source : BCP

#	Topic	Records
1	DSGE models	1768
2	MABM	750

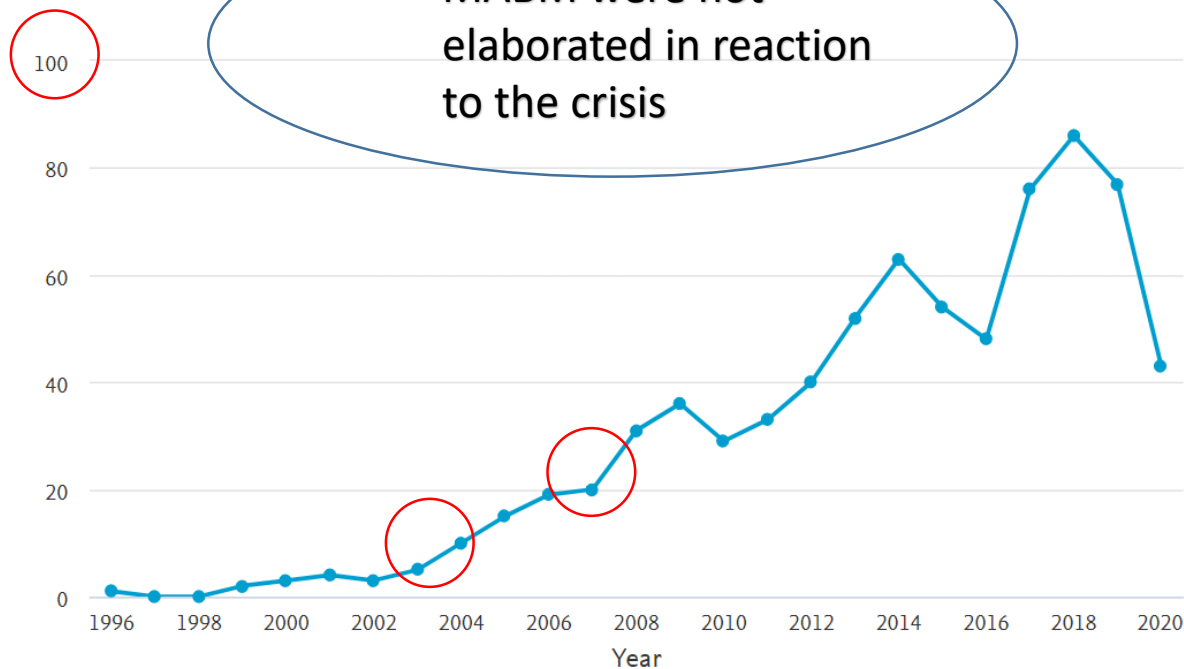
DSGE models

Despite criticism after the crisis, the rate of publication of DSGE models has never significantly decreased



MABM

MABM were not elaborated in reaction to the crisis



- **Few comments** about analytical roots.
- They were not developed strictly in reaction to DSGE models neither: their research program was existing much before (through post-Keynesian and/or non-linear approaches of Business cycles, network analysis *etc.*).
 - Partly in reaction to EBC which developed since the 1970s
 - Partly simply the continuity of former research programs (Dal Pont Legrand 2020)
 - Minskyan research program
 - Schumpeter/Keynes
 - Information theory (New Keynesians insights)
 - disequilibrium microfoundations (Leijonhufvud, Clower, Howitt....)
 - An increasing number of publications after 2011... Organization of the field (societies, conferences, journals....higher participation to economic policy debates)

Top journals

DSGE models (n journals = 152)

SOURCE TITLE	
Journal Of Economic Dynamics And Control	134
Economic Modellingc	118
Journal Of Macroeconomics	66
Journal Of Monetary Economics	66
Journal Of Money Credit And Banking	57
Macroeconomic Dynamics	52
Economics Letters	47
Journal Of International Money And Finance	39
International Journal Of Central Banking	33
European Economic Review	32

Source : BCP

A relatively important number of journals publishing MABMs
But many of them belong to other fields or research : autonomy but also relative exclusion

MABM (n journals = 103)

SOURCE TITLE	
Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics	43
JASSS	27
Journal Of Economic Dynamics And Control	21
Journal Of Evolutionary Economics	18
Journal Of Economic Behavior And Organization	16
Advances In Intelligent Systems And Computing	15
Journal Of Economic Interaction And Coordination	15
Physica A Statistical Mechanics And Its Applications	11
Advances In Complex Systems	8
Computational And Mathematical Organization Theory	8
Economics	8

Journals belonging to other research fields

Part II – Should we consider that DSGE evolved
under the pressure from MABM?

Topics convergence

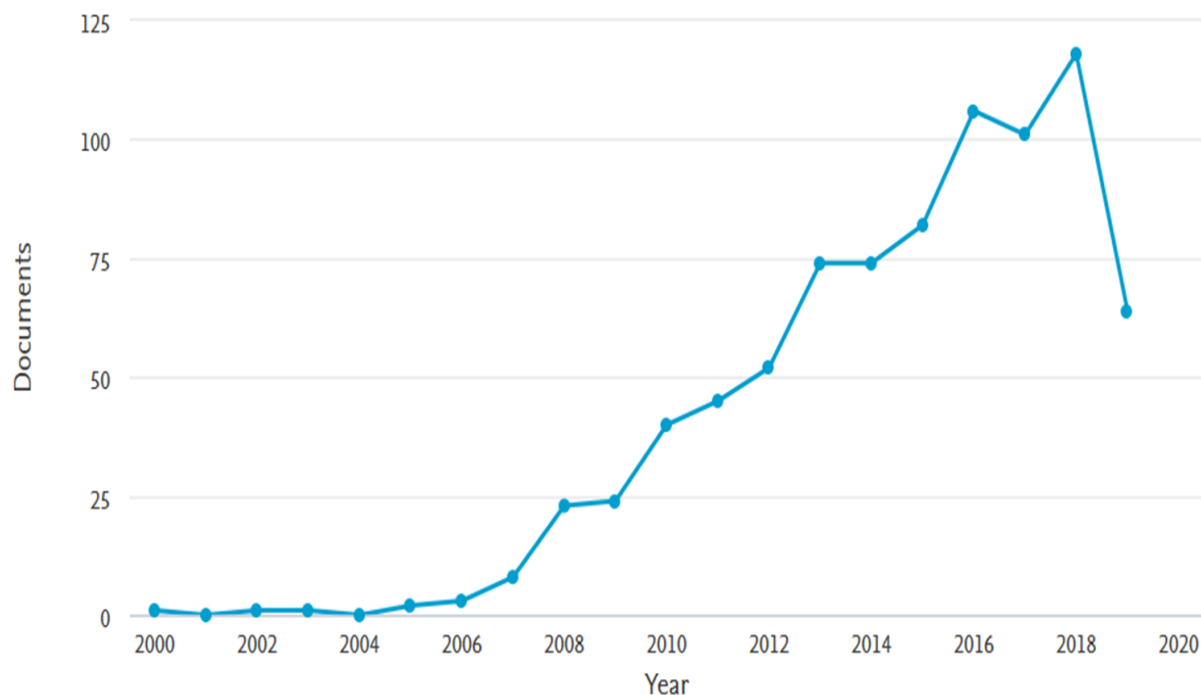
- Examining these literatures, we have identified 3 topics of growing importance
 - The integration of **financial intermediation** / financial sphere in general
 - The capacity to deal with **heterogeneity**
 - The formation of **expectations**

Integrating financial intermediation / the financial sphere

DSGE and 'Finance', per year

Cumulated data: **819** papers

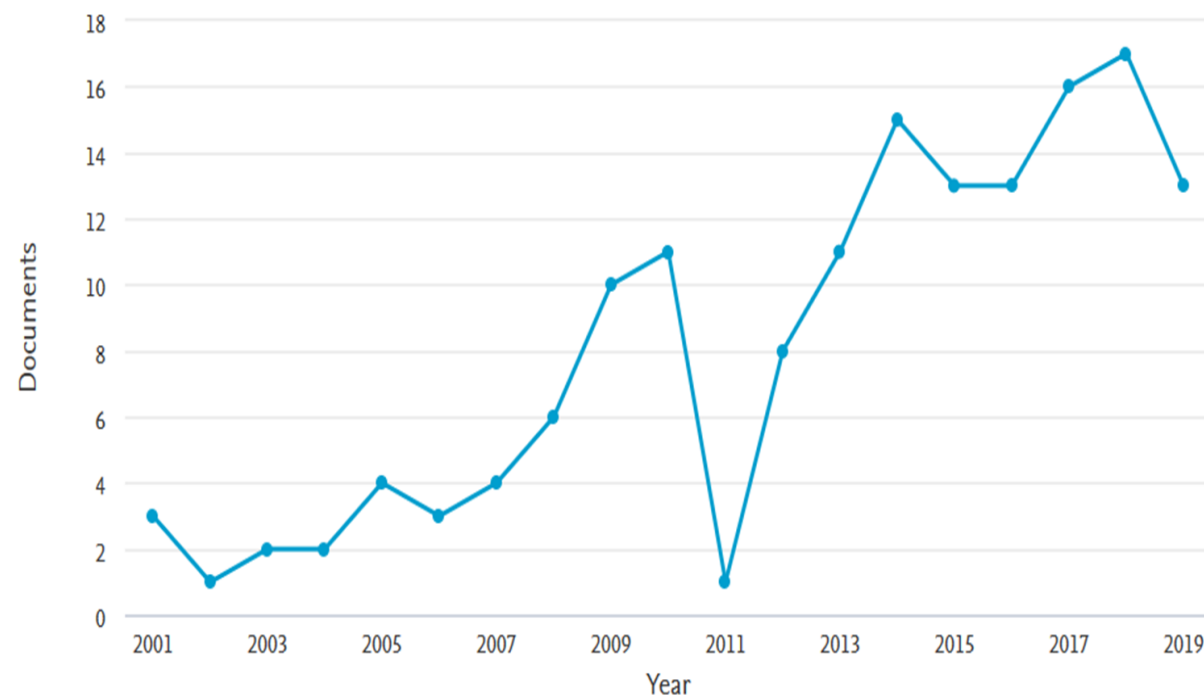
Documents by year



MABM and « Finance », per year

Cumulated data : **153** papers

Documents by year

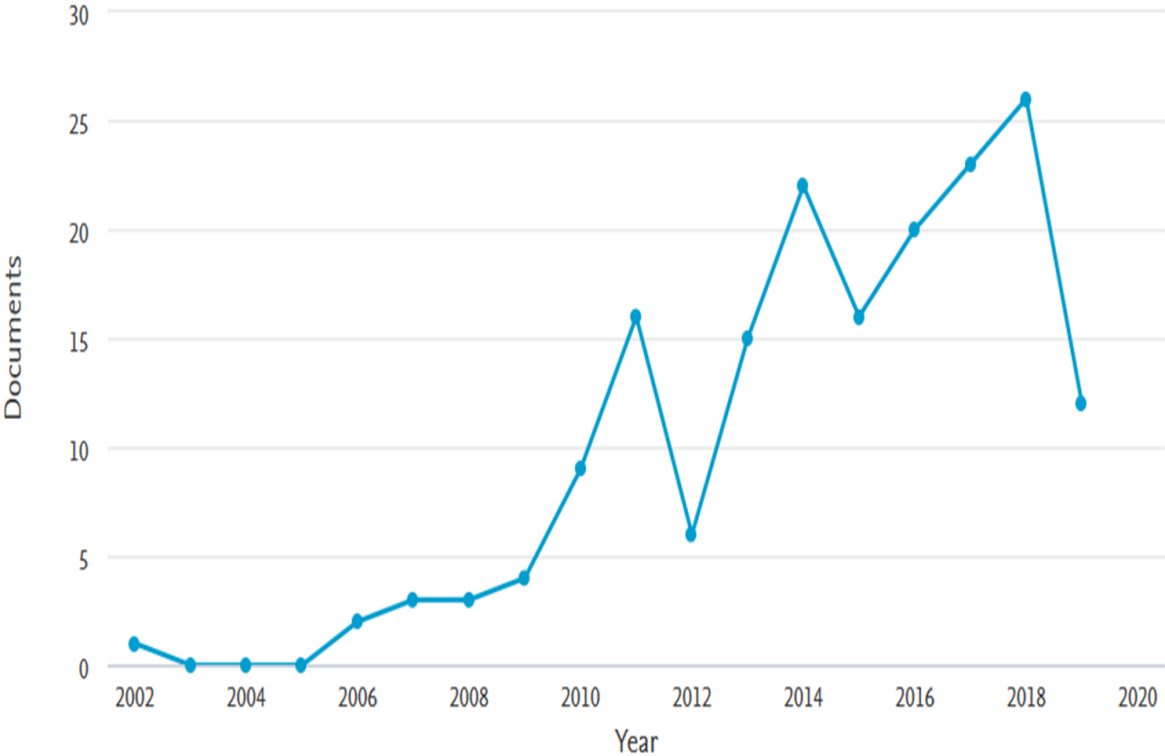


MABM developed earlier its interest for finance / financial intermediation (we could even start earlier)
A stronger (recent) focus on this topic by DSGE models (almost half of the papers) : consistent with the way DSGE models developed *i.e.* expanding progressively a core model.

Examining Heterogeneity

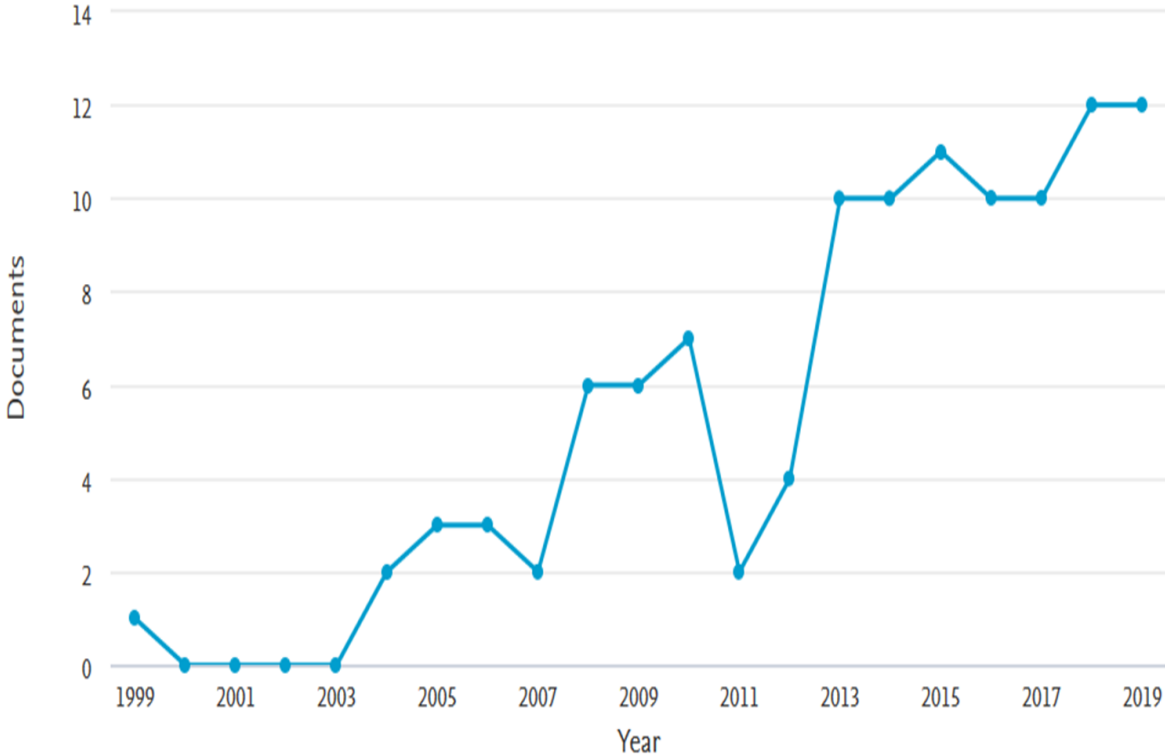
DSGE and « Heterogeneity », per year
Cumulated data [2002 - 2019] : 178

Documents by year



MABM and « Heterogeneity », per year
Cumulated data [2002 - 2019] : 110 papers

Documents by year



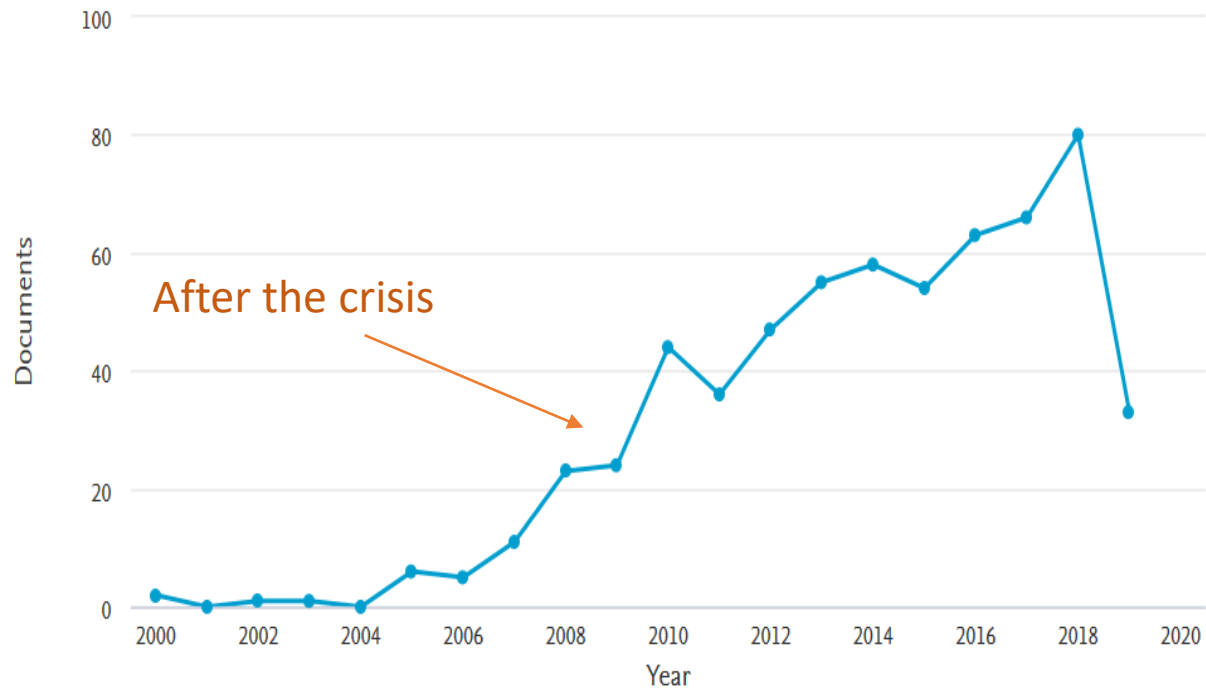
Despite the large difference in the size of the two communities, a small difference in absolute number of papers.

Expectations

DSGE and « Expectations », per year

Cumulated data : 609

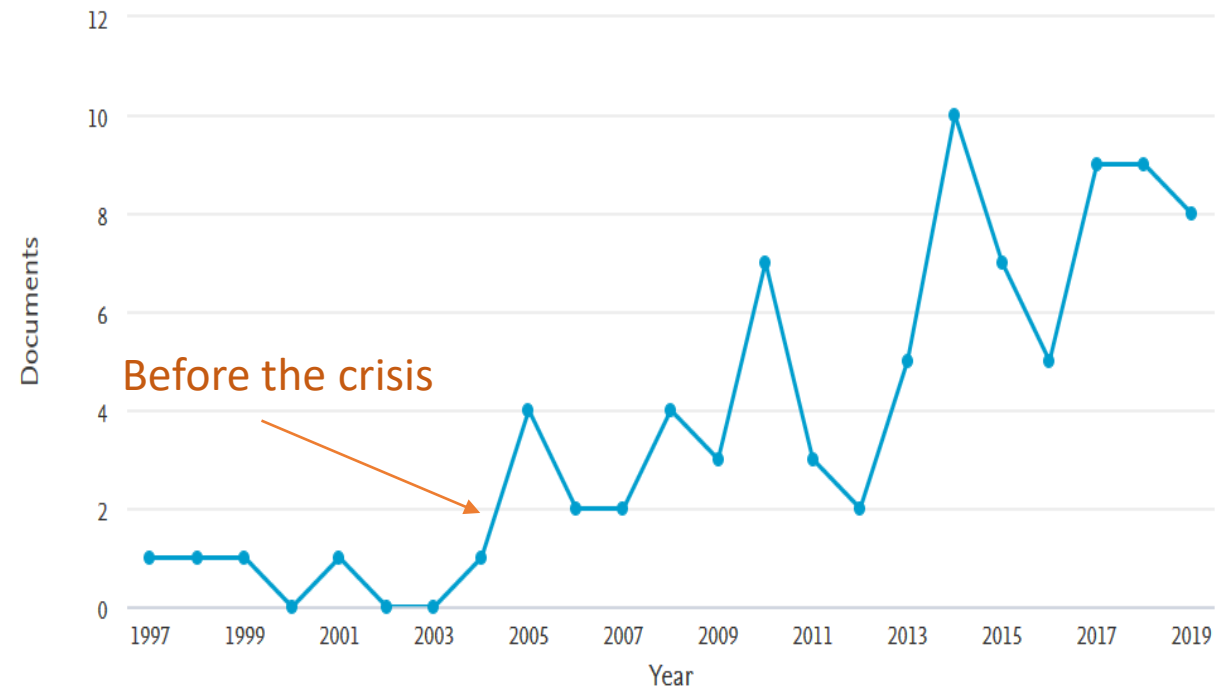
Documents by year



MABM and « Expectations », per year

Cumulated data : 85

Documents by year



Topics convergence

- A clear intensification of papers related to those issues after the crisis but investigations on those topics started much before
- MABMs generally started before DSGE models:
 - For DSGE, a progressive expansion
 - For MABMs, a heritage

Part of the (M)ABM research program also adopted by DSGE models

- The topics which are addressed by MABM are also analyzed by DSGE
 - Heterogeneity of agents, of expectations, financial instability... for instance, Di Bartolomeo et al. (2014), Kurz et Al. 2009,
 - Woodford (2003), Gali (2008)...etc.): a proportion of the population has a bounded rationality, learning rules, only partial equilibrium.
- MABMs and DSGE models developed at the same period but they both have older roots.
- This evolution is consistent with the modeling strategy of DSGE from a core model, with progressive expansion, and a program certainly also pushed by the crisis...

But their methodologies still differ

- It does not allow for the same dynamics or macro-effects. MABM allow:
 - Disequilibrium dynamics,
 - Feedback,
 - Emergence properties (/ amplification)

Agendas' Convergence

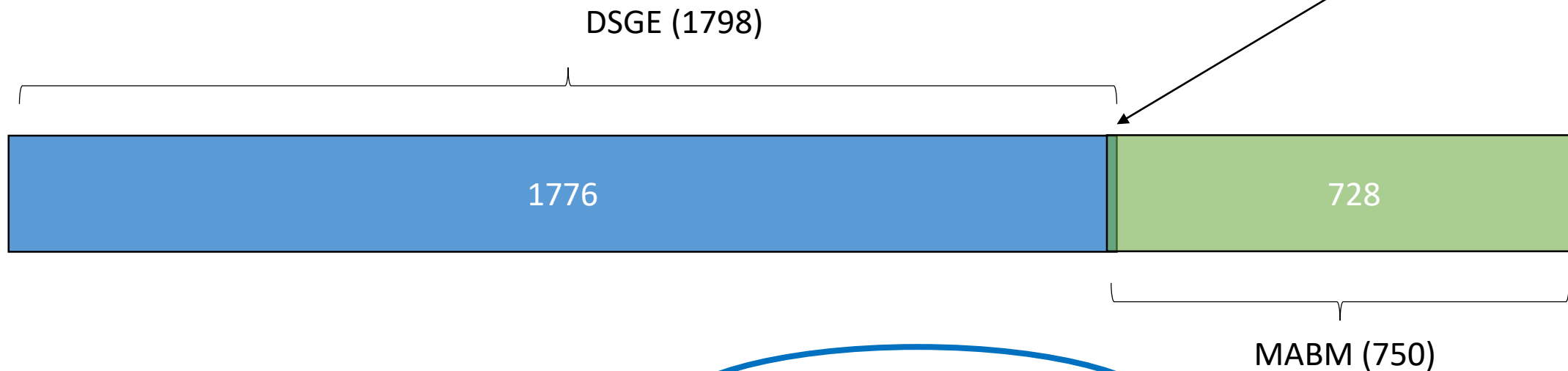
- It is clear that the two approaches share the same agenda and focus now on rather identical core questions.
- What do we know about this convergence process?
 - Do they converge because they are influenced each others by the « progresses » made by the other ?
 - Or do they converge simply because they are facing the same challenging economic issues?

Part III – Is there a convergence between those competing approaches? A cross-fertilisation or co-evolution?

Common documents

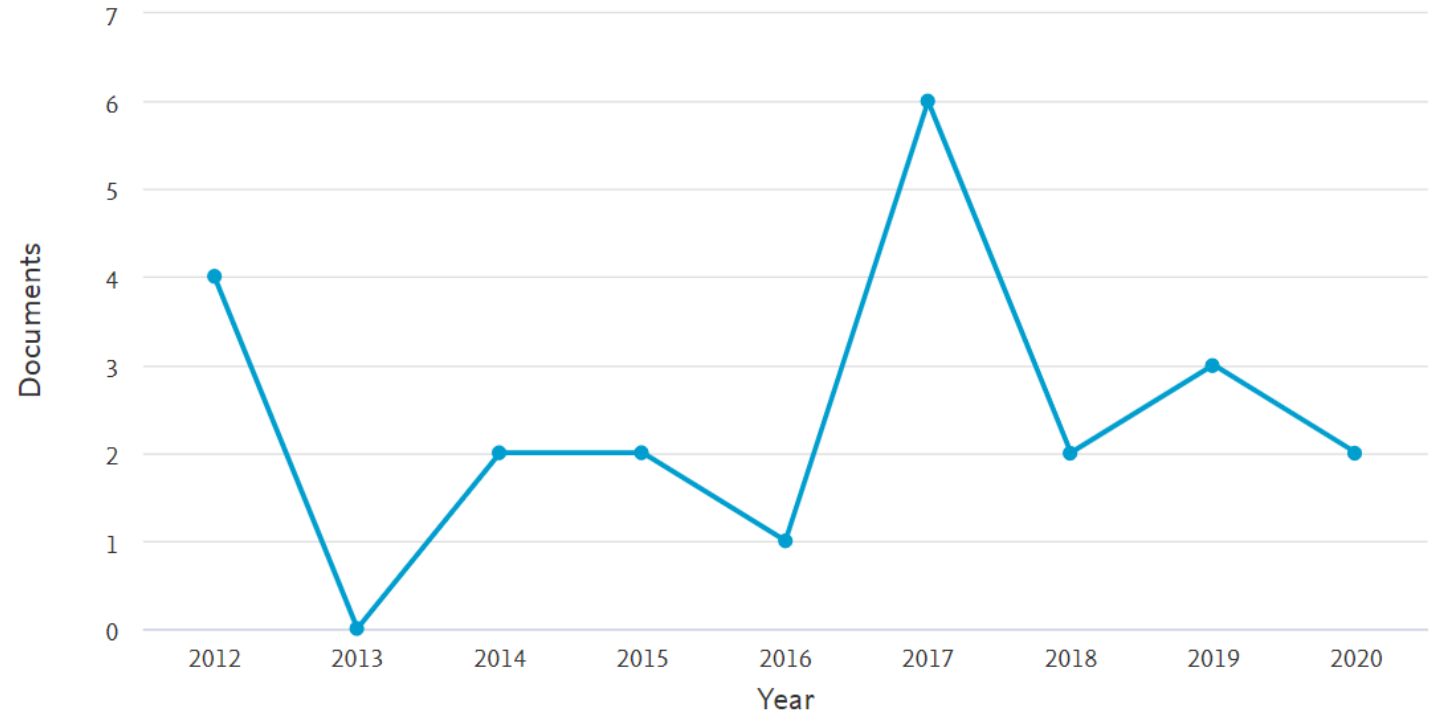
24 ((TITLE-ABS-KEY(macroeconomic AND agents-based AND models)) OR (TITLE-ABS-KEY(macro AND agents-based AND models))) AND (TITLE-ABS-KEY(dsge AND models))

22 document results

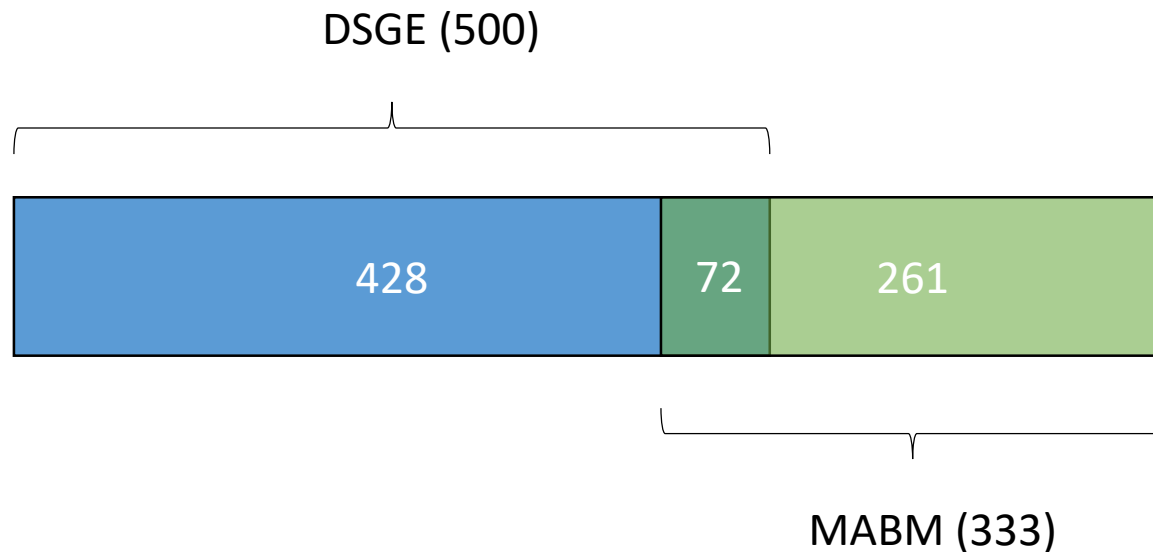


Very small overlap!
But all MABMs...

Common documents over time



Overlap top cited authors between DSGE and MABM



Most cited overlapping authors

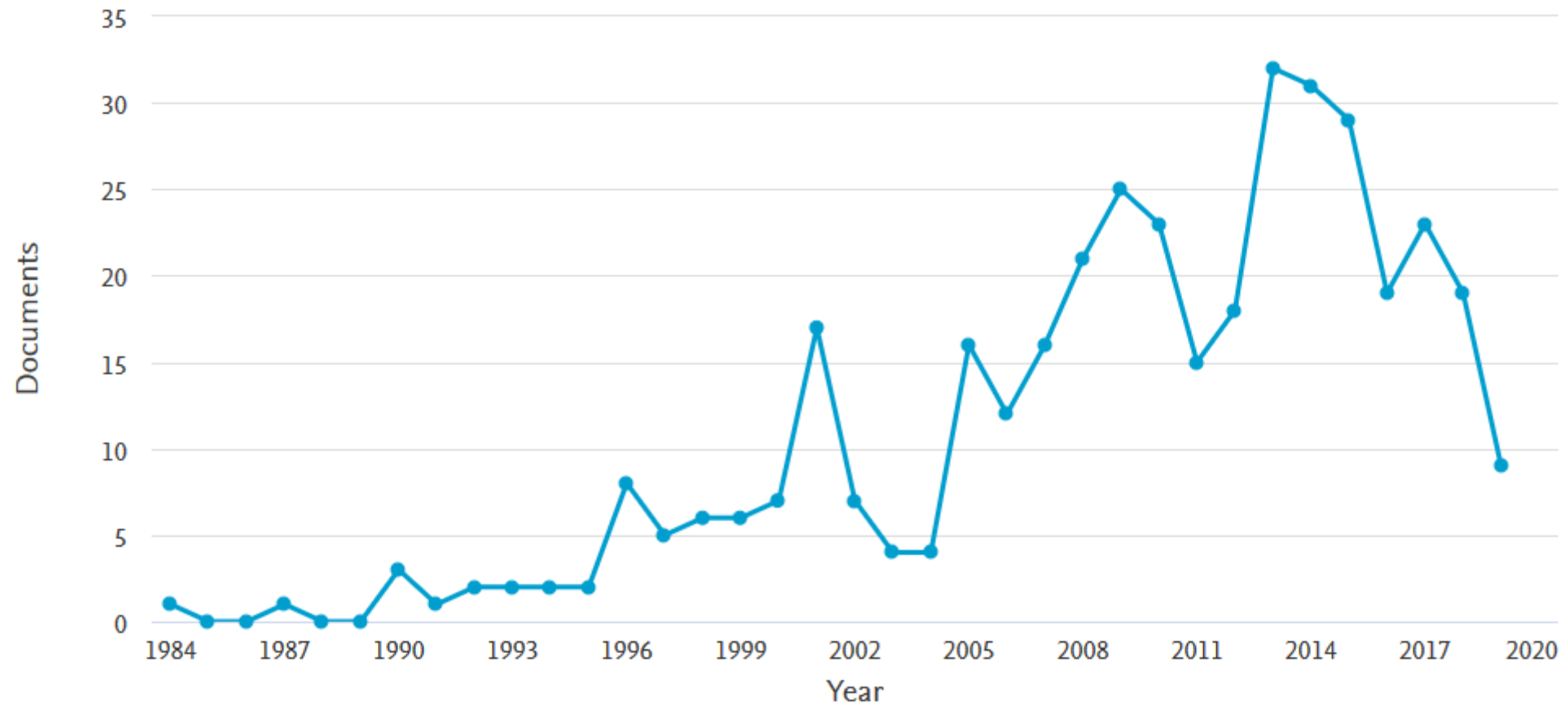
Cited authors	Citations
smets, f.	1571
wouters, r.	1533
gertler, m.	1439
gali, j.	1401
woodford, m.	1071
gilchrist, s.	492
bernanke, b.s.	386
blanchard, o.	384
taylor, j.b.	372
kiyotaki, n.	347
prescott, e.c.	298
bernanke, b.	295
lucas, r.e.	190
mankiw, n.g.	188
judd, k.l.	182
stiglitz, j.e.	171
friedman, m.	154
kumhof, m.	146
krusell, p.	142
roventini, a.	137

Mutual influence?

-An example (no generalisation) with two (representative) Journals for each community

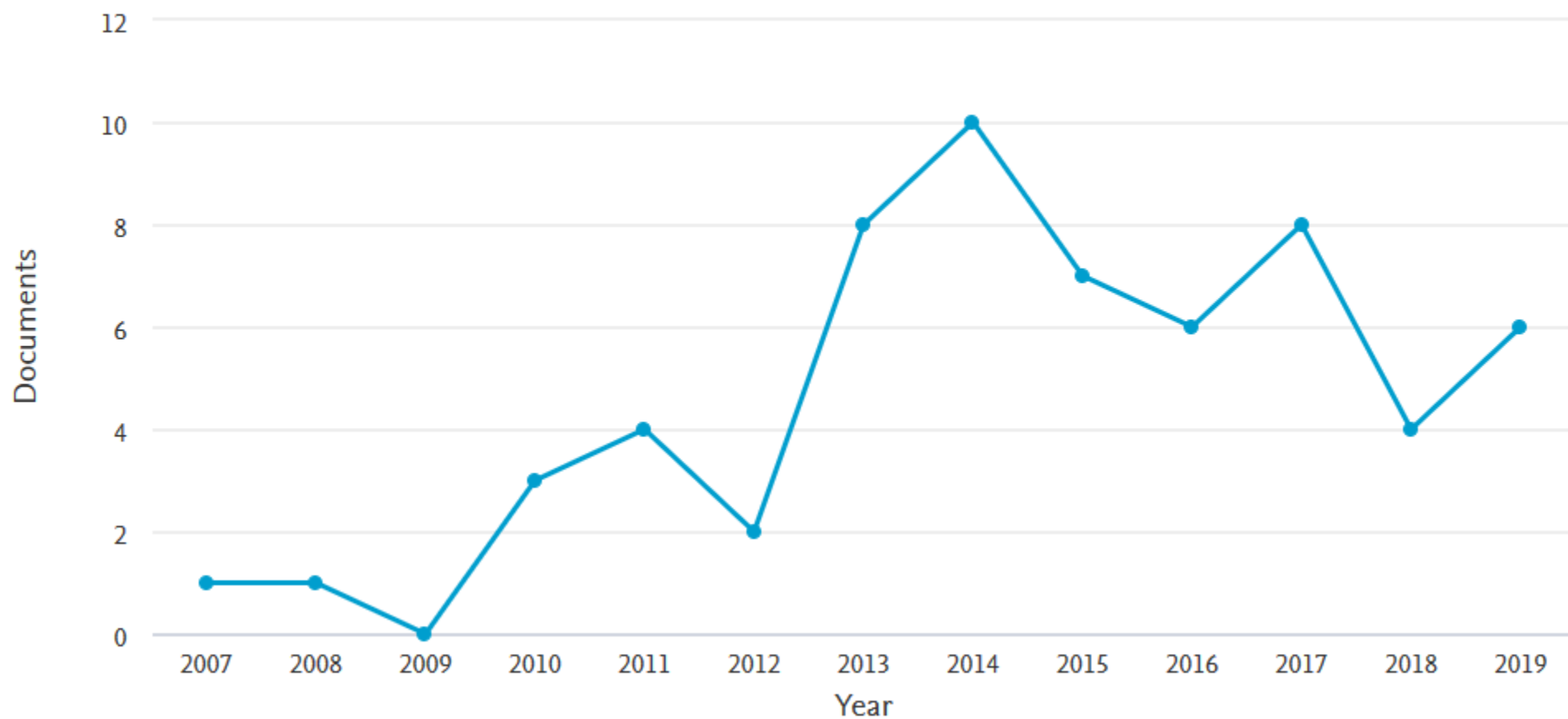
A growing literature : JEDC and « agents based model » 375

Documents by year



JEDC within « agents based models » list, the ones mentioning « DSGE »
60

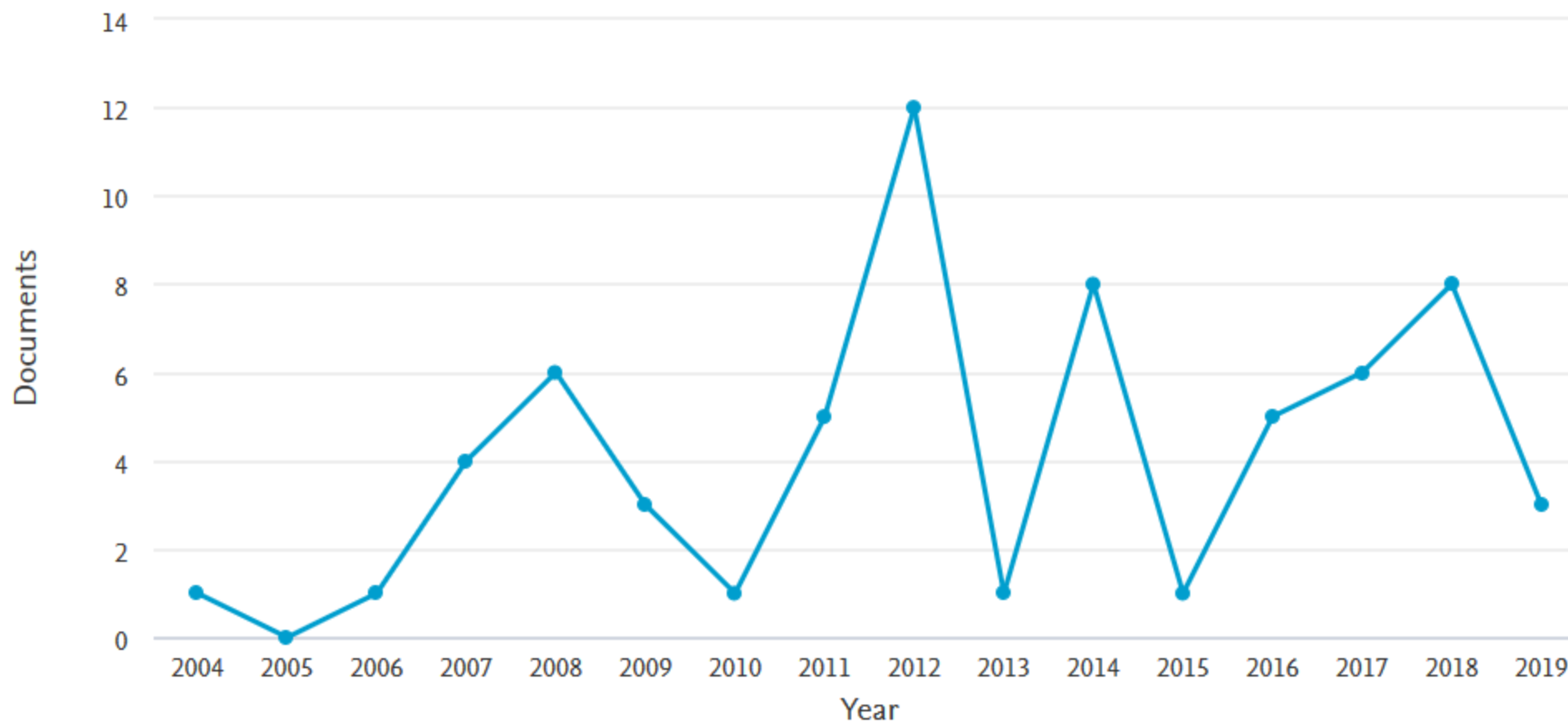
Documents by year



16 %

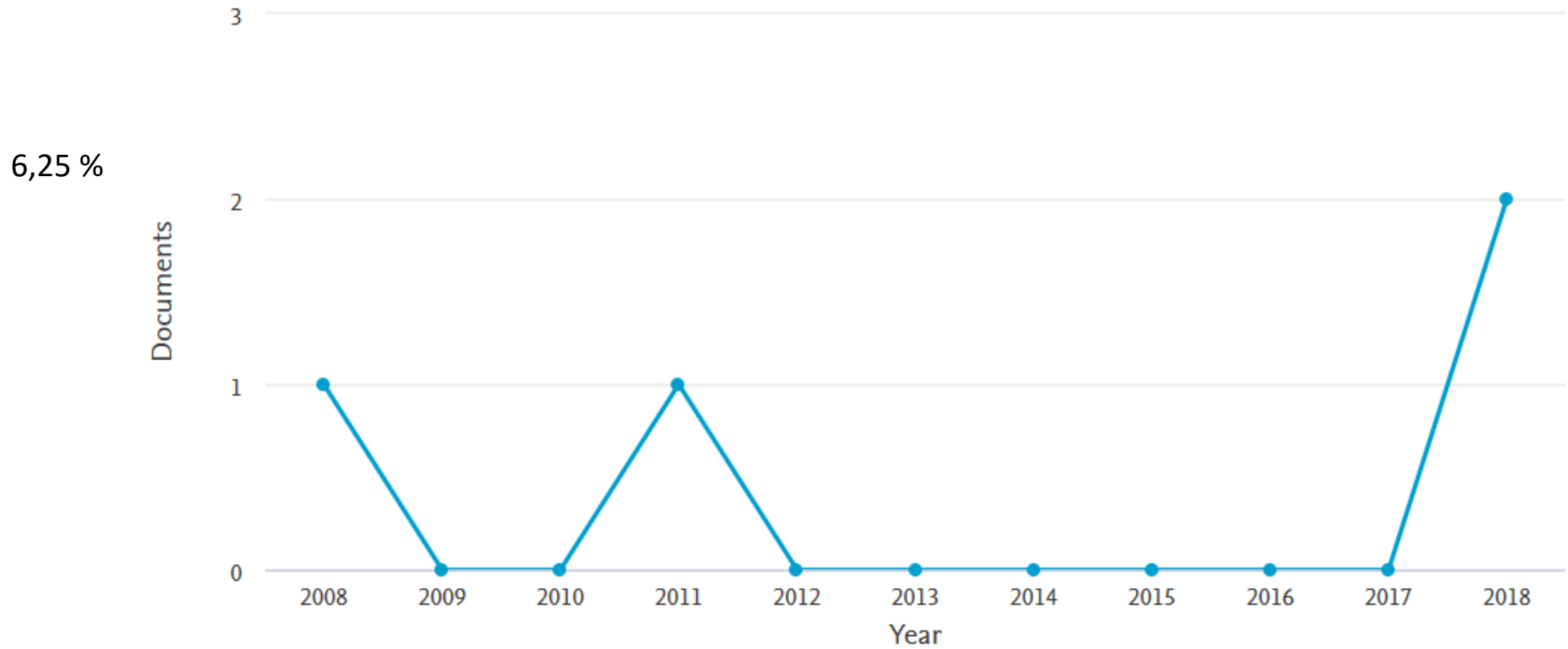
Papers on DSGE published in the AER, per year

Documents by year



AER papers on DSGE mentioning « Agents based models », per year 4

Documents by year



- A priori, a clear asymmetric influence,
 - MABM referring to the mainstream even if not systematically (and perhaps less than expected)
 - Mainstream models rather ignoring MABM developments
- Cross-fertilization is not “obvious”.

- Does this mean that MABM had no influence on DSGE models?
- Can we say that MABM were built independently from DSGE models?

Part IV– Did MABM developed independently from DSGE models
trajectory?

MABMs / An independent research program but some (strategic) developments

M&ABM – Hybrid MACRO

In an attempt to escape the “black box” critics addressed to ABM, Assenza-Delli Gatti 2013 propose to nest an ABM into a standard macro model, therefore building a hybrid macroeconomic **and** agent-based model (**M&ABM**)

Modelling strategy which reduces the dimensionality of an agent-based framework by replacing the actual distributional features (in this model: the distribution of firms' financial conditions) with the first and second moments of the distribution itself.

The moments of distribution « play here the role » of macroeconomic variables: better traceability

- Behavioural equations are derived from optimization
- The equilibrium condition is necessary to "solve" the macroeconomic model (i.e. to compute the reduced form).
- The dynamics of GDP is determined "in equilibrium", i.e. through the reduced form of the macroeconomic component of the model, instead of through the procedure "from the bottom up".

This allows

- To better trace the mechanism by which shocks are propagated
- **To draw comparisons of M&ABM with pure DSGE models**

Part V – The nature of the “transformation” of the DSGE models (the direct or indirect influence of the MABM)

- Despite the Crisis, one cannot consider that there is a fundamental reconsideration of the DSGE approach.
- Nevertheless, one can observe **inflections** in the literature which can be interpreted as (direct or indirect) impacts of MABM literature on DSGE modeling strategy.

An increasing diversity

- First, the fact that DSGE models engaged in some new topics, had the consequence to **increase their diversity**. Is this diversity a source of segmentation? Or does it allow the conservation of a core model?

For instance, the literature on financial issues, led them to model the impact of financial intermediation (financial accelerator) in various ways

- Kyotaki and Moore (1997) (Iacoviello)
- Gilchrist and Gertler (1996) (Merola, Gertler....)
- Greenwald and Stiglitz (1983)

Collateral
Financial frictions
Asymmetric information

- DSGE approach became less monolithic (some models are more “permeable” to a sort of endogenous instability)

New microfoundations?

Behavioral Keynesian DSGE

- **Second**, as ABM are integrated in DSGE models they provide new microfoundations (an increasing tendency)
 - a success *versus* a strategy (see. Dilaver O., R. Jump P. Levine (2016))
 - For instance, in behavioural Keynesian DSGE (based on Brock-Hommes, Branch et al. (2012, 2011),

It has two main consequences

- The slight and progressive modification of the DSGE approach, i.e. of the **nature of their microfoundations**
- Allowing them to addressing them a larger range of economic (coordination) issues

- ... but not with a fully different methodology.

Thinking about the futures of Macroeconomics

- So far no abandonment of DSGE
- More an inflection of a part of the literature
 - Diversity of the models pushed by the expansion of the topics / issues covered (less monolithic, but same method)
 - The emergence of Hybrid models... but with an uncertain fate...(still emerging only from one side)
 - We could also notice that there is a growing convergence in empirical validation methods within the two literatures allowing for more systematic comparison, maybe a source of convergence...

So a fragmentation of the literature more than a total absorption or a domination by one of the approaches

Perhaps finally, simply the whiteness of the resurgence of dialogues, debates and also controversies in economics which had been overlooked by the *consensus* of the NNS.

Macro Agent-based versus DSGE modeling:

A Short History of two Competing Approaches to Macroeconomics

Chair: David Colander, Middlebury College

Organizer: Muriel Dal Pont Legrand (Université Cote d'Azur CNRS GREDEG)

Paper 1 : Agent Based Macroeconomics : A Syncretic View

Author: Domenico Delli Gatti (Università Cattolica del Sacro Cuore, Milan)

Paper 2: Is Cross-Fertilization Possible in Macroeconomics? DSGE confronts MAB Models

Author : Muriel Dal Pont Legrand (Université Cote d'Azur CNRS GREDEG)

Paper 3: The Incorporation of Agent-Based Models in the Bank of England's Toolkit

Author : Romain Plassard (Université Paris Dauphine)