Ricardo J. Caballero

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Abstract

This chapter reviews the work of Ricardo Caballero, focusing on his seminal contributions to three areas of research: the economics of heterogeneity and lumpy adjustment; the economics of restructuring and rent sharing; and the economics of safe assets and financial crises. The chapter also discusses Caballero's contributions to the policy debate on the world economy and his influence on many generations of graduate students at MIT.

1 Introduction[1]

Ricardo Caballero was born in Chile in 1959. In 1982, the year Ricardo was graduating from college, Chile went through a severe financial crisis. The crisis came, as often happens, following a period in which the country had opened up to outside financial flows – leading to inflated domestic asset prices and a large increase in indebtedness. It was a classic example of a credit boom gone wrong, which then caused a domestic recession. The exposure of emerging economies to financial crises and their consequences for the real economy would eventually become a central theme in Caballero's research. But, at the time, the Chilean crisis had more practical, immediate repercussions, encouraging him to explore outside opportunities and to travel to the US to start a PhD programme in economics at MIT.

Caballero's academic life is closely linked to MIT. It was there that he got his PhD in 1988 and where he has spent almost all his career, joining the department as an assistant professor in 1992,

[1] For extensive conversations in the preparation of this chapter and for comments on an earlier draft, I am thankful to Ricardo Caballero, Mark Aguiar, Olivier Blanchard, Eduardo Engel, Anil Kashyap, Arvind Krishnamurthy, Annette Vissing-Jørgensen, Iván Werning, and Thomas Winberry. Sviatoslav Tiupin provided excellent research assistance.

after four years at Columbia. He was the chairman of the department between 2008 and 2011.

In this chapter, I will summarise the evolution of Caballero's research and discuss how it influenced successive generations of MIT PhD students. I do not aim to be exhaustive, but to identify a few core ideas, how they affected some of his students and, directly and indirectly, macroeconomic research inside and outside MIT.

Caballero's research style and advising shaped MIT macroeconomics during a crucial passage between the 1990s and the 2000s – after the rational expectations revolution had been accepted and absorbed in academic research and leading scholars were at work building micro-founded models of increased sophistication in many dimensions. Three dimensions especially attracted the attention of young researchers at the time: the heterogeneity of economic actors; the richness of the decision problems they faced (e.g. the presence of adjustment costs and of risk-taking); and the presence of frictions (e.g. costs of adjusting prices, incomplete contracts and lack of enforcement). Caballero made seminal contributions in all three of these areas.

I will review his work dividing it in three parts: the economics of heterogeneity and lumpy adjustment; the economics of restructuring and rent sharing; and the economics of safe assets and financial crises. Throughout, I will highlight a common element to all of Caballero's work: the idea of embracing micro-foundations but, at the same time, taking what I would call a "bottom-up approach to micro-foundations", that is, use micro-foundations as a challenge to build models that capture in a realistic way the context in which economic decisions are made. I will argue that this approach allowed the MIT macro tradition not only to stay ahead of the methodological revolution of the 1970s and 1980s but paved the way for the style of context-driven, empirically grounded, general equilibrium work that is more and more dominating macro research after the financial crisis.

Caballero's work can also be seen from a different angle, as providing crucial input into our understanding of the major macroeconomic events of the last few decades, and in particular, changes in labour markets and economic restructuring across the world, and the large global demand for safe assets, with its impact on international financial flows, on low global interest rates, and on financial fragility and crises. In my narration, I will go back and forth between methodological advances and policy-relevant insights, as the two are strictly intertwined in his work. Along the way, I will also discuss some of the MIT students whose work was most closely

influenced by Caballero's advising and coauthoring.

As I mentioned, I am not aiming to be comprehensive, neither in covering Caballero's massive research output nor in mentioning all the students and scholars he has influenced directly or indirectly. Rather, I hope to tell stories useful to reconstruct the evolution of three areas of research that remain open and exciting today.

Ricardo is still very much active in research today. Since this chapter is written in the spirit of a historical reconstruction, to get the benefit of distance, I will stop somewhere in the mid-2010s, before the pandemic shock.

2 Heterogeneity and Lumpy Adjustment

The first area in which Caballero made fundamental advances is the study of economies with heterogeneous agents, fixed adjustment costs and infrequent adjustment. What distinguishes his contributions in this area is a deep interest in understanding the response to shocks of economies characterised by heterogeneity and, in particular, addressing the question: does the state of the economy – captured by a potentially rich cross-sectional distribution of individual state variables, e.g. liquid balances, levels of debt, stocks of capital – matter for the effect and propagation of shocks? That is, does the same shock have different effects depending on this distribution? Do some configurations of individual states make the economy more vulnerable to amplification? It is an approach that emphasises asymmetries, history dependence and nonlinearities. Caballero was ahead of his time in pushing these elements to the centre of macro research.

Today, we tend to take it for granted that moving away from a representative agent framework is a good idea, in order to tackle in more realistic ways many important questions in macro. At MIT in the early 1990s, the main motivation for introducing heterogeneity was not just a general dissatisfaction with the fiction of the so-called representative agent. Rather, heterogeneity came up as a necessary by-product of wanting to attack substantive issues, of practical relevance in the construction of aggregate models.

There are two cases where it is clear from empirical observation that businesses make infrequent decisions and, when they adjust, they make relatively large adjustments: first, when firms choose the price at which to sell their goods and services, and second, when they make investments in

new infrastructure and equipment. Understanding inaction and adjustment seems indispensable for a deeper understanding of the aggregate dynamics of prices and the role of nominal rigidities in the first case, and of the volatility of aggregate investment in the second.

Once you analyse economies in which people make infrequent adjustment, you are necessarily pushed to build models with heterogeneity, because it would be of little interest to study economies where either everyone is completely inactive, or everyone makes perfectly synchronised large adjustments. Studying infrequent adjustment leads to models with agents that randomly adjust at different dates and end up with different histories. Keeping track of these different histories is the core challenge of heterogeneous agent macro.

When Caballero was finishing his PhD, he met a first-year student, also from Chile, Eduardo Engel. Engel already had a PhD in statistics from Stanford, and the two of them started discussing tools that could be used to study the ergodic behaviour of a process. At the same time, Caballero, like many other macroeconomists at the time, was mulling over the perplexing results of Caplin and Spulber (1987), which had shown that in an economy with menu costs and infrequent price adjustment, it is possible to obtain some surprising neutrality results, by which an injection of money has no effect on real activity. Caballero and Engel started exchanging ideas. The maths side suggested the possibility of analysing an economy in terms of a distribution of states, where one can look both at the probability distribution of future states from the point of view of a single agent and at the cross-sectional distribution across agents, and these two mathematical objects are tightly related. The economic side suggested that how an economy will react to a given aggregate disturbance would depend on where agents are distributed in the state space. Developing the tools to deal with distributional dynamics and aggregation in this type of economy would be a task to which Caballero and Engel would devote a large part of their energies in their early careers.

Meanwhile, Caballero was also collaborating with Giuseppe Bertola, another MIT classmate. Olivier Blanchard, who had been Ricardo's thesis adviser at MIT, invited both to write a paper for the NBER macro annual meeting in 1990. The paper contained important technical advances on how to deal with a two-sided adjustment band in lumpy adjustment models and at the same time was pointing the way to the estimation of models with infrequent adjustments, using the case of durable consumption as an application. Andy Caplin was the paper's first discussant at the meeting and welcomed enthusiastically their contribution. In the same year, Caplin, Caballero and John Leahy would start a research group at the NBER, with the title "Heterogeneity", which for the

following decade became a home for research on the aggregation of heterogeneous agent models, emphasising both heterogeneity due to adjustment costs and dispersed information.[2]

This period was generally one of convergence in macro. Despite disagreement on many modelling choices, researchers from the East Coast schools and from the Chicago/Minnesota tradition were finding that the common formal language of dynamic equilibrium models allowed for a spirited but constructive debate. An amusing anecdote is that Bob Lucas in 1994, in a famously scathing discussion of Ball and Mankiw's "sticky-price manifesto", complained that if 'the IS/LM model…is all we need, why do I need to work through hard papers by Caballero or Caplin and Leahy?' (Lucas 1994: 154). What is more interesting, though, is that Lucas indeed kept working through those hard papers until, a decade later, he gave it his own spin by joining forces with Mike Golosov in a classic paper that led to a new wave of quantitatively oriented research on menu costs.

Another episode, this time from the early 2000s, illustrated well the creative tension between different approaches to general equilibrium modelling in macro at the time. At a conference in Gerzensee, Switzerland, in the early 2000s, Lucas teased Caballero: hey, it looks like all these micro dynamics of lumpy investment end up not mattering much at the aggregate level! Lucas was referring to some recently circulated work by Julia Thomas that was showing that when you embed a model of lumpy investment à la Caballero-Engel in a full-blown general equilibrium model, the behaviour of aggregate output, consumption and investment looks very much like it does in a baseline real business cycle (RBC) model with smooth, convex adjustment costs (Thomas 2002).

The findings of Thomas challenged the view that lumpiness and inaction were relevant at the aggregate level. It would take several years for researchers to fully unpack the different conclusions of Caballero and Engel on the one side and of Thomas and others on the other. We now understand that a fundamental limitation of Thomas' approach was the fact that it was embedding the partial equilibrium model of Caballero and Engel in a frictionless RBC model, in which the equilibrium interest rate was playing a very potent counteracting role. Whenever lumpiness could potentially cause interesting forms of state-dependence or amplification in the behaviour of aggregate investment, the equilibrium interest rate would move so as to kill these effects. To simplify to the excess: if you put a source of investment amplification in a model where consumption and total output do not move much, and output is equal to the sum of consumption

[2] Bob Hall's account of some of the group's contributions is in Hall (1999).

and investment, then, simply by adding up, investment cannot move much. Some price must be doing work behind the scenes to temper the amplification force that you have identified in partial equilibrium. In this specific case, that price is the interest rate. This has remained a very active and exciting area of research. For example, recent work by Thomas Winberry has vindicated the original approach of Caballero and Engel, showing that interest rates do not in fact behave in the way that the standard RBC model predicts, and that amplification and sensitivity to the state of the economy are indeed possible and relevant.[3]

This specific episode illustrates well a tension in general equilibrium macro modelling: sometimes you want to enrich your model to explore some mechanism motivated by empirical observation and some partial equilibrium reasoning. But to have a complete analysis, you need to make assumptions about the rest of the economy. You need to "close" the model. The way in which the model gets closed is not innocuous and can mislead you to think that your new mechanism does not matter (or, in other instances, that it matters too much). Caballero has at times explicitly expressed frustration about how the tyranny of always embedding our ideas in some agreed-upon canonical machine can stifle innovation (Caballero 2010a). In his research, he has constantly pushed the idea of giving more space to innovative research, watching out for the danger of imperfect assumptions needed to "close" the model. Sometimes closing the model in the wrong way can close the door to new ideas.

One could contrast the two sides of this tension as that between a desire of doing micro-foundations "from the bottom up" against the desire to maintain overall consistency "from the top down". An important merit of the MIT tradition of macro in this period has been to strongly push the bottom-up approach, and Caballero was central in this endeavour.

The interest in heterogeneity and in how the response of the economy can depend on multi-dimensional state variables capturing the position of different economic actors has left a mark on many students from this time. Jonathan Parker (PhD, 1996) was one of Caballero's students. His classic work with Pierre-Olivier Gourinchas on consumption over the life cycle started when they were both students. It was one of the earliest examples of a quantitative heterogeneous consumer model fitting observed patterns of consumption and saving over the life cycle and identifying the role of precautionary motives.

[3] Winberry (2021) and Koby and Wolf (2020) also show that the original models of lumpiness imply that aggregate investment is excessively sensitive to the interest rate and proposes ways to improve them in that dimension.

Caballero's interest in heterogeneity clearly influenced Annette Vissing-Jørgensen's (PhD, 1998) work on heterogeneity in stock market participation and my own work with Veronica Guerrieri (PhD, 2006) on heterogeneous consumers' response to the financial crisis of 2007–2008.

It is beyond this chapter to trace Caballero's influence outside of MIT, but some connections are close to home. For example, two researchers that have recently been at the forefront of exploring state-dependent responses of the economy to various shocks are Joe Vavra and David Berger. Both were Yale PhDs and their advisers were Engel and Giuseppe Moscarini, who was in the earliest cohort of Caballero's students at MIT (PhD, 1996). For example, see their work on the effects of monetary policy depending on the distribution of the times at which people refinanced their mortgages in the past (Berger at al. 2021).

3 Restructuring and Rent Sharing

The next area I want to cover in this review is Caballero's vast contributions to the economics of restructuring. Market economies are characterised by the constant creation and destruction of businesses, jobs and other productive relations. This classic observation that goes back to Schumpeter has had an enormous influence on research on long-run economic growth and on the underlying process of technological innovation. While Caballero has also worked on long-run growth, one of his fundamental contributions in this area has been to redirect our attention to the importance of restructuring processes in our understanding of many medium- and short-run issues, like the responses of economies to recessions or to financial crises. This was a natural continuation of the themes discussed in the previous section, given that to develop this idea necessarily requires capturing the heterogeneity of production units, some of which are entering and some exiting the economy at any point in time. Again, as in the previous section, Caballero's interest is not so much in the properties of the economy when it is in a steady state or, as is common in the growth literature, on a balanced growth path, but on responses to shocks. This interest led him to develop a whole new set of tools and concepts.

Several events contributed in different ways to stimulate his work in this area. First, at MIT there was lots of interest in the idea of developing something that went under the label of "medium-run" macroeconomic analysis, that is, the analysis of those economic processes that are slower than the business cycle frequency but shorter than secular growth. Two specific applications played

an important role here, namely the transition to a market economy in the post-Soviet states, and the problem of high structural unemployment in Western Europe in the 1980s.[4] Second, the work of Davis et al. (1998) on job creation and destruction opened the door to a much more detailed empirical analysis of the restructuring process. Third, there was a very active dialogue between macroeconomics and contract theory, with lots of interest and progress on the analysis of incomplete contracts and their application to macro questions.

Two papers of Caballero's from this period capture well some distinct and crucial steps in his contributions. The first step is more descriptive and positive: develop models that capture the notion that over the cycle there are less efficient businesses, which are close to shutting down, and new businesses are ready to enter, adopting more innovative and productive techniques, and organisational strategies. In the 1994 article, "The Cleansing Effect of Recessions", Caballero and Mohamad Hammour build the cleanest model to capture this process, focusing on a perfectly competitive benchmark, and capturing the potential richness of how an economy can adjust to aggregate reduction in demand. A sector can adjust to a negative shock that reduces total demand in different ways: all active business units can cut production proportionally, the least efficient firms can stop production altogether, and new units that would normally enter the sector are disallowed from doing so. Caballero and Hammour focus on entry and exit. They show that, in principle, all production slack could be taken by the entry margin, with no faster exit, a case they dub "pure insulation". In addition, they then show that to match observed patterns in the data, the model needs to move away from this particular case, given that in recessions a large proportion of the adjustment happens on the "destruction" margin. In other words, recessions are often characterised by an unusual speed of destruction, hence the "cleansing" effect.

The notion of recessions characterised by a cleansing process of least efficient production units echoes an idea very much present in Schumpeter and other early scholars of the business cycle, a "liquidationist" view in which a positive side effect of economic contractions is the elimination of the least efficient firms and techniques. However, Caballero did not stop here and in fact built an entire agenda of questioning the liquidationist view. His interest in emerging economies certainly played a role, as an optimistic view of macroeconomic crises as episodes of regeneration seemed visibly contradicted by many countries' poor post-crisis productivity performance.

For this, Caballero needed to move beyond the perfectly competitive model and explore models

[4] Olivier Blanchard played a crucial role in making these central themes at MIT in those years.

with potential inefficiencies both on the creation and on the destruction margin. This is where the introduction of incomplete contracts becomes essential. Ricardo focuses on productive relations characterised by a so called "hold-up problem": after a production unit is created, the various participants – entrepreneurs, workers, financiers, suppliers – are in part stuck, as they have made specific investments that are not easily portable to other economic exchanges. The units produce a surplus, or rent, over and above the potential use of the same resources in other uses and this rent needs to be shared. The fact that it is not possible to write down in advance and commit to a contract to anticipate how this rent will be shared implies that the actual division of it is not going to be, in general, one that ensures aggregate efficiency, even if it satisfies individual rationality at the level of each production unit.[5]

To see how important this deviation from perfect competition is, notice that it can completely turn on its head the liquidationist view of recessions. We can have a model with cleansing recessions, in which many inefficient units get destroyed, and yet, the model can feature *excessive destruction* from the point of view of social welfare. How is this possible? The problem is that, due to contractual incompleteness, recessions can also be periods in which there is not enough creation. This means that the factors of production that are liberated due to destruction are not going to be absorbed by faster creation but will remain unemployed or underutilised. A social planner that takes into account this imperfect process of reallocation would want to reduce destruction in recessions, even if it happens in the least productive units. This argument is fully developed formally and empirically supported in another paper by Caballero and Hammour aptly titled "The Cost of Recession Revisited: A Reverse-Liquidationist View".

As Caballero developed his views on inefficient restructuring, the financial side of the problem started to receive increased attention. The intimate connection between his interest in restructuring and financial frictions, which I will cover next, is the classic paper, "Zombie Lending and Depressed Restructuring in Japan" written with his former MIT classmates Anil Kashyap and Takeo Hoshi. The idea of banks keeping inefficient businesses afloat to avoid reporting losses had circulated in the policy debate and Hoshi brought it to the attention of Kashyap and Caballero. They went on to write the first paper to recognise the general equilibrium effects of this practice where the act of subsidising firms that would have naturally exited this process would jam the restructuring process and impede creation and entry. The additional crucial theoretical observation

[5] The benchmark macroeconomic model of restructuring with specificity and inefficient rent-sharing is developed in Caballero and Hammour (1998a).

that came from their work was the fact that it was not sufficient to have weak businesses in distress, but that the incentive to evergreening loans only arose when the banking sector itself was undercapitalised.

This line of work had a long-lasting impact both inside and outside MIT. Many students were working on labour markets and reallocation at the Institute at the time, including Moscarini (PhD, 1996) who has worked extensively on frictional job markets and search. Traditional search models focus on flows between employment and unemployment, and less on workers' transitions from employment to employment at a different firm. One of Moscarini's core contributions has been to point out that the latter flow is crucial for the efficiency of the labour market, as it leads workers to climb the job ladder to positions where they are more productive, a theme very much in line with Caballero's emphasis on reallocation and restructuring.

Caballero's growing interest in international finance in this period, which I will discuss in detail shortly, corresponds to his advising an increasing large group of students who would end up working in the area of cross-border finance in either academia, international institutions or central banks. Just to mention a few in order of PhD year: Roberto Rigobon (PhD, 1997) has spent well over two decades next door at Sloan, with fundamental contributions to the debate on contagion, financial crises and pricing across borders; Mark Aguiar (PhD, 1999) who, among many interests, would become a leader in the field of sovereign debt, recently writing the foundational textbook on this vast topic with another MIT former graduate, Manuel Amador (PhD, 2003) (Aguiar and Amador 2021); Pablo Garcia (PhD, 1999) who has spent most of his career at the Central Bank of Chile, where he was vice governor from 2022 to 2024; Fernando Broner (PhD, 2000) whose recent work on "retrenchment" in international capital flows would stimulate Caballero to work on the idea of "fickle capital flows" with Alp Simsek; Petya Koeva (PhD, 2000) has spent her career so far at the IMF where she is now Deputy Director in the Research Department; Kevin Cowan (PhD, 2002) who has held high level positions at the Central Bank of Chile and at the Inter-American Development Bank (IDB), and led the main financial markets regulatory agency in Chile; and Claudio Raddatz (PhD, 2003) who is now Director of the Financial Policy Division at the Central Bank of Chile.

4 Crises and Safe Assets

It is a commonly heard complaint that economic research arrived unprepared to the financial crisis

of 2007–2008. That is for sure an *inaccurate* description of MIT in the early 2000s, where much research and PhD training was focused on the risks posed by financial crises and on policy responses. This attention was partly due to the fact that at MIT the fields of macroeconomics and international finance had been traditionally closely linked, thanks to the towering presence of Rudi Dornbush and Stan Fischer, and it was impossible to study macro in emerging economies without paying attention to the role of recurrent financial crashes. The East Asian crisis of 1997 was in many ways the focal point that reignited interest in this area.

As I mentioned, Caballero's original interest in economics had been, in a very practical sense, sparked by financial crises in emerging economies, so it is not surprising that in the late 1990s he got more and more interested in the topic. From the very beginning, his analysis was tightly directed towards an understanding the role of safety, both in the sense of interpreting crises as moments in which international investors run for safety, and in the sense that countries potentially exposed to crises would look for safety by accumulating reserves of specific assets that would provide a buffer in the event of capital flight.

In 1999, Caballero was on sabbatical in Washington, D.C., visiting the American Enterprise Institute, and put together three reports for the IDB on structural volatility in Argentina, Chile and Mexico (Caballero 2000). The fundamental observation was that while these countries did experience real shocks of domestic origin and due to changes in the terms of trade, the volatility of international capital flows appeared excessive relative to the size of the real shocks, pointing to an independent role for capital flows as drivers of volatility and to amplification effects.

Caballero developed his views on the external financial vulnerabilities of emerging markets in a series of very influential papers with Arvind Krishnamurthy, who had secured his PhD at MIT in 1998, having been advised by Bengt Holmström, who at the time was conducting fundamental research with Jean Tirole on financial intermediation and crises (Holmström and Tirole 1997). Krishnamurthy's dissertation focused on models of collateral constraints and amplification. The collaboration between Caballero and Krishnamurthy proved extremely fruitful as it pushed the literature to pay more attention to what they called a "vertical" view of financial crises.

The dominant way of thinking and modelling emerging economies is to think of them as small and open. From the financial point of view, that often leads to an additional assumption. If the assets issued by these economies are absorbed by a representative world consumer, the share of these

assets in the world portfolio is small, which implies that these economies effectively face a perfectly elastic supply of funds, at some price which reflects risk premia driven by the volatility of domestic shocks. This is a "horizontal" view of financial flows. The vertical view proposed by Caballero and Krishnamurthy emphasises instead the idea that emerging economies do not face infinitely elastic, but an upward-sloping supply of funds and especially steep in times of global financial turbulence, albeit not necessarily exactly vertical. This upward-sloping supply reflects the fact that investment flows from international investors need to be channelled through financial intermediaries who have a limited balance sheet and face limits to arbitrage (in the language of Andre Shleifer) (Shleifer and Vishny 1997). That means that when these intermediaries are withdrawing funds, the emerging economy does not have other elastic sources of financing to turn to. The way in which these more limited funds would be allocated internally is also interesting for Caballero and Krishnamurthy, as it points to important internal channels of propagation. Businesses that have previously accessed international borrowing will often turn to domestic banks when they are faced with an external credit crunch, and will crowd out firms without external access, thus transmitting the crunch to the whole economy (Caballero and Krishnamurthy 2001).

A normative observation immediately follows the description just given of a financial crisis in an emerging economy with dual access to foreign finance. The businesses who have access to international financial flows may underestimate, from a social welfare point of view, the damage that the domestic economy incurs when they lose access to these flows in a crisis. This implies that if we take a step back and think about the period preceding the crisis, the ex-ante borrowing decisions, the choice of leverage and the risk-taking choices of these businesses may all display a socially inefficient degree of vulnerability.

The work of Caballero and Krishnamurthy had profound effects on both the positive and normative analysis of cross-border financial flows. On the positive side, the work of Gabaix and Maggiori (2015) on the role of intermediary constraints on exchange rate movements naturally builds on their view of international financial markets with imperfect intermediation, while on the normative side my own work (Lorenzoni 2008) and that of Bianchi (2011) and Korinek (2011) all add to their way of thinking about externalities.

The East Asian crisis of 1997 made Chinese authorities aware of the dangers of external financial openness and large waves of international borrowing, contributing to a policy that favoured external surpluses and the accumulation of foreign currency reserves. Very early on, Caballero

connected this wave of reserve accumulation to a broader trend in the global economy in which countries and financial institution seek protection by accumulating safe assets; this has important implications for global interest rates. For this project, he joined forces with Gourinchas and Emmanuel Farhi, who had just finished his PhD in 2006 (his joint advisers were Caballero and Iván Werning). Their 2008 paper connected the limited degree of financial development of many emerging economies with their desire to accumulate safe assets, to the opening of imbalances between these countries and the US as the prime supplier of such assets, and to the downward trend in global interest rates. "An Equilibrium Model of 'Global Imbalances' and Low Interest Rates" was an instant classic and foreshadowed many of the themes that would dominate research after the financial crisis, when low global interest rates would become an endemic feature of the world macro environment.

An important theme that Caballero pushed in several contributions, before and after the crisis, is the idea that when many different financial players are trying to achieve safety, their efforts may end up being self-defeating, leading to social welfare losses. This is a difficult idea to capture in standard models for a simple reason: in these models of risk-sharing, agents who are exposed to uncorrelated shocks can provide each other with protection by writing state-contingent arrangements – when you are in trouble, I will channel resources to you, and when I am in trouble, you will do the same in exchange. The demand for safety is satisfied by risk-sharing arrangements that are welfare-improving for the parties involved. Caballero has investigated the possible pathologies caused by the demand for safety in a variety of ways, exploring different deviations from this canonical view of risk-sharing and potential market failures.

In "Collective Risk Management in a Flight to Quality Episode", Caballero and Krishnamurthy (2008) attack the problem by introducing decision makers who display uncertainty aversion. Uncertainty aversion means that whenever a risk-sharing arrangement is in place, all the parties will be overly concerned with the worst-case scenario. If there is a state of the world in which I will have lower payoffs, I will tend to overweigh the probability of that state of the world. To put it in practical terms, let us think of banks in the financial system. Even if we all agree that the risk of a systemic crisis is small, the moment we put in place a risk-sharing arrangement that transfers resources to the banks most in need, all participants would tend to put a higher probability on the event of being badly affected in a systemic event and would behave as if they perceive a high probability of such an event. This form of Knightian demand for safety can interact in fascinating ways with the structure of the financial system. In his work with Simsek, Caballero studies the

possibility of domino effects in a financial system characterised by a complex network of cross-exposures. When the uncertain-averse institutions in the network do not know whether or not they are in the most fragile part of the chain of connections, they will behave as if they all think they are, amplifying the risk of a cascading crisis. A crucial message of this line of research is that policies like lender of last resort can actually encourage better risk-sharing among participants by reducing the "fearful" behaviour of participants, unlike in standard models where moral hazard effects dominate.

A classic market failure that can make the demand for safety self-defeating is aggregate demand effects in a Keynesian context. This is the theme of Caballero's 2018 paper with Farhi on "The Safety Trap". It identifies connections and differences between two different views. World central banks operated near the zero lower bound for many years after the financial crisis. A classic secular stagnation view is that there is an excessive demand for savings, which pushes down the natural rate of return of all assets. A story more centered on demand for safety instead emphasises a low risk-free rate, associated with high returns to risky financial assets. The fact that measuring risk premia is hard has kept the debate open.[6] A story based on demand for safety seems clearly to play a central role at the onset of crisis episodes where asset prices tend to drop sharply at the same time as central banks lower interest rates.

At this point in my narration, the history of ideas starts to merge into the current debate. Caballero is very active with Simsek on their agenda of putting risk at the centre of business cycle analysis and on capturing the constant back and forth between central banks and financial markets, each trying to anticipate future turns and moves by the other, and each influencing the cycle by their very actions.

A large number of Caballero's students have worked on macro-finance and are still very active today. A nonexhaustive list includes Jonathan Parker (PhD, 1996), Thomas Philippon (PhD, 2003), Stavros Panageas (PhD, 2004), Farhi (PhD, 2006), Tatiana Didier (PhD, 2008), Simsek (PhD, 2010) and Pablo Kurlat (PhD, 2010). This is not surprising in light of the dramatic effect of the 2008–2009 financial crisis on economic research and the fact that Caballero had been training students to think about financial channels of transmission even before the crisis struck. The work of Vissing-Jørgensen and Krishnamurty has been especially close to his idea of capturing the scarcity of safe assets, providing fundamental evidence on the safety premium of government debt

[6] Farhi and Gourio (2018) provide evidence broadly in line with a scarcity of safe assets view.

and the effects that quantitative easing can have in periods of heightened demand for safety. Simsek, beyond his work with Caballero discussed here, has worked extensively on credit crises, with seminal contributions on the study of so-called aggregate demand externalities and the role of different beliefs in financial markets.

This is not the place for me to try to summarise the enormous body of work left by Farhi, a former student and coauthor for whom Cabellero had unlimited affection and admiration. I will just point out that a deep interest in financial crises and their international dimension is visible in a large part of Farhi's work beyond the research he conducted with Caballero.

5 Conclusion

At some point in the late 1990s, the urban legend among the econ graduate students at MIT was that there was not an hour in the day where one would not find some faculty in their office in Building E52. Susan Athey, at the time an assistant professor, would stay up in her office till late at night, and she would be leaving when Ricardo Caballero was walking into the building at the break of dawn. The story is a perfect reflection of Caballero's lifelong attachment and dedication to research, teaching and advising at MIT.

All of his former students remember well how he pushed them to focus on the core innovative ideas in a project, while being eclectic and ready to learn in terms of the tools to use. This is visible in the wide variety of approaches and styles of Caballero's former students in all areas of macro, macro-labour, macro-finance and international finance.

Caballero's passion for going for the ideas is reflected in his almost obsessive attention to finding the right words to describe a mechanism. Everyone who has worked and studied with him has at some point encountered a bit of linguistic extravagance, like a theorem with the title "elastification/rigidification" (Caballero and Hammour 1998a). In the 1996 "Creative Destruction" article with Hammour, he went as far as trying to introduce the term "hyperkinesis", as the opposite of "sclerosis". Although this word somehow has not been picked up by the profession, it is a good way to describe the mind at work of the trailblazing economist who is the subject of this chapter.

References

Main Works by Ricardo J. Caballero

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