My research focuses on two related themes: asymmetric information and liquidity.

One strand of my work explores models of trade with informed sellers and heterogeneously informed buyers. I propose a new notion of competitive equilibrium suitable for these environments and, across a series of papers, apply it to study theoretical and empirical questions about financial, housing and labor markets.

Another line of work addresses questions related to liquidity, from several different angles. Building on my work on asymmetric information, I study the informational microfoundations of asset liquidity and how it responds to and amplifies macroeconomic shocks. I also examine the risk-sharing implications of fluctuations in the price of liquidity services.

**Beyond Pure Information Asymmetry**

In this line of research I analyze economies where the information pattern lies between the polar cases of common information and pure information asymmetry, which have been studied extensively. Sellers have private information but buyers, rather than being purely uninformed, observe imperfect, heterogeneous signals about each of the objects on sale. For instance, buyers of used cars may have heterogeneous ability to detect lemons. This information pattern has rich implications that don’t arise in either of the polar cases.

The theoretical foundations are in my paper *Asset Markets with Heterogeneous Information* (*Econometrica*, 2016). The first task is to define a competitive equilibrium. In my equilibrium concept, each price defines a separate market, any asset may be traded in any market, and markets need not clear, a construct that has been used in the previous literature. I add to it by enriching buyers’ decisions, specifying how they act on their information. I assume that buyers can be selective about what assets they buy in a given market, to the extent that their own information allows them to tell them apart. This introduces an additional complication: the order in which buyers’ trades are executed affects the allocation since each buyer skews the sample from which subsequent buyers select assets. Which of the possible allocations should one expect? I solve this by postulating that the set of markets consists of all possible combinations of a price and a rule for ordering trades. Thus the sequence in which trades are executed becomes an endogenous equilibrium object (in the sense that which markets are active is endogenous), along with prices and the allocation. I then show examples where the equilibrium can be characterized quite simply. The model can shed light on fire sales, cross-market contagion and flights to quality, none of which would emerge if buyers were equally uninformed. In particular, fire sales are a challenge for models based on asymmetric information, since in most models an increase in forced sales improves the pool of assets on sale and leads to higher, not lower, prices. With heterogeneously informed buyers, there is a countervailing force along the extensive margin: in order to absorb increased volume, the marginal buyer shifts to a less informed trader, who is rationally aware of his relative inability to distinguish assets, and requires lower prices as compensation.

In this framework there is a natural measure of expertise: the accuracy of a buyer’s information. In a related project, *The Social Value of Financial Expertise* I calculate the ratio of social to private return to acquisition of expertise. Expertise has social value because more informed buyers make assets more liquid, i.e. allow a larger fraction of the gains from trade to be realized,
and has a private value because it allows a buyer to obtain a better selection of assets. These values are not necessarily aligned. Under the assumption that marginal costs are equated to private marginal returns, the ratio of social to private marginal value also measures the social marginal benefit/cost ratio. A number greater than one indicates that society underinvests in expertise, and vice-versa. I show that the ratio can be decomposed into measurable sufficient statistics, which I then measure using data on junk bond underwriting and venture capital. In both cases I find the ratio to be less than one, which implies that at the margin investments in financial expertise destroy net surplus.

The models described above all assume a single-dimensional contract space: outright sales at some price. When contracts include an additional dimension, such as education in labor markets, it can be used to signal quality. In the paper Signaling to Experts (joint with Florian Scheuer) we ask what happens to education signaling when firms have heterogeneous ability to assess workers’ skill. We first extend the definition of competitive equilibrium to this environment, introducing a refinement that jointly restricts workers’ beliefs about their chances of finding jobs and firms’ beliefs about the distribution of workers they would encounter in inactive markets. We find that there is a class of equilibria where some high ability workers choose not to obtain education and are recruited by firms with sufficiently accurate signals to identify them. Workers’ education decisions and firms’ recruiting decisions are strategic complements, and there can by multiple equilibria. Furthermore, the market can create either insufficient or excessive incentives for firms to acquire expertise in worker evaluation.

Another setting where it is natural to believe that there are investors with different quality of information is the housing market, where information about house quality and neighborhood features can differ among both buyers and sellers. In Testing for Information Asymmetry in Real Estate Markets (Review of Financial Studies, 2015, joint with Johannes Stroebel) we derive predictions of such a framework for the dynamics of real estate prices. We show that the composition of sellers in a neighborhood should predict subsequent appreciation, but less strongly for more informed buyers. We then test this prediction using transaction-level data from Los Angeles in 1994-2011 and find strong empirical support.

**Liquidity**

Liquidity is an elusive concept, plagued by challenges of both definition and measurement. Yet the periodic turbulence in financial markets makes it clear that understanding it is of vital importance. Across a series of projects, I examine several questions related to liquidity.

In Liquidity as Social Expertise (Journal of Finance, forthcoming) I build a theory of liquidity dynamics based on information dynamics. I start by defining liquidity as the percentage of the potential gains from trade that are realized in equilibrium. I then write down a simple model of trading where information asymmetry leads to illiquidity and ask how liquidity should be expected to evolve over time and in response to shocks. The key assumption is that publicly available information (for instance, a firm’s financial statements) could in principle be used to alleviate information asymmetry and improve liquidity. However, for this information to be useful, agents need to know the mapping between information and probabilities over outcomes. In a world with noise, learning this mapping can take time. The model predicts that liquidity within an asset class tends to increase over time but illiquidity can be self-perpetuating, that liquidity falls in response to unexpected events that lead agents to question their valuation models, may be slow to recover after a crisis and is higher in periods of stability.
In 

**Lemons Markets and the Transmission of Aggregate Shocks** *(American Economic Review, 2013)*, I look at a dynamic general equilibrium model where trading real assets can partially make up for limited enforceability of borrowing contracts. I show that if there is asymmetric information about the quality of those assets they will be partially illiquid, in the sense that potential gains from trade will go unrealized. I show that information-based illiquidity is formally equivalent to a tax on asset transactions, and ask how the implicit tax rate responds to shocks. For standard macroeconomic shocks, the degree of illiquidity will respond in a way that amplifies the effect of the shocks on investment and output.

For reasons that may in part have to with information, some assets such as bank deposits are highly liquid, and therefore useful for facilitating transactions. The spread between market interest rates and interest rates on deposits is the price of the liquidity service that deposits provide. In the working paper *Why are Banks Exposed to Monetary Policy?* (joint with Sebastian Di Tella) we study the implications of fluctuations in deposit spreads for bank risk management. We first document a strong correlation between deposit spreads and market interest rates. We then build a general equilibrium model where this pattern arises because liquidity services are valued and currency and deposits are close substitutes. We assume there are complete markets for interest rate risk and ask what exposure banks choose to take. If risk aversion is higher than one, banks’ optimal dynamic hedging strategy is to take losses when interest rates rise, because higher future deposit spreads will make up for it, and vice versa. This risk exposure can be achieved by a traditional maturity-mismatched balance sheet. We show that the magnitude of the maturity mismatch implied by the model quantitatively matches the average level, time series pattern, and cross-sectional pattern of banks’ maturity mismatch. We conclude that banks’ exposure to interest rate risk is a symptom of hedging rather than risk-taking.

**Other projects**

Search frictions are believed to be important in labor, housing, securities and other markets. An ongoing project, entitled *Job Interviews in General Equilibrium* (joint with Sebastian Di Tella) builds an information-based theory of search frictions. The idea is that the gains from trade from a match between a buyer and a seller are not immediately known, and acquiring information about them can take time, leading to delays in trade. We show that under a form of competitive search equilibrium, allocations (including trading delays) are efficient. Under Nash bargaining, with no commitment to an interview protocol, generically they are not.

In *Optimal Stopping in a Model of Speculative Attacks* *(Review of Economic Dynamics, 2015)*, I examine the informational underpinnings of speculative attacks. I ask under what conditions on the underlying environment will the sufferer of a speculative attack find it optimal to try to withstand the attack at first but give up after some time. This response is optimal if the hazard function of the size of the attack (which is endogenous) is sufficiently downward sloping. This will be the case if the payoffs of speculators are highly uncertain but not very heterogeneous.

In *Should we Regulate Financial Information?* *(Journal of Economic Theory, 2015*, joint with Laura Veldkamp) we ask under what conditions does mandatory disclosure of financial information benefit investors. We show that investors benefit from mandatory disclosure only when information is cheap to obtain by other means. The reason is that when information is cheap most investors will acquire it so an uninformed investor will be at an informational disadvantage. In other words, mandatory disclosure is desirable if it prevents severe informational asymmetry. Otherwise, investors are hurt by mandatory disclosure.

**Teaching**
In my time Stanford I have taught four different courses.

ECON 212 (the third quarter of the first year graduate macroeconomics sequence). Depending on the year, the topics of this course were consumption-savings problems, general equilibrium with incomplete markets, dynamic contracting, search, financial constraints and optimal taxation.

ECON 210 (the first part of the first year graduate macroeconomics sequence). This course was focused on dynamic optimization with applications, plus an introduction to competitive equilibrium, the neoclassical growth model and overlapping generations models.

ECON 235 (a second year graduate topics course). Each time I taught it I included somewhat different topics, but the focus was mostly on models of financial market imperfections and their macroeconomic applications.

ECON 52 (intermediate undergraduate macroeconomics) I designed a somewhat new syllabus for this course. I present macroeconomics in what I think is a modern microfounded way. I start by discussing the Solow growth model. Then I discuss intertemporal choice, labor-leisure choice and how wages and interest rates clear markets in general equilibrium, and talk about the first welfare theorem and its implications. After that, I simplify to a two-period version and add shocks, which lets me discuss the main ingredients of real business cycle theory. Finally, I introduce money, imperfect competition and sticky prices to derive a simplified New Keynesian model and discuss monetary and fiscal policy in that context.

Textbook

I have written a first draft of a textbook with the ECON 52 course materials. It aims to bring the ideas and way of thinking of modern macro to students in a unified way that is accessible with a moderate amount of maths. I am working with a publisher to get it ready to bring to market.

Advising

I have advised 9 Ph.D. students: Alina Arefeva, Juliane Begenau, Andrés Drenik, Kareem Elnahal, Egemen Eren, Guzmán González-Torres Fernández, Diego Pérez, Juliana Salomao and Rui Xu.