

**RESEARCH NARRATIVE**  
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My research centers on the causes and consequences of macroeconomic fluctuations. In addressing these issues, I have worked on a variety of general equilibrium models with market imperfections, focusing especially on matching models of the labor market, and buffer-stock models of consumption and saving under imperfect insurance. But I have also been led further afield, to study bilateral bargaining games, unemployment insurance, numerical methods, and strategic complementarities.

**1. Unemployment insurance in general equilibrium.**

As a graduate student, I considered working on the business cycle dynamics of economies with imperfectly insured risk. But at that time papers like Krusell and Smith (1998) on computing distributional dynamics were only beginning to circulate as working papers. Thus my dissertation studied the costs and benefits of unemployment insurance, which is a technically simpler question since it can be addressed in steady state.

The main paper resulting from my dissertation is "**Unemployment insurance with endogenous search intensity and precautionary saving**", UPF Economics Working Paper #243, 11/97. This paper studies a general equilibrium job matching model in which unemployment risk is assumed to be privately uninsurable. Finitely-lived workers with constant relative risk aversion smooth consumption over time by accumulating assets, choose search effort when unemployed, and suffer disutility from work. Firms hire workers, purchase capital, and pay taxes to finance worker benefits; their equity is the asset accumulated by workers. A matching function relates unemployment, search effort, and hiring expenditure to the formation of jobs.

The model is calibrated to US data. The parameters relating job search effort to the probability of job finding are chosen to match microeconomic studies of unemployment spells. Risk aversion and impatience parameters are chosen so that the aggregate US capital stock is held by the population of workers. With these parameters, the numerical analysis shows that the consumption smoothing benefits of a public unemployment insurance (UI) program are small. Even without UI, workers can self-insure effectively through asset accumulation. Under some parameterizations, I find that varying the UI replacement ratio leads to fairly large welfare gains or losses. However, most of this welfare impact has nothing to do with consumption smoothing effects. Job matching models can yield an unemployment rate that is either inefficiently high, or inefficiently low, depending on parameters; I find that most of the gains or losses from changing the UI benefit are attributable to moving the unemployment rate towards or away from its optimal level, not from insurance *per se*.

Two additional papers resulted from my dissertation. "**General equilibrium unemployment insurance: the exponential utility case**", 11/95, shares most of the structure of my main dissertation paper, but assumes that workers have exponential utility and exogenous search effort. This allows the full distribution of assets and consumption to be characterized analytically. "**On the quantitative importance of wage bargaining models**", UPF Economics Working Paper #262, 1/98, shows that apparently small changes in the bilateral bargaining game determining wages have large effects on unemployment and hence on the optimal level of unemployment insurance benefits.

## 2. Portfolio choice as a propagation mechanism.

My next paper, "**A simple model of multiple equilibria based on risk**", UPF Economics Working Paper #407, 7/99, shows that an economy with uninsured unemployment risk may exhibit a strong business cycle propagation mechanism if there are multiple assets available. In this model, jobs are formed through a decreasing-returns-to-scale matching function. Individuals choose between two ways of saving: riskless storage, or founding a small business. This second option may be risky, but it implies a positive externality: it creates jobs, through the matching function.

These ingredients imply a strategic complementarity, which is of an unusual type because it results from uninsured risk, not from increasing returns. If both unemployment and business formation are imperfectly insured, then an increase in the unemployment rate makes individuals less willing to take risks (assuming constant relative risk aversion utility). Therefore, they shift out of the riskless asset (business formation) and into the riskless storage technology, further increasing unemployment.

I show that equilibrium is unique if there is full insurance of unemployment risk or full diversification of business risk. However, I construct examples in which there exist multiple Pareto-ranked equilibria if both risks are imperfectly insured. Since the strategic complementarity is sufficient for multiplicity, this propagation mechanism can also, for some parameters, have a large amplifying effect on exogenous shocks. Thus, improving insurance may be especially beneficial in this context since it could prevent multiplicity, stabilize output, and raise output by promoting risky investment. However, this depends on parameters, because the relationship between the degree of imperfection of insurance markets and the volatility of output is ambiguous in general.

To avoid calculating time-varying asset distributions, my paper on portfolio choice was based on a two-period model. But serious quantitative analysis of the propagation mechanism requires a truly dynamic version of the model, which Michael Reiter (UPF) and I tried to solve in "**Computing business cycles with endogenous risk**", 11/00. We used a parameterized expectations approach, and found that the dynamics were sufficiently volatile that more than ten statistics of the asset distribution entered significantly into the expectations functions. However, we never managed to find an accurate representation of the equilibrium, so we have stopped attempting to simulate this model.

## 3. Are self-fulfilling prophecies plausible in practice?

Models in which strategic complementarities can lead to multiple outcomes have been criticized recently on grounds of nonrobustness when agents are heterogeneous. Partly in order to defend my previous work, three of my latest papers have addressed this robustness issue. I find that none of the recent critiques seem important in practice: as long as there exist sufficiently strong strategic complementarities, multiplicity of outcomes for given aggregate fundamentals is quantitatively and empirically plausible.

One of the recent robustness critiques is that of Herrendorf, Valentinyi, and Waldmann (2000), who study a game with strategic complementarities, symmetric information, and binary choice. Their game has multiple equilibria if agents are identical, but they show that as players' utility functions become more and more heterogeneous, the equilibrium becomes unique. In "**On payoff heterogeneity in games with strategic complementarities**" (2004), *Oxford Economic Papers* 56 (4), Antonio Ciccone (UPF) and I show that the result of Herrendorf *et. al.* relies on making players so different that almost all of them are completely unreactive to others' choices. That is, by making agents very heterogeneous in a context of binary choice between 0 and 1, uniqueness obtains because most agents either prefer 0 regardless of the choices

of the others, or 1 regardless of the choices of the others. But in other words, this means that strategic complementarities have been eliminated. Moreover, their result is mainly relevant for binary choice, because examples of multiplicity are especially easy to construct, but fragile, in binary choice models. Thus, the argument of Herrendorf *et. al.* is correct, but it is not very general, and it appears to require extreme parameterizations.

On first sight, the "global games" argument of Carlsson and van Damme (1993) and Morris and Shin (1998) appears much stronger. These authors criticized simultaneous-move, symmetric-information models with multiple equilibria, claiming that the introduction of an infinitesimal amount of asymmetric information ensures uniqueness. However, in "**A herding perspective on global games and multiplicity**", UC3M Economics Working Paper 03-29 (08), 5/03, I show that the "global games" robustness critique is itself not robust, because it relies crucially on simultaneous choice. If we generalize the game by assuming that players move at slightly different times, so that they can observe a few others' choices before making their own decisions, then multiplicity of outcomes (*not* multiplicity of equilibrium) is restored. That is, for some values of macroeconomic fundamentals, more than one value of the endogenous macroeconomic variables may occur. My paper explores the relative importance of strategic complementarities versus information revelation incentives in generating multiplicity, and also the role of the expected number of observations.

I am currently finishing up a new paper on this topic, "**Multiple outcomes of speculative behavior in theory and in the laboratory**", 11/04, joint with Frank Heinemann (Munich) and Peter Ockenfels (Frankfurt). We study a sequential-choice version of the currency crisis model of Morris and Shin (1998), who claimed that the fraction of players attacking the currency is uniquely determined by the exogenous aggregate fundamentals. In our experiment, eight to sixteen players decide whether or not to attack the currency, after observing a noisy signal about fundamentals, and also, in some sessions, a sample of preceding decisions. We find a unique mapping between fundamentals and the fraction of players attacking in sessions where previous actions are unobserved, but when most previous actions are observed, there is an intermediate interval of fundamentals where anything can happen. More precisely, we estimate the width of the interval of fundamentals in which all players attacking, and no players attacking, both occur with at least 1% probability. This interval is always empty if previous actions are unobserved. When the fraction of previous actions observed is 0.75 or 1, the point estimate of this interval is always nonempty, and its width is usually significantly different from zero.

We interpret our results as evidence that Obstfeld's (1996) viewpoint, where multiple outcomes may occur in some states, better describes speculative attacks than does the model of Morris and Shin. Numerically and experimentally, a small average number of observations of previous actions suffices to generate an interval of multiple outcomes, so conclusions that rely on exact simultaneity should not be taken seriously. Moreover, while it could be argued that Obstfeld's model does not provide well-defined predictions, since it is based on multiplicity of equilibrium, our model is not subject to this critique, since we generate multiple outcomes within a single equilibrium. The comparative statics of our model are well-defined and intuitive: attacks are more likely when the aggregate state is worse. The distribution of outcomes observed in our experiments matches the quantitative predictions of our model quite closely, although middle interval shows greater bimodality in our theory than in our experiment.

#### 4. Business cycles in matching economies

Michael Reiter (UPF) and I are continuing work on general equilibrium matching models, because we believe these are important tools for studying social insurance policies and macro stabilization policies. For quantitatively meaningful results, we need a specification consistent with observed aggregate fluctuations, and also consistent with the observed effects of social insurance.

In "**Business cycles, unemployment insurance, and the calibration of matching models**", CESifo Working Paper #1008, 08/03, we find that it is difficult to make a real business cycle model with a matching function fit the labor market data. In order to generate cyclical fluctuations of unemployment as large as those observed in the data, firms' hiring expenditure must also vary strongly, which will occur only if the expected surplus associated with hiring also fluctuates a lot. The obvious way to obtain this is to make the match surplus small on average, so that it is a highly leveraged function of the marginal product of labor and thus procyclically volatile. However, this also makes the unemployment rate vary far more in response to unemployment benefits than is observed in cross-country studies.

We show analytically that the standard version of the model cannot generate unemployment behavior that is simultaneously consistent with cyclical fluctuations and with the observed effects of UI. Numerically, we show that this result is robust. However, we also find two specifications that resolve the problem. A version of the model in which wages are sticky (both in ongoing and in new matches) matches the data (Shimer 2004 and Hall 2003 make similar points), but we offer no justification for this wage stickiness. Alternatively, assuming that technological progress is embodied in new matches, instead of being disembodied as real business cycle models usually assume, also suffices to resolve our puzzle, because embodied technological progress makes the expected surplus associated with hiring fluctuate more.

Now that we have a version of the matching model that fits data well, Michael Reiter and I are using it to study the welfare cost of business cycles and optimal fiscal policy in "**Stabilization versus insurance: welfare effects of procyclical taxation under incomplete markets**", 11/04. Lucas (1987, 2003) has long argued that business cycles are not costly in representative agent economies, but he also emphasizes that this need not be true in economies with imperfect insurance of individual risks. Krusell and Smith (1999) studied the same question in an economy with imperfect insurance, but since their paper treats "unemployment" as an exogenous shock, their model says nothing about one of the most relevant quantitative issues: how idiosyncratic risk changes when business cycles are smoothed. Our model is an RBC economy with job matching, wage bargaining, and precautionary saving to protect against unemployment risk, which is assumed privately uninsurable. The government provides unemployment insurance, financed by taxes on the employed. By varying taxes or UI benefits, it can also smooth or amplify business cycles.

If cycles are magically "switched off" in our economy, welfare increases by 0.23% of average consumption. Part of the gain comes because the probability of experiencing an unemployment spell long enough to run out of savings is lower in an economy with constant unemployment than in an economy where the unemployment rate has the same mean but varies over time. Welfare also increases because business cycles make wages quite volatile, which feeds into workers' consumption. Running a deficit of 4% of output during recessions, thus making taxes strongly procyclical, also eliminates most aggregate fluctuation, and achieves a welfare gain of 0.19% of average consumption. Further gains are achieved by lowering the average level of UI, and making taxes even more procyclical. Thus, even in a flexible-price economy driven by

productivity shocks, the existence of incomplete markets for individual risks means that optimal fiscal policy involves strong stabilization of the cycle.

## 5. Ongoing research

It is frustrating that so much of our knowledge about precautionary saving comes from numerical models, where it is hard to draw general conclusions and to judge accuracy. Thus I believe it is important to have as many approaches to studying these problems as possible. In "**A perturbation analysis of the buffer-stock saving model**", I analyze a continuous-time buffer-stock model using perturbation methods. To be precise, the method I use is not a higher-order Taylor expansion around a single steady-state point, but instead an expansion around the value and policy functions associated with the entire steady-state asset distribution. I show that the unknown functions representing the first- and higher-order terms in the expansion are all described by first-order, linear ODEs, and that there exists a simple recursive relation between each term and the next. The approximation procedure offers both an alternative numerical method and analytical insights into the form of the solution. This method may be especially useful in contexts where otherwise simple models appear analytically intractable because of risk and heterogeneity.

I am currently continuing work on cyclical labor market fluctuations, together with Marcel Jansen (UC3M), in "**Employment fluctuations with downward wage rigidity**". While recent work has emphasized that wage rigidity may help generate the unemployment variation generated in the data (Shimer 2004), this rigidity has thus far been imposed in a rather *ad hoc* way. Therefore we study how the dynamics of Mortensen and Pissarides' (1994) model of job creation and job destruction are altered if a moral hazard problem like that of Shapiro and Stiglitz (1984) causes downward wage rigidity. While some authors (such as Ramey and Watson 1997, whose model is not fully dynamic) have claimed that incentive problems could enhance unemployment variation through bursts of job destruction, we find that workers who know they would be fired in recessions are difficult to motivate and are therefore unlikely to be hired in the first place. On the other hand, the no-shirking condition makes the firm's share of surplus procyclical (especially if it is binding only in recessions), which can amplify fluctuations in job creation.

Recent empirical work has offered conflicting evidence on the role of technology shocks in business cycles. Galí (1999) runs a VAR in productivity and labor, and finds that technological innovations drive labor down, and have little to do with the cycle. On the other hand, Beaudry and Portier (2003) estimate a VAR in productivity and stock prices, and find that technology shocks (while unrelated to current productivity) are an important driving force for cycles. Both results are inconsistent with the standard RBC model, but they also seem inconsistent with each other. In an ongoing project, tentatively called "**Productivity shocks and the business cycle: reconciling recent VAR evidence**", Beatriz de Blas Pérez and I study VARs containing all three variables, asking which identification strategies lead to results like those of Galí, and which generate results like those of Beaudry and Portier.

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