

A Five Page Summary:  
Research, Teaching, and Advising

Fourth Year Review

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# Research

My research focuses on business cycles and the macroeconomic implications of micro-product level data. In both areas, I combine new data and quantitative theories to tackle long-standing macroeconomic questions. My business cycle research can be divided into four categories. The first centers on the role of demographic factors in business cycle analysis, and specifically on the interaction between a country's labor force age composition and its business cycle volatility. My second line of business cycle research examines the empirical and theoretical plausibility of signals about future economic fundamentals functioning as important drivers of business cycles. A different, but related, part of my research agenda focuses on the role of uncertainty factors in business cycle dynamics and their implication for government policy during recessions. Finally, my early work studied the implications of firm dynamics for the measurement of different business cycle statistics. My second main area of research encompasses two classes of projects. First, I use micro data to test for and develop new pricing theories and relate them to the question of the effectiveness of monetary policy. Second, I exploit this data to shed light on different international fields of research such as the dynamics of the real-exchange-rate (RERs) and of large devaluations.

## Business Cycle Research

**Demographics and Macroeconomics:** My work with Siu<sup>1</sup> focuses on the empirical interaction between a country's labor force age composition and its business cycle volatility. We begin by documenting significant differences in the responsiveness of labor market activity to the business cycle for individuals of different ages in all the G7 countries. We show that in all these countries the young (e.g., 20-29 year olds) experience much greater volatility of employment and hours worked than the prime-aged (e.g., 40-49 year olds) over the business cycle. As a result, although the below 30s comprise only a third of aggregate employment, they account for more than half of its volatility. That these economies differ greatly in terms of industry composition and the degree of labour market regulation makes this finding all the more striking and suggests that the age composition of the labor force is potentially a key determinant of the responsiveness of an economy to business cycle shocks.

During the postwar era, these countries experienced dramatic demographic change, although details regarding timing and nature differ from place to place. Using panel-data methods, we exploit this variation to identify the effect of workforce age composition on business cycle volatility and show that the effect is large and statistically significant. In particular, periods featuring a larger proportion of young workforce are associated with periods of greater business cycle volatility. As workforce composition is largely determined by fertility decisions made at least 15 years prior to current volatility, we are able to obtain unbiased inference on the causal effect. The final contribution relates these findings to the changes in macroeconomic volatility experienced in the US over time, where we find that demographic change accounts for approximately one-fifth to one-third of these changes. Clearly, demographic change is not the sole factor responsible for volatility changes; nevertheless, demographic change serves as a common factor relevant for understanding the evolution of business cycle volatility — not only in the US, but also in other G7 countries.

These results indicate that the demographic composition of an economy's workforce constitutes a potentially important propagation mechanism in business cycle analysis. As such, there are strong returns to a theoretical understanding for why differences in cyclical volatility of market work exist across age groups. In my work with Pruitt and Siu,<sup>2</sup> we address this issue and show that understanding the mechanism underlying this observation, while interesting in its own right, has the potential to help solve a long standing puzzle in the business cycle literature: why aggregate hours are nearly as volatile as output.

Broadly speaking, differences in the volatility of employment across age groups arise from differences associated with labor supply, labor demand, or both. We suggest that the joint behavior of age-specific hours and wages over the cycle can help in this identification. Our finding that young individuals in the US not only experience greater hours volatility, but also greater wage volatility than prime-aged individuals, suggests a role for differences in cyclical labor demand. To articulate this view, we consider a model characterized by labor

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<sup>1</sup>Jaimovich, Nir, and Henry E. Siu. 2009. "The Young, the Old, and the Restless: Demographics and Business Cycle Volatility." *American Economic Review*, 99(3): 804–26.

<sup>2</sup>Jaimovich, Nir, Seth Pruitt, and Henry E. Siu. 2009. "The Demand for Youth: Implications for the Hours Volatility Puzzle." Submitted to the *Review of Economic Studies*.

demand differences due to capital-experience complementarity in production. More generally, we view our theoretical mechanism as reflecting the existence of complementarity in production between experienced labor and factors that are hard to adjust in the short-run (such as organizational capital or operational knowledge) and that inherently require experienced labor. It is then natural that young or inexperienced labor, who are less tied to these factors, experience greater cyclical fluctuations. We estimate the key structural parameters from the model's factor demand equations, exploiting the relationship between aggregate prices and quantities in the data. We then show that the model accounts for the joint behavior of age-specific hours and relative wages and, as a result, the aggregate volatility of hours.

**News and Macroeconomics:** Business cycle data features two important forms of comovement. The first is aggregate comovement: major macroeconomic aggregates tend to rise and fall together. The second is sectorial comovement: different economic sectors tend to rise and fall together in. It is surprisingly difficult to generate both types of comovement in business cycle models. In my work with Rebelo<sup>3</sup> we solve this enduring challenge and propose a unified model that generates both types of comovement in response to various types of shocks. In this summary I will concentrate on aggregate comovement and relate it to the response of the economy to *news (signals)* about future fundamentals. Aggregate comovement is usually obtained in one-sector growth models *only* in the presence of *contemporaneous* shocks to TFP. In contrast, early business cycle literature emphasized news shocks as important drivers of business cycles. News shocks change agents' expectations about the future, affecting their current economic decisions. Recent years have seen a revival of interest in this idea, motivated by the US investment boom of the late 1990s and the subsequent economic slowdown. However, assuming that agents' information sets include signals about future fundamentals generally implies that good (bad) news about tomorrow generates a recession (expansion) today! The main reason for this is that good news about the future make agents wealthier, inducing them to increase their consumption and leisure. Since fundamentals only change in the future, output and investment immediately fall.

We introduce different elements that together generate the types of comovement mentioned above, especially in response to news shocks. The key theoretical result is the derivation of a new *general* class of preferences that nest as special cases the two classes of utility functions most widely used in the business cycle literature. With these preferences we parameterize the strength of the short-run wealth effect on the labor supply while remaining consistent with a balanced growth path. We simulate a version of our model that exhibits no technological regress (a good empirical approximation for investment-specific technology), where we discipline the modelling of the signals by requiring them to be consistent with the forecasting accuracy in the survey of professional forecasts. We show that the model generates business cycle moments which are similar to those in postwar US data and account for the salient features of US recessions. On average, recessions are driven not by a "bad shocks" today but by lackluster news about future technological change.

We then extend this analysis<sup>4</sup> to study "sudden stops" (shocks to open economies that increase the cost of rolling over their foreign debt). These shocks have been empirically associated with falls in economic activity, but usually in models generate booms in output due to the shock's negative wealth effect. We show that our model generates a recession both when sudden stops are anticipated and unanticipated.

As our model incorporates realistic signals about future fundamentals, we ask<sup>5</sup> whether behavioral biases associated with these signals are important for business cycle theories. We study two biases emphasized in the behavioral finance literature: overconfidence (overestimation of signals' precision) and optimism (expectations that are biased toward good outcomes). The former is found to amplify shocks as it generates overinvestment (underinvestment) in booms (recessions). However, deviations from rationality must be large in order to generate substantial volatility. Also, optimism is not found to be a significant source of volatility. We conclude that these biases can be sources of volatility but are not sufficient to produce a successful business cycles theory. Finally, with these new preferences I show<sup>6</sup> how the indeterminacy of one-sector growth models depends on

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<sup>3</sup>Jaimovich, Nir, and Sergio Rebelo. 2009. "Can News about the Future Drive the Business Cycle?" Forthcoming September 2009 in the *American Economic Review*.

<sup>4</sup>Jaimovich, Nir, and Sergio Rebelo. 2008. "News and Business Cycles in Open Economies." *Journal of Money Credit and Banking*, 40(8): 1699-1711.

<sup>5</sup>Jaimovich, Nir, and Sergio Rebelo. 2007. "Behavioral Theories of the Business Cycle." *Journal of the European Economic Association*, 5(2-3), 361-368.

<sup>6</sup>Jaimovich, Nir, 2007. "Income Effects and Indeterminacy in a Calibrated One-Sector Growth Model." *Journal of*

the magnitude of wealth effects on the demand for leisure. By allowing for varying degrees of wealth effects, I find that indeterminacy occurs for aggregate-returns-to-scale that are well within recent empirical estimates.

**Uncertainty and Macroeconomics:** What is the impact of economic uncertainty on fluctuations in the US economy? Key policy makers, such as Larry Summers, Christina Romer, and Ben Bernanke have all recently commented on the damaging impact of economic uncertainty. In my current work with Bloom and Floetotto,<sup>7</sup> we explore the role of uncertainty (second moment) shocks for business cycle analysis and government policy. We first study the empirical behavior of uncertainty, as measured by various proxies, over the business cycle and find strong empirical evidence that it is strongly counter-cyclical. We then quantify the impact of time-varying uncertainty on the economy by developing a DSGE model that features this variation (modelled as variation in the cross sectional establishment productivity), in addition to heterogeneous firms that face non-convex adjustment costs in capital and labor. We find that increases in uncertainty lead to large drops in economic activity and a fall in measured TFP due to a freeze in reallocation. This occurs because a rise in uncertainty generates an option value for firms, leading them to pause hiring and investment. We then use our model to study the effectiveness of government policies aimed at stimulating the economy during high uncertainty periods. We show that since uncertainty makes firms cautious, the response of the economy to a stimulative policy is significantly mitigated relative to the policy effects during low uncertainty periods.

This work extends in two directions. On the empirical side, we recently gained access to the US Census establishment data. This data is particularly suitable for the accurate measurement of uncertainty, since as a second moment concept, it requires large micro-samples. The data allows us to test various model predictions that can only be analyzed with detailed micro data. On the policy side, in a new project we focus on the impact of policy in times of high uncertainty. We begin by studying the effectiveness of a range of policies (such as a hiring tax credit) in the presence of uncertainty. We also expect this research to provide new "government multiplier" estimates. Finally, we intend to include nominal frictions which will allow us to study the effectiveness of monetary policy in the presence of uncertainty.

**Firm Dynamics and Macroeconomics:** The interaction between two empirical observations (*i*) procyclical variations in the number of competitors, and (*ii*) countercyclical markups negatively correlated with the number of competitors, motivated my interest in the implications of this interaction for business cycle analysis. In my work with Floetotto,<sup>8</sup> we formulate a DSGE model where shocks generate variations in profit opportunities that lead to changes in the number of competitors. These changes in turn lead to endogenous countercyclical markups. We use the model to derive a simple structural decomposition of variations in TFP into exogenous and those originating endogenously from the above interaction. We find that a significant fraction of the movements in measured TFP can be attributed to the impact of firm entry/exit decisions on markups. We also show that this mechanism provides a powerful magnification mechanism for shocks to agents' environments.

Motivated by the lack of a theory for the source of the countercyclicality of the price of investment goods, and the empirical contribution of the fluctuations in the price of investment goods to postwar US business cycles, we extend the above model<sup>9</sup> to show that a realistic process for *sector* specific endogenous countercyclical markups can account for some of the salient features of the price data. Finally, I show that the interaction between entry/exit and markup variations leads to indeterminacy in which economic fluctuations occur as a result of self-fulfilling shifts in the beliefs of rational forward looking agents.<sup>10</sup> When calibrated with empirically plausible parameters and driven solely by self fulfilling shocks to expectations, the model can quantitatively account for the main empirical regularities characterizing postwar US business cycles.

## Product-Level Pricing Data and Macroeconomics

**Micro Pricing and Macro Implications:** A central question in macroeconomics is to what extent

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*Economic Theory*, 143(1): 610-623.

<sup>7</sup>Bloom, Nicolas, Max Floetotto, and Nir Jaimovich 2009. "Really Uncertain Business Cycles." Draft completed.

<sup>8</sup>Jaimovich, Nir, and Max Floetotto 2008. "Firm Dynamics, Markup Variations and the Business Cycle." *Journal of Monetary Economics*, 55(7): 1238-1252.

<sup>9</sup>Floetotto, Max, Nir Jaimovich, and Seth Pruitt 2009. "Markup Variations and Endogenous Fluctuations in the Price of Investment Goods." Submitted to the *Journal of Economic Theory*.

<sup>10</sup>Jaimovich, Nir, 2007. "Firm Dynamics and Markup Variations: Implications for Multiple Equilibria and Endogenous Economic Fluctuations." *Journal of Economic Theory*, 137(1): 300-325.

monetary policy has a significant impact on the economy. The answer to this question is heavily grounded in the behavior of prices. If prices are flexible and they react instantaneously to the Federal Reserve's monetary policy, then such policy has no real effect on the economy. However, if prices are "rigid," then monetary policy has the potential to affect the aggregate economy.

Macroeconomists usually assume that price rigidities take the form of "sticky prices." From this perspective, assessing the importance of price rigidities requires an evaluation of how often prices change. In my work with Eichenbaum and Rebelo,<sup>11</sup> we use scanner data from a major US retailer containing information on prices, costs, and quantities to argue that price rigidities are important but that they do not only take the form of sticky prices. Instead, they take the form of inertia in reference prices, defined as the most common price within a given quarter. Reference prices have an average duration of roughly one year, even though weekly prices change roughly once every two weeks. The existence of reference prices and their importance (two-thirds of price observations correspond to reference prices, and half of the quantities and revenues are sold at reference prices) raises the possibility that price rigidities may be significant, even if prices change frequently. Our research also systematically explores the interaction between prices and costs in our study of the determinants of the reference price duration. We find that the retailer chooses the duration of reference prices so as to limit markup variation. We base this inference on several findings, the most important being the sharp evidence of state dependence in the probability of reference price changes.

Why should macroeconomists care about reference prices? One possibility is that macroeconomists can safely abstract from high-frequency movements in prices when analyzing the monetary transmission mechanism. To explore this issue, we develop a model which captures key features of the data, most importantly matching the duration of weekly and reference prices. We show that a monetary shock has a large effect on quantities and very little effect on prices even though prices change frequently. Taking our model as the DGP, we ask which frequency of price changes is more important to match (weekly or reference) when trying to approximate the real effects of monetary policy, within simpler standard menu-cost models. We first choose the menu cost to match the frequency of weekly price changes. In this instance, prices are flexible and the model misleadingly concludes that a monetary shock has very small real effects. We then choose the menu cost to match the frequency of reference price changes. In this case, prices are quite sticky and the model does a very good job of reproducing the real effects of a monetary shock. These results hint to the possibility that the frequency of reference price changes is more revealing about the underlying nature of nominal rigidities than the simple frequency with which prices change.

In a new project,<sup>12</sup> we examine a unique new data set from a large chain of convenience stores in the US that gives us access to (i) all costs and price changes, (ii) the firm's price managers' reports regarding the exact reason for the price changes (i.e., whether it is a reaction to a cost shock, demand shock, competition etc.), (iii) descriptions of items' characteristics, (iv) "consumer loyalty cards" information, (v) direct measures of the cost of changing prices ("menu costs") divided between the labor and tag cost, and (vi) information regarding "item linkage pricing." This data allows us to quantify and paint an accurate description of why firms change prices, test existing models' predictions about the frequency of price changes, and propose a model that is consistent with the key facts.

Finally, with Siu and Vincent<sup>13</sup> we build on the observation that firms often report that the main reason they keep prices stable is for fear of upsetting customers and on marketing literature showing that the variability of prices is a prime factor in customer choice. We first use the mentioned consumer loyalty data and test for "customer market" theories. We then build a model where rational consumers are loyal to firms as long as price changes are infrequent. Firms do not face menu costs and are free to change nominal prices but understand that their pricing decisions affect their customer base, and hence future profits. We characterize the nature of price rigidity and contrast the implications of our model to those of the menu cost literature.

**International Prices:** Why are RER so volatile over time? This question lies at the heart of discussions

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<sup>11</sup>Eichenbaum, Martin, Nir Jaimovich, and Sergio Rebelo 2009. "Reference Prices and Nominal Rigidities." *Revise and Resubmit American Economic Review*. Revision submitted.

<sup>12</sup>Anderson, Eric, Martin Eichenbaum, Nir Jaimovich, Sergio Rebelo, and Duncan Simester 2009. "Why do Firms Change Prices?" Work in progress.

<sup>13</sup>Jaimovich, Nir, Henry E. Siu, and Nicolas Vincent 2009. "Customer Base, Price Variability and Nominal Rigidities." Work in progress.

on optimal exchange rate policy. In my work with Burstein,<sup>14</sup> we document new facts on movements in RER and assess the role of pricing-to-market (PTM) by individual producers in accounting for these relative price movements. We then use this set of facts as a guide to design a model of trade and international prices. Our empirical work is based on scanner data from a major retailer that sells in multiple locations in Canada and the US. For each product/location, we observe a time-series of weekly wholesale prices. Our key empirical contribution is to measure the extent to which movements in relative prices of individual products across locations reflect PTM by producers. We can do so because of three unique features of our data. First, we match individual products sold in multiple locations in the two countries. Second, we observe wholesale prices (as opposed to retail prices, which include substantial distribution costs). Third, we identify the country of production (in each country) for these matched products. Without this information, one cannot distinguish to what extent movements in relative prices reflect the practice of PTM as opposed to movements in production or retail costs across locations. Our finding is that movements in product-level RER are pervasive even for traded products that are manufactured in a common location and sold in multiple locations, suggesting that producers and wholesalers in our data engage in substantial PTM which displays two patterns. First, product-level RER for the matched products are roughly four times as large as exchange rate movements. Second, PTM is more prevalent across regions in different countries than across regions within the same country.

In light of our empirical findings, we construct a simple model of international trade and PTM that rationalizes our facts. We provide an analytical characterization suggesting that the size of international trade costs is central to the model's success. These costs segment the markets and imply that if exporters are more likely to face the same competitor (with a common cost shock) within a country than across countries, then PTM is more prevalent across countries than within countries.

In new work,<sup>15</sup> we use a new data set covering the prices and quantities of all goods sold in all Argentinian supermarkets between 1996-2005. The data covers Argentina's 2001 great depression (characterized by soaring inflation and huge devaluation and output contraction). We are currently in the process of decomposing aggregate price movements into *(i)* continuing goods' inflation, *(ii)* continuing goods' composition effect, *(iii)* new goods' composition effect, *(iv)* exiting goods' composition effect, and *(v)* new goods' inflation effect. This decomposition is done for both domestic and foreign goods and is similarly used to decompose aggregate changes in quantities. The extremely detailed micro data offers an exceptional opportunity to study the dynamics of large devaluations, high inflationary periods, and huge output contractions.

## Teaching and Advising

I have taught Stanford undergraduate (52) and graduate (210 & 233) courses. At the graduate level, I introduce students to modern macroeconomic techniques and quantitative business cycle research. I have been the advisor for a few students and have coauthored three papers with Max Floetotto and one in progress with Max and Yaniv Levi. I have weekly meetings with them where we discuss their research, and I gave Max the opportunity to present our work in many high visibility conferences (such as the NBER Institute). I have also funded trips for them to academic conferences, as I believe this allows them to acquire valuable research and professional skills not easily gleaned from textbooks or in classrooms. Other students whom I meet with to discuss their research include Albert Bollard, Matthew Elliot, and Marcello Miccoli.

At the undergraduate level I am still working towards striking the right balance between intellectual rigor (given the high quality of our students) and accessibility so that my class is appealing for students across the broad spectrum of aptitude and interest. I received very positive evaluations the first time I taught the class, but I felt I was not challenging the students enough. The next time I taught the course, I probably erred too far in the opposite direction, and my reviews reflected a general sense that the class was too difficult. As mentioned, my plan going forward is to take a more balanced approach in the future. I have also advised several students, and four have done a directed reading class with me in which they applied the theoretical and empirical tools acquired during their studies.

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<sup>14</sup>Burstein, Ariel, and Nir Jaimovich. 2009. "Understanding Movements in Aggregate and Product-Level Real-Exchange Rates." Submitted to the *American Economic Review*.

<sup>15</sup>Burstein, Ariel, Nir Jaimovich, and Andres Neumeyer. 2009. "Argentina's Great Depression Through the Lens of Product-Level Data." Work in progress.