

# Research proposal

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My research agenda builds on my job market paper and examines the impact of technology adoption on the macroeconomy throughout history. I first describe my job market paper and then the research projects I plan to carry out at the NBER during the one-year fellowship.

My job market paper focuses on the labor market effects of the adoption of computers and electricity. Three long-term features of the labor market changed in recent decades: employment has shifted away from routine occupations, the growth rate of labor productivity increased, and the labor share of income declined. The acceleration in computer investment in recent decades led several authors to point to computers as a potential cause.<sup>1</sup> Two short-term features of the labor market also changed: the decline of employment in routine occupations accelerated in the last three recessions and the ensuing recoveries were jobless. The theoretical part of my job market paper clarifies the conditions for a simple neoclassical model to reconcile these five facts. The model assumes that computers substitute workers in routine occupations, such as clerks, and their price decreases with time. As computers become cheaper, firms replace routine jobs with computer capital, shift employment away from routine occupations, increase the growth rate of labor productivity, and decrease the labor share of income. With adjustment costs to hiring the model also matches the cyclical changes. Nonroutine jobs are expanding and a forward-looking firm knows that destroying these jobs in the recession will entail hiring costs in the recovery. So the firm avoids firing workers in nonroutine occupations, hoards them during the recession, shifts the burden of adjustment on routine occupations, and concentrates the secular decline in routine jobs during the recession. The model matches both the structural and the cyclical changes of the US labor market since the 1980s.

My job market paper also provides evidence for this explanation using electricity, another General Purpose Technology that became widespread in the first decades of the 20th century. Testing the model in the context of electricity has several advantages compared to computers: the price of electricity has regional variation depending on the source of power (water power or steam power); electricity is a homogeneous product; and we have measures on actual consumption.

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<sup>1</sup>See Autor, Levy and Murnane (2003) for the decline in routine jobs, Oliner, Sichel and Stiroh (2007) for the productivity speedup, and Karabarbounis and Neiman (2013) for the labor share of income.

In contrast, the price of computers is the same across regions; computers are a heterogeneous product requiring hedonic adjustments; and we only have information on initial investment. Furthermore, electrification occurred before offshoring was feasible, which helps distinguish the two hypotheses of technology adoption and international relocation of jobs. The paper uses a newly digitized plant-level dataset for the concrete industry from the Census of Manufactures between 1929 and 1935. Using the source of power as an instrument for shifts in the electricity supply curve, this paper finds that the decrease in the price of electricity caused a decrease in the labor share of income of the concrete industry, consistent with the predictions of the model.

The next research project after my job market paper consists of explaining “slow recoveries:” after the last three recessions the recovery of employment is slow and the recovery of output is also slow. Galí, Smets and Wouters (2011) estimate a structural model in Dynamic Stochastic General Equilibrium and find that slow recoveries were caused by “a dramatic change in the sign of demand shocks experienced during the recovery itself.” The theory in my job market paper takes the path of US GDP as given and matches the jobless recovery. This research project extends that theory to explain recent slow recoveries with heterogeneous households, a reallocation cost between routine and nonroutine jobs, and imperfect insurance between households. Recessions cause the destruction of routine jobs and these households become unemployed. During the period of retraining, they consume less. The recovery in consumption is slow and so is the recovery of output. Slow recoveries occur after recessions that coincide with the secular decline in routine jobs. In contrast, a recovery from a recession earlier in history lead firms to hire back workers in routine occupations, with a fast recovery of consumption and output.

I go further into the past and examine the correlation between the adoption of steam power and inequality using firm-level data. Davis and Stettler (1970) examine the textile industry in New England between 1825 and 1860 using business records in museums and libraries. They document a 4.4% yearly increase in labor productivity per year between 1856 and 1858, compared to a 0.8% yearly increase between 1846 and 1856. This statistic is consistent with a model of technological adoption of steam power and capital-labor substitution. The authors did not examine the correlation between inequality and equipment investment, which is the objective of this research project. The wage payments by occupation from the business records of firms permit an analysis of technology investment and inequality.

I will examine the correlation between computer adoption and labor productivity growth using the Annual Survey of Manufactures and regional variation in the business cycle. I will correlate the growth rate of labor productivity to long-term investment in computers. Then I will restrict the sample to non-traded industries and use regional variation in the recession of 2007, instrumented by the increase in property values in the 2000s (Mian and Sufi, 2009), to assess the causal effect of recessions in capital-labor substitution and productivity growth.

I will investigate a pattern in the US economy: corporate profits are a leading indicator of the business cycle but the stock market is not. Corporate profits start falling years before the recession but the stock market keeps increasing until the recession. I propose a model for this divergence between profits and the stock market based on Clay Christensen’s “Innovator’s Dilemma.” He suggested that new firms selling cheaper technologies compensate the low profit margins by selling to a larger customer base. As they erode the customer base of established firms, they disrupt their technologies and cause a fall in profits by a compositional effect. The stock market focuses on ratios, such as the high profit margin of the incumbent, and takes some time to adjust. When investors realize the low volume of sales by the incumbents, the fall in

the stock price leads to a decline in the wealth of households and to a recession in the wider economy.

My research agenda focuses on the consequences of technology adoption on the macroeconomy. It has an unusual combination of macroeconomic theory, economic history datasets, and applied microeconomics. Its implications for economic policy, such as educational policy in the transition from routine to nonroutine occupations or countercyclical policy depending on the stage of the disruption cycle, are sure to fit your search for the interactions between innovation and public policy.

## References

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