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The "Rajan Hypothesis": a counter-factual experiment

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The "Rajan Hypothesis": a counter-factual experiment

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Abstract

We integrate a centralized wage bargaining process into an otherwise standard DSGE model with a financial accelerator to simulate distributional shocks in the presence of financial instability. Our framework provides a counterfactual analysis of the effects of the observed decrease in the labor share when no concomitant rise in households' credit offsets the adverse effect on consumption. The result is a prolonged under-consumption recession that outweighs the initial boost in investment.

Keywords Income inequality; Distributional shocks; Under-consumption.

JEL classification codes E70; C63; E03; E52.

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1 Introduction

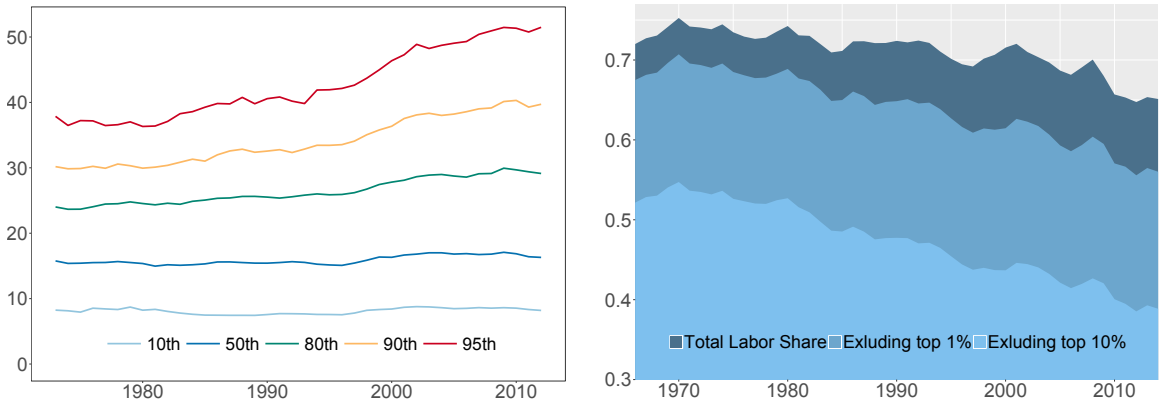
This paper analyzes the economic impact of a persistent distortion of the functional income distribution using a simple DSGE framework with financial frictions.

Income inequality has been increasing in all but the low-income countries over the last thirty years, especially at the very top of the distribution. This phenomenon appears to be multi-causal. Often due to competitive needs, the fall in unionization rate has entailed the workers' bargaining power, and contributed to a growing wage inequality (Jaumotte & Osorio-Buitron 2015). As clearly visible from Figure 1a, lower percentiles have remained completely flat, while only upper percentiles show a positive trend, particularly remarkable at the top. Furthermore, the advent of ICTs has given rise to a "skill-biased technological change" (Acemoglu et al. 2001) and a growing disconnect between the wages of high-skilled and low-skilled workers. Stiglitz et al. (2009) also underlines the role of "asymmetric globalization": because capital has become relatively easier to move across borders than labor, the threat of outsourcing production abroad has weakened the wage bargaining power of workers. The fall in top marginal tax rates and the rise in CEOs' wage compensations may also have contributed to the rise in top-income shares (Piketty et al. 2014).

Beyond mere ethical concerns, the growing concentration of income, together with increasing financialization, may have contributed to the 2007-08 financial crisis: easier access to financial instruments may reinforce the disconnect between the top-earners and the low-income households, who face a higher risk of unsustainable debt (Kus 2013). Rajan (2010) argues that the recourse to credit by bottom-earners has been encouraged by the US authorities as a palliative to the issue of stagnating wages. The interplay between growing income inequality, households' indebtedness and the risk of financial imbalances has further been discussed by, *inter alia*, Iacoviello (2008), Stiglitz et al. (2009) and Fitoussi & Saraceno (2010). Empirically, the rise in consumption inequality has been milder than the rise in income inequality and US households' debt ratio has roughly doubled over the past thirty years, which tend to back up the "Rajan hypothesis" (see, e.g., Krueger & Perri 2006).

This paper tests this hypothesis by replacing the Walrasian labor market in the seminal model of Bernanke et al. (1999) by a centralized wage bargaining procedure. Such a procedure stands for the institutional part of the wage setting process that undoubtedly plays a large role on the labor markets in developed and even emerging countries.

This change enables us to simulate an increase in income inequality triggered by a drop in workers' bargaining power, in an otherwise fully-fledged microfounded macroeconomic model with nominal rigidities and potential financial instability. In particular, we can tune



(a) Real Hourly Wages by Percentiles (2012 $)

(b) Labor Shares of National Income

Figure 1: Evidence of increasing income inequality in the US. Source: authors' computations based on data from wid.world and stateofworkingamerica.org.

the functional distribution of income (wages *versus* return on capital), which is a natural "catch-all" variable for capturing the complex structure of overall inequality. As clearly revealed by Figure 1b, labor shares have decreased, and excluding the top earners makes the downward trend steeper.

Our paper is mostly related to Kumhof et al. (2015) but, in that contribution, households facing decreasing wages attempt to maintain their consumption level by resorting to unsustainable debt in an otherwise frictionless economy. By contrast, in our model, credit only finances investment and we use a setup with nominal and financial frictions, as common in the macroeconomic literature. Therefore, our framework represents the right playground for a test of the "Rajan hypothesis" through a counterfactual experiment: what happens following a prolonged decrease in the wage share without credit "pumping-up" workers' consumption?

In line with the Rajan hypothesis, such a distributional shock generates a structural deficit in aggregate demand because the initial boom in investment is quickly offset by the negative effect on wages and employment. Our intuitive findings are at odds with the more common ones in Bernanke et al. (1999) because their competitive labor market abstracts from this negative effect. The model is presented in Section 2 and the simulation results are discussed in Section 3.

2 The Model

Entrepreneurs produce a wholesale goods using labor and capital, which is the only asset households can invest in. Wholesale goods are transformed into final goods under monopolistic competition with price stickiness. Entrepreneurs self-finance their investments or resort to the credit market at the cost of an external finance premium. The risk-free interest rate is set by the central bank. Lowercases represent percentage deviations of any variable (expressed in uppercases) from its steady state value (denoted by a star).

2.1 Wage Bargaining

Following Layard et al. (2005), we introduce a Nash bargaining process that determines the nominal wage W_t as follows:

$$\underset{W_t}{\text{Max}} \quad (W_t)^{\Sigma_t}(MPL_t - W_t)^{1-\Sigma_t}$$

where MPL_t is the marginal productivity of labor as specified in Bernanke et al. (1999) and Σ_t the time-varying households' bargaining power that follows an AR(1) process with a steady state value $\Sigma^* = 1$ as in Kumhof et al. (2015). The optimal labor demand corresponds to $W_t = \Sigma_t \cdot \text{MPL}_t$. Hence, shocks on the bargaining power create a discrepancy between the otherwise equal marginal productivity of households' labor and wage. Assuming a logarithmic utility function in consumption C and leisure $1 - H$, the households' optimal labor supply satisfies the standard first-order condition $W_t = \frac{C_t}{1-H_t}$. Equalizing the two and log-linearizing give the labor market equilibrium:

$$\sigma_t + mpl_t = h_t\eta^{-1} + c_t \tag{1}$$

where η is the Frisch labor supply elasticity. Importantly, a decrease in households' bargaining power can be interpreted as a downward shift of the labor demand curve, which results in lower wages and employment.

2.2 The rest of the model

The final goods are produced with capital k and households' labor h as follows:[1]

$$y_t = \alpha k_t + (1 - \alpha)\Omega h_t \tag{2}$$

[1]Entrepreneurs are assumed to supply inelastically one unit of labor.

where α is the capital share and Ω the households' share of labor income.

Investment is transformed into capital goods with increasing marginal adjustment costs. Hence, there is a positive relationship between investment ι and capital prices q given by $q_t = \varphi(\iota_t - k_t)$, with $\varphi > 0$ a parameter. Capital is predetermined and accumulates as $k_{t+1} = \delta\iota_t + (1-\delta)k_t$, where δ is the depreciation rate of capital.

Optimal investment depends on the expected external finance premium that evolves as follows:

$$E_t\{r^k_{t+1}\} - E_t\{r_{t+1}\} = -\upsilon[n_{t+1} - (q_t + k_{t+1})] \tag{3}$$

with $\upsilon > 0$ a parameter that equals zero in the limiting case of perfect credit markets and zero premium. The premium is negatively related to the stake of the entrepreneur in the project, which is measured by the net worth n with respect to the value of the project $q+k$. Aggregate net worth is also predetermined and accumulates through the net return on entrepreneurs' equity as: $n_{t+1} = n_t + \mu(r^k_t - r_t) + r_t$, with $\mu > 0$ a parameter that depends on the entrepreneurs' creditworthiness.

The centralized bargaining power now introduces a discrepancy between the marginal productivity of capital and its return, which we have to compute marginally by subtracting labor compensations from output. Assuming that entrepreneurs receive a competitive wage[2], one unit of capital is paid in $t+1$:

$$E_t\left\{\frac{\left[\frac{Y_{t+1}}{X_{t+1}} - (\Sigma_{t+1}\cdot MPL_{t+1})H_{t+1} - (1-\alpha)(1-\Omega)\frac{Y_{t+1}}{X_{t+1}}\right]}{K_{t+1}}\right\}$$
$$= E_t\left\{\frac{Y_{t+1}}{X_{t+1}K_{t+1}}\left[\Omega\Sigma_{t+1}(\alpha-1) + \alpha + \Omega - \alpha\Omega\right]\right\}$$

where $1/X$ is the relative price of the wholesale goods (normalized to one) in terms of the final goods. Replacing terms, the gross return on capital from t to $t+1$ is then given by:

$$E_t\{R^k_{t+1}\} = E_t\left\{\frac{\frac{Y_{t+1}}{X_{t+1}K_{t+1}}\left[\Omega\Sigma_{t+1}(\alpha-1) + \alpha + \Omega - \alpha\Omega\right] + Q_{t+1}(1-\delta)}{Q_t}\right\}$$

Notice that $\Sigma_t = 1$ gives the original specification of Bernanke et al. (1999).

Log-linearizing and rearranging terms gives:

$$mE_t\{\sigma_{t+1}\} = E_t\{x_{t+1}\} + k_{t+1} + E_t\{q_{t+1}\} - E_t\{y_{t+1}\} + bE_t\{r^k_{t+1} + q_t - q_{t+1}\} \tag{4}$$

[2]It would make little sense to let them bargain with themselves.

with $b \equiv \frac{R^{k*}}{R^{k*}-(1-\delta)}$, $m \equiv \frac{\Omega(\alpha-1)}{\alpha}$ and $Q^* \equiv 1$.

The rest of the model follows Bernanke et al. (1999), to which we refer for technical details. Households' consumption c reacts negatively to the real interest rate r following the usual Euler equation: $c_t = E_t\{c_{t+1}\} - r_{t+1}$, Entrepreneurs' consumption c^e simply varies proportionally with their net worth n: $c^e_t = n_{t+1}$.

Given the respective share of each component of aggregate demand in output and abstracting from fiscal policy, the aggregate resource constraint reads as: $y_t = \frac{C^*}{Y^*}c_t + \frac{I^*}{Y^*}\iota_t + \frac{C^{e*}}{Y^*}c^e_t$

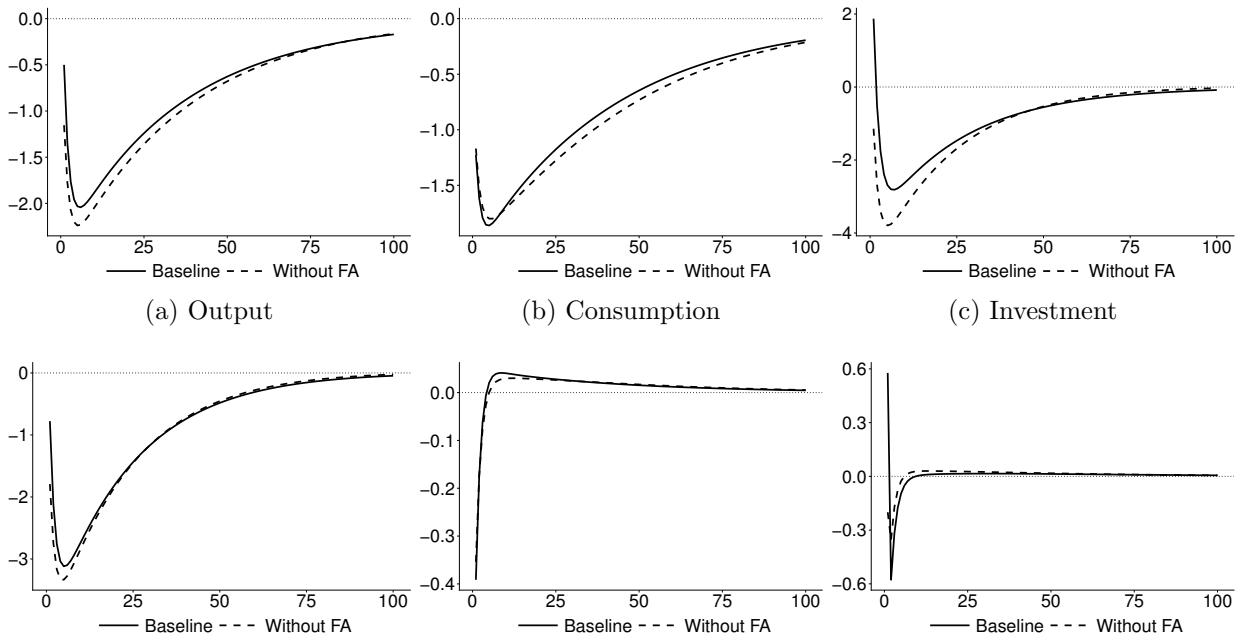
Price stickiness yields a downward-slopping Phillips curve $\pi_t = E_{t-1}\{-\kappa x_t + \beta\pi_{t+1}\}$, in which π_t is the inflation rate between $t-1$ and t, the mark-up x is inversely related to the state of the economy, β is the discount factor and $\kappa > 0$. Monetary policy sets the nominal interest rate as $i_t = \rho i_{t-1} + \varsigma\pi_{t-1}$, with $0 < \rho < 1$ and $\varsigma > 0$.

We trigger an increase in income inequality by a negative shock on σ, which represents a loss of wage bargaining power and a redistribution of income from households to entrepreneurs. The log-linearized law of motion of Σ corresponds to $\sigma_t = \rho_\sigma\sigma_{t-1} + \varepsilon^\sigma_t$, with $\varepsilon^\sigma \hookrightarrow nid(0, \varsigma_\sigma)$. We use the standard quarterly calibration of Bernanke et al. (1999). In particular, the households' labor share $(1-\alpha)(1-\Omega)$ is set to 0.64. Households' consumption share of GDP $\bar{C}/\bar{Y}$ is set to 0.76 and $\bar{C}^e/\bar{Y} = 0.02$ for the entrepreneurs, while investment represents a $\bar{I}/\bar{Y} = 22\%$-share. Our results are not sensitive to the specific choice of those values.

3 Simulations and Discussion

We simulate two series of shocks. The reaction of the main variables are described by impulse response functions. The first simulation is a one-time, persistent, unanticipated negative shock on σ with a standard deviation $\varsigma_\sigma = 0.5$ and $\rho_\sigma = 0.96$. Those values generate the high persistence in workers' bargaining power reported empirically (Kumhof et al. 2015). The dashed lines illustrate the responses without the financial accelerator (i.e. $\upsilon = 0$ in Eq. (3)).

The drop in households' bargaining power provokes a recession, output reaches a slump of almost -2% in the first few quarters, and the recovery is particularly long (see Fig. 2a). The shock triggers two opposite effects on output. On the one hand, the loss of bargaining power erodes households' wages (as clear from the labor demand equation), who react by working less (as clear from the labor supply equation and Fig. 2d), which decreases consumption and, hence, output. As testified by Figure 2b, consumption follows a similar drop and sluggish



(a) Output (b) Consumption (c) Investment

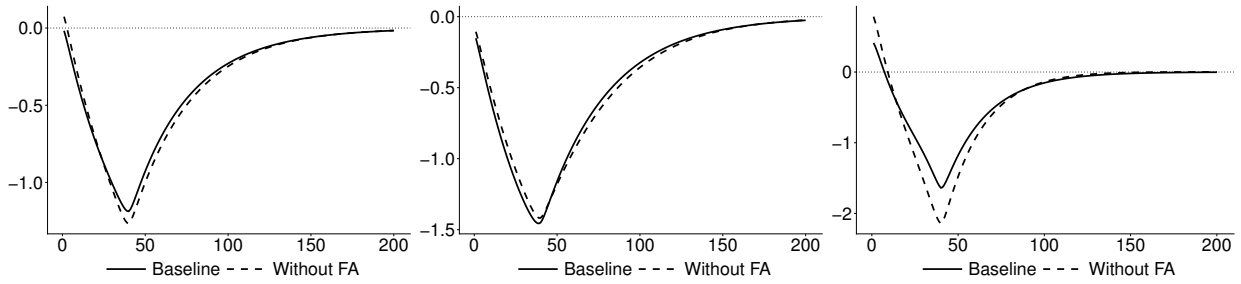
(d) Employment (e) Real interest rate (f) Return on capital

Figure 2: Effects of a one-time distributional shock (shock on σ)

recovery pattern as output, and the crisis is characterized by under-consumption. On the other hand, the redistribution of wealth from households to entrepreneurs initially fosters investment due to the initial rise in the return on capital (see Figs. 2e-2f). However, the negative aggregate demand effect quickly reverts this initial push. The drop in output erodes asset prices and profits, which results in lower entrepreneurial net worth, higher external finance premium and lower investment (Eq. (3)), hence lower output.

We conclude that a distortion in the functional income distribution to the disadvantage of workers weakens aggregate demand more than it stimulates investment. This is even clearer from the simulations in the absence of the financial accelerator amplification mechanism. In this case, there is no initial positive reaction of investment (Figure 2c), because neither the return on capital nor the entrepreneurial net worth rise, as is the case in the presence of the financial accelerator (see Figure 2f). Hence, the adverse shock on households' bargaining power only operates through the negative aggregate demand channel, and the crisis is deeper.

Most interestingly, our findings are at odds with those obtained by Bernanke et al. (1999) when simulating a transfer of wealth from households to entrepreneurs. The authors report the same initial increase in entrepreneurial wealth and investment as we report here, but in their case, it triggers a virtuous cycle in investment activity and net worth accumulation induced by the financial accelerator, and output rises. By contrast, in the presence of a



(a) Output (b) Consumption (c) Investment

Figure 3: Effects of a cumulative distributional shock (shock on σ)

wage bargaining process, the initial increase in investment is rapidly dragged down by the downturn on the labor market and the adverse aggregate demand effect.

Our second experience uses a deterministic simulation as it allows to trigger cumulative shocks. We introduce 40 consecutive shocks, each of 0.0125 standard deviation, to represent a cumulative fall in households' bargaining power of 7.5%, across 10 years, which is a stylized replication of the fall in bargaining power experienced by workers in the years preceding the 2007 financial crisis (see, e.g., Kumhof et al. 2015). Results are displayed on Figure 3.

The main message and mechanisms just discussed remain unchanged: a more unequal income distribution triggers an under-consumption crisis (Figure 3b) that overrides the initial boost in investment (Figure 3c). As a result, Figure 3a shows that output falls over the 40 quarters of the shock, reaching a minimum of -1.3%. The fluctuations are milder than in the stochastic simulations due to the perfect anticipation of the shocks in a deterministic environment.

As a conclusion, both a one-time and a series of adverse shocks on households' wage bargaining power result in a recession characterized by a structural shortfall in aggregate demand. This conclusion is at odds with the original one obtained by Bernanke et al. (1999) (and the following ones obtained in, e.g., Mumtaz & Zanetti 2016) because the initial investment boom is dragged down by the drop in wages and consumption that our extension of the model has allowed us to incorporate.

Of course, the simulated under-consumption recession is not matched by the recent historical experience, because our analysis deliberately abstracts from credit-fueled households' consumption to provide a counterfactual experiment. This experiment appears to reinforce the Rajan hypothesis, i.e. easy credit has acted as a palliative to lower wages to maintain consumption levels in the wake of growing income inequality.

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