Comparing US and French business cycles taking into account labor market frictions∗†

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Abstract

In this study, we explore differences between US and French business cycles focusing on labor market frictions. We calibrate a DSGE model augmented with a frictional labor market for both the United States and France and estimate the various shocks processes on the period 1986-2007. We find that the US economy usually goes back faster to its balanced growth path than the French economy. By performing counterfactual experiments, we find that the main explanation for this difference in dynamics is not the difference in labor market flexibility. Difference in labor frictions only matters in response to labor-market specific shocks. Besides we find that the empirical contribution of those shocks to output fluctuations is low.

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1 Introduction

At the beginning of the 2000s, the United States output gap decreased more strongly and more quickly than in the Euro area. Then it returned back to its potential more quickly (figure 1). The differences in the short term behavior between the American and the European economies have been recently reported in the quarterly report on the Euro area of the European Commission (DG-EcFin (2007)) and in OECD studies (Drew, Kennedy, and Slok (2004) and Duval, Elmeskov, and Vogel (2007)). Among the explanations of those dynamic differences, differences in flexibility seems a natural starting point. What is the contribution of flexibility to dynamic properties? More precisely, do the observed differences in rigidities account for the observed differences in response to shocks? Duval, Elmeskov, and Vogel (2007) examine this question from an empirical perspective. The authors identify a common shock that affect all OECD economies simultaneously. They find that, in response to that common shock, more flexible economies return faster to their potential.

Figure 1: Output gaps, in % relative to the potential.

Note: The US output gap is in full line, the other countries in full line with stars. Output gaps have been computed using standard HP filters.

In this paper, we adopt a more structural approach to quantify the importance of flexibility to dynamic properties. Contrary to Duval, Elmeskov, and Vogel (2007), and in line with DG-EcFin (2007), we believe that there are as many dynamics as many types of structural shocks. As in DG-EcFin (2007), we compare the Impulse Response Functions (IRFs) of the US and those of a
typical continental European country, France. Then we evaluate to what extent the differences in IRFs are due to differences in flexibility.

Smets and Wouters (2004) and Grenouilleau, Ratto, and Roeger (2007) perform the same kind of comparison exercise we are interested in. They use estimated Dynamic Stochastic General Equilibrium (DGSE) models. The model estimated in Smets and Wouters (2004) is a closed economy featuring real rigidities (monopolistic competition) on the goods and the labor market, and nominal rigidities on prices and wages (Calvo pricing). It shares other features of the standard New Keynesian model, such as habit persistence in consumption, investment adjustment costs and variable capital utilization rate. Estimation results do not suggest significant differences in structural parameters across both areas. Nonetheless they find that variances of demand shocks are greater in the United States than in the Euro area whereas their persistence is less important. They also find that nominal rigidities on wages are greater in the United States. At the end of the day, the dynamics of the two economies in response to the same structural shock seem to be relatively similar. However historical shocks shaping the three last cycles are very different. So the differences in the American and European business cycles would rather be explained by differences in the historical shocks that affected the economies.

The DSGE model estimated in Grenouilleau, Ratto, and Roeger (2007) is enriched with international trade and fiscal policy. Those two elements could potentially affect the results of Smets and Wouters (2004). Actually, both areas are quite different along those two dimensions. The Euro area is known to be more affected by external shocks and public spending represents a greater share of total product. Despite the modeling enrichment, Grenouilleau, Ratto, and Roeger (2007) do not find significant structural differences in the dynamics between the two economies. Rigidities are found to be different between areas, but it is also the case for the shocks properties. Finally, both effects compensate each other. As in Smets and Wouters (2004), examining historical shocks is very interesting. According to Grenouilleau, Ratto, and Roeger (2007), if the Eurozone had been hit by the same productivity shock as the United States in the early 2000s, this area would have followed the same path as the United States.

The lack of differences in the dynamics of the American and European economies in response to structural shocks may come from a bad specification of the standard DSGE model. Namely the standard DSGE model may miss some important mechanisms linked to the adjustment process on the labor market. Most economists agree to the fact that the American labor market evolves in a very different way than the typical European one. More particularly, real matching frictions on the labor market and wages rigidities could be central to the business cycles description. This intuition is confirmed by the current literature in which frictional unemployment is introduced in standard DSGE models (cf. Blanchard and Galí (2007a)).

Are the differences between French and American business cycles on the period 1986-2007 explained by differences in labor market frictions? This question has not only a positive value, but it may also be of normative interest. To the extent that faster recovery is welfare improving, a positive link between flexibility and capacity of absorbing shocks would imply new argument for policies of reduction in labor market rigidities.

In this paper, we introduce, in a DSGE model, frictional unemployment in a way similar to Christoffel and Linzert (2005). In the following section, we motivate our modeling choice and we describe the model. Our main innovation is to incorporate balanced growth and explicit real rigidities à la Hall (2005). In the third section, we present a reasonable calibration of our model to replicate the American and the French economy. The job destruction rate is higher in the US

\[1\] Symmetrically, one can view this literature as an attempt to introduce nominal rigidities in models à la Diamond-Mortensen-Pissarides.
than in France, while matching is more efficient in the US. Prices and wages are assumed to be more rigid in France. The American monetary policy is calibrated to be more reactive. Once the behavioral structural parameters calibrated, we estimate the processes of the shocks affecting each economy. In the fourth section, we compare the dynamics of the two economies in response to the various estimated shocks. Then we conduct counterfactual simulations and compare implied IRFs. At this point we evaluate to what extent the observed differences in the IRFs are due to the estimated shock processes or to the structural characteristics of the economies. In particular we ask whether differences in nominal rigidities and labor market frictions explain differences in IRFs. In the last section, we study the empirical contribution of each shock to the output gap fluctuations and the historical shock decomposition of the 2000s slowdown.

2 Model

In this first section, we motivate our modeling assumptions and we describe our model in details.

2.1 Modeling motivation

The relation between frictional unemployment and cyclical fluctuations has been a very dynamic field of investigation for the last 10 years. The output of this investigation can be divided into three types of studies:

- theory and parsimonious models (Blanchard and Galí (2007a), Blanchard and Galí (2007b) and Trigari (2004));
- simulations and extensive models (Moyen and Sahuc (2005), Christoffel and Linzert (2005));
- estimations (Feve and Langot (1996), Christoffel, Kuester, and Linzert (2006), Gertler, Sala, and Trigari (2007)).

All those studies highlight the importance of real frictions and wage rigidities on the labor market to explain shocks propagation. Some of them even put forward some specific wage settings that are needed to replicate the wage dynamics. Christoffel and Linzert (2005) and Trigari (2004) point out the importance of the Right-To-Manage (RTM) hypothesis. The RTM hypothesis means that only wages are concerned by the bargaining between firms and workers, workers supplying the number of hours demanded by firms. Christoffel and Linzert (2005) show that, in the RTM case, the response of inflation to monetary policy shocks is more in line with the data (more persistent).

Our model choice results from a trade-off between parsimony and realism. Introducing productive investment decisions would hamper the parsimony of our model, without much gain of empirical realism according to Christoffel, Kuester, and Linzert (2006) and Gertler, Sala, and Trigari (2007). On the contrary, because we are interested in flexibility, introducing a nominal sphere is essential. We use a model à la Christoffel and Linzert (2005), which features a clear distinction between employment and hours worked. Because of the previous argument and because it is robust to the Barro critic, we adopt the RTM hypothesis to model wage bargaining. Finally we prefer wage rigidities à la Hall (2005), according to which real wages are anchored on past levels. This modeling choice moderates the impact on current wage of very procyclical replacement revenues.

In Christoffel and Linzert (2005), the job destruction rate is assumed to be exogenous and constant. We relax the constancy assumption because of the results in Yashiv (2006) and Yashiv
They evaluate the relative volatilities of job destruction rates and job finding rates. They find that the contribution of each rate reveals to be essential to explain the unemployment evolution in the United States.

2.2 Description of our model

In the following subsection, we describe our model in details. There are four agents: households, intermediate firms, retailers and a central bank. Intermediate firms use the labor force to produce a homogeneous intermediate good, the labor market features a search and matching model à la Diamond-Mortensen-Pissarides (DMP). The intermediate good is sold in perfect competition to the retailers who use it to produce differentiated final goods. Differentiated final goods are sold by retailers under monopolistic competition and consumed by households under an aggregate.

**Intermediate good market** The intermediate good is homogeneous, produced by firms using the labor force of an unique employee. The production function \( y_{I}^{t} \) of an intermediate producer depends on the hours worked by the employee \( h_{t} \), has decreasing returns to scale (of elasticity \( \alpha \)) and is influenced by the technological progress \( z_{t} \). We assume that \( z_{t} \) increases along a stochastic trend\(^{2} \) of rate \( g_{z} \). The employee is paid an hourly real wage \( w_{t} \) and the intermediate good is sold under perfect competition at the relative price \( x_{t} \). The profit of the intermediate firms is denoted \( \psi_{t} \).

**Labor market** The labor market is non-Walrasian. Active population is made up of all households. Some of them are working, others are unemployed and look for a job. Each period, a fraction \( \rho_{t} \) of employees become unemployed.

The search and matching process of unemployed individuals is described by the matching function \( m_{t} \), depending on the number of unemployed \( u_{t} \) and on the number of vacancies \( v_{t} \). The decision for the firm to open a vacancy results from the trade-off between the vacancy posting cost \( \kappa_{t} \) expressed in terms of marginal consumption utility \( \lambda_{t} \), and the expected profit. Thus this trade-off depends on the probability of finding a worker \( q_{t} \).

When the household is employed by a firm, he/she works \( h_{t} \) hours. As already explained, hours \( h_{t} \) are determined by the firm (Right-To-Manage). Wages \( w_{t} \) feature rigidities à la Hall: they are partly anchored \((\gamma_{w})\) on past wage and partly \((1-\gamma_{w})\) on a notional wage \( w_{n}^{t} \) determined during the Nash bargaining. Under the notional Nash bargaining, employer and employee choose the notional wage \( w_{n}^{t} \) to maximize their joint surplus, given the firm’s right to manage. In the end, the notional wage depends on two terms. The first is the profitability of the job. The second is the cost of the job for the employee, in terms of leisure loss \( g(h_{t}) \) and opportunity cost of the unemployment status (the replacement revenue \( b \) and the opportunity of future job). The relative part of both terms depends on the bargaining power of workers \( \eta \). The opportunity cost of the unemployed depends on their probability to find a job \( s_{t} \).

**Final good market** The intermediate good is sold under perfect competition to retailers at price \( x_{t} \). Each retailer indexed by \( l \), transforms one unit of the intermediate homogeneous good \( y_{I}^{t} \) into one unit of a differentiated good \( y_{l}^{t}(l) \), without any other factors\(^{4} \). On their markets, retailers are under monopolistic competition and fix their prices à la Calvo. Each period, only a random fraction \( 1 - \varphi_{p} \) can adjust their prices to their preferred re-optimization prices \( P_{t}^{*} \),

\(^{2}z_{t}\) is a random walk.\\n\(^{3}\)Relative price are deflated by the price of final consumption.\\n\(^{4}\)The quasi tautological retailer production function is necessary to decouple the hiring and price decision.
whereas the other fraction of retailers index their prices partly \( (\gamma_p) \) on past inflation \( \Pi_{t-1} \), and partly \( (1 - \gamma_p) \) on the monetary policy inflation target \( \bar{\Pi} \). All the differentiated goods \( ((1 - u_t)y^I_t(t)) \) which are sold by the retailers are then aggregated in a homogeneous final good \( y_t \), whose price is \( P_t \). This final good is a CES aggregate of intermediate goods with elasticity \( \varepsilon^{cp} \).

**Households and Central bank**  
Households are characterized by a separable utility function which depends on present and past consumption \( U(C_t, C_{t-1}) \) and on leisure \( g(h_t) \). They have rational expectations, live infinitely and discount future at the rate \( \beta \). They have access to complete financial markets \( \mathbb{F} \) which can thus be reduced to the market for nominal bonds of the monetary authority. A central bank follows a Taylor rule, in which the nominal interest rate \( R_t \) depends on the deviation of inflation from its target \( \bar{\Pi} \) and on the deviation of production from the balanced growth path.

**Uncertainty**  
Besides the productivity shock already introduced, there are other structural shocks, such as a preference shock on the consumption utility \( (\varepsilon^{pref}) \), a shock on the disutility of work \( (\kappa_h) \), a shock on the vacancy posting cost \( (\kappa) \), a shock on the job destruction rate \( (\rho) \), a monetary policy shock \( (\varepsilon^m) \) and a cost-push shock \( (\varepsilon^{cp}) \).

**Timing assumption**  
The timing assumptions are relatively standard. Nonetheless, we want to stress that productive employment is only affected by the current separation rate shock. Thus, it is in most cases predetermined.

The translation of the previous description of the model into equations is exposed in appendix A. We do not present the solution to the balanced growth path, available on demand. We just recall that, given our assumption of separability in the utility function, the utility in consumption has to be logarithmic to assure the existence of a balanced growth path. The log-linearization is also available on demand.

### 3 Calibration and estimation

In order to compare the dynamics of France and the United States, we build two versions of our model: one for France the other representing the United States. First, we calibrate the behavioral structural parameters of our model. When needed, we use French and American data from 1986Q1 to 2007Q2. Then we estimate separately for France and the United States the processes of the strustructural shocks on the same time period.

#### 3.1 Calibration

The calibration strategy can be decomposed in two steps: calibration of the balanced growth path and calibration of the dynamics. Parameters that affect the long run equilibrium of the model can also be divided into two groups: the ones that are common to both countries and those which differ. The calibration of the usual common parameters is very classical. We only quote

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5External consumption habit formation.  
6The household implicitly values a third factor the time spend to fond a worker for a firm.  
7This assumption is essential to aggregation. See Merz (1995).  
8The data used comes from the OECD, from the French Ministry of Labor and from the Bureau of Labor Survey.
a few studies motivating our choice presented in table 1. The consumption habit persistence parameter is fixed to 0.7 (cf. Boldrin, Christiano, and Fisher (2001)). We choose quadratic disutility of work. The production elasticity to hours is calibrated according to the share of wages in value added (a mean value of that share for our two economies is 0.7).

Table 1: Classical calibration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount factor</td>
<td>$\beta$</td>
<td>0.995</td>
</tr>
<tr>
<td>Habit persistence</td>
<td>$h_c$</td>
<td>0.7</td>
</tr>
<tr>
<td>Intertemporal elasticity of substitution</td>
<td>$\sigma$</td>
<td>1</td>
</tr>
<tr>
<td>Elasticity of labor disutility</td>
<td>$\phi$</td>
<td>1</td>
</tr>
<tr>
<td>Mark-up rate</td>
<td>$\mu_p$</td>
<td>1.1</td>
</tr>
<tr>
<td>Production elasticity to hours</td>
<td>$\alpha$</td>
<td>0.77</td>
</tr>
</tbody>
</table>

The rate of technological progress, inflation and nominal interest rate differ across economies. They are directly observed in the data and reported in table 2.

Table 2: Balanced growth path and nominal sphere

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>France</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technological progress</td>
<td>$g_z$</td>
<td>0.0035</td>
<td>0.0042</td>
</tr>
<tr>
<td>Inflation</td>
<td>$\Pi$</td>
<td>1.0051</td>
<td>1.0062</td>
</tr>
<tr>
<td>Nominal interest rate</td>
<td>$\bar{R}$</td>
<td>1.0137</td>
<td>1.0155</td>
</tr>
</tbody>
</table>

Labor market flows and stocks We aim at replicating the unemployment rate and the job finding rate in each country. This strategy pins down the separation rate. Results are in table 3. Despite very different job finding rates, the two economies have very close separation rates. Differences in job finding rates and unemployment rates cancel out. The similarity across economies of the separation rates is noteworthy, they are an upper bound of each economy reallocation rate.

The choice of the conventional unemployment statistics as our equivalent to $u_t$ has to be discussed. In Trigari (2004), a broader definition of unemployment is chosen. We have tested the robustness of our results when the model is calibrated with employment rates (including out of the labor force population).

In agreement to the literature (cf. Petrongolo and Pissarides (2001)), we set the elasticity of unemployment in the matching function to $\sigma_2 = 0.5$ in both countries. We then deduce the market tightness of both countries and the efficiency of the matching technology. We compute the vacancy posting cost from the free entry condition. We check that orders of magnitude are consistent with reasonable profit rates.

Wages Wages and hours on the balanced growth path depend on the replacement rate $\eta_b$ and the bargaining power $\eta$. They also depend on the labor disutility parameters, its weight $\kappa_h$ and its elasticity $\phi$. The replacement rate calibration is tricky, because our model oversimplifies the

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9 Given the Beveridge curve we have $\rho = \frac{g_z}{1-\nu+\kappa}$

10 A first attempt with equal matching efficiency has also been tested. It does not affect our result.
real unemployment benefits policies. We use effective mean replacement rate from the OECD, namely 60% in France and 30% in the United States. Without any further information, we satisfy the Hosios condition by setting $\eta = \sigma_2$, even though it is not clear whether it means efficiency in our model. Finally, we normalize the models with the weight on labor disutility $\bar{\kappa}_h$. We precise in table 3 the previous choices and what they imply for the ratio of the marginal rate of substitution over wages ($\bar{mrs}/\bar{w}$) and for the dynamic bargaining power of the workers ($\bar{\chi}$). The first ratio gives the implicit mark-up rate on the labor market.

Table 3: Calibration of labor market

<table>
<thead>
<tr>
<th>Parameter or variable</th>
<th>Symbol</th>
<th>France</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Labor market flows and stocks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployment rate $\bar{u}$</td>
<td>0.092</td>
<td>0.055</td>
<td></td>
</tr>
<tr>
<td>Job finding rate $\bar{s}$</td>
<td>0.39</td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td>Separation rate $\rho$</td>
<td>0.038</td>
<td>0.044</td>
<td></td>
</tr>
<tr>
<td>B. Wages</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replacement rate $\eta_b$</td>
<td>0.6</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>Bargaining power $\eta$</td>
<td>0.5</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Weight on labor disutility $\bar{\kappa}_h$</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Wedge between $mrs$ and $w$ $\bar{mrs}/\bar{w}$</td>
<td>0.77</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td>Dynamic bargaining power $\bar{\chi}$</td>
<td>0.005</td>
<td>0.06</td>
<td></td>
</tr>
</tbody>
</table>

Some of the previous parameters have not only an influence on the potential of the economy, but also on its dynamics. For example, the unemployment rate determines the slope of the log-linearized Beveridge curve. Still, there are some parameters that only affect the dynamics, namely those concerning the price and nominal wage rigidities and the monetary policy.

When new Phillips curve are estimated within full DSGE models, as in Smets and Wouters (2004), differences in price rigidities among areas are found to be small. Typical values for the probability of reoptimizing prices or for indexation on past inflation are displayed in the column for France in table 4. The story is slightly different, when the new Phillips curve estimation is independent of any model. In Gali, Gertler, and Lopez-Salido (2001), American rigidities are found to be less important. We report their results in the column for the United States of the previous table.

The parameter of indexation of the current wage on the notional bargained wage $\gamma_w$ can be seen as the fraction of matches bargaining each period. As a first approximation, it can be linked to the average duration between two bargainings. Despite possible contradiction between micro evidence and macro estimation, we choose to rely on mean bargaining delay observed in Heckel T. and Montornes (2007), a micro study of France. While estimating wage dynamics, Smets and Wouters (2004) do not find large differences in the probability to re-bargain between both areas. In the end, we propose a slightly lower wage rigidity in the US (See table 4).

Grenouilleau, Ratto, and Roeger (2007) and Clarida, Gali, and Gertler (1998) display evidence that the Euro area or the French monetary policy is less reactive than the Fed one. It also reacts relatively less to output gap than to inflation deviations. See table 4.

$^{11}$Note that this parameter does not influence the log-linearized dynamics.
Table 4: Calibration of the dynamic parameters

<table>
<thead>
<tr>
<th>Parameter or Variable</th>
<th>Symbol</th>
<th>France</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Price rigidities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probability not to reoptimize</td>
<td>$\phi_p$</td>
<td>0.9</td>
<td>0.8</td>
</tr>
<tr>
<td>Mean time elapsed (trimesters)</td>
<td></td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Automatic indexation on past inflation</td>
<td>$\gamma_p$</td>
<td>0.3</td>
<td>0</td>
</tr>
<tr>
<td>Slope of the new Phillips curve</td>
<td></td>
<td>0.009</td>
<td>0.051</td>
</tr>
<tr>
<td>B. Wages parameters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indexation</td>
<td>$\gamma_w$</td>
<td>0.75</td>
<td>0.66</td>
</tr>
<tr>
<td>Mean delay (trimesters)</td>
<td></td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>C. Monetary policy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inertia</td>
<td>$\gamma_m$</td>
<td>0.9</td>
<td>0.7</td>
</tr>
<tr>
<td>Reaction to inflation deviation</td>
<td>$\gamma_\pi$</td>
<td>1.5</td>
<td>2</td>
</tr>
<tr>
<td>Reaction to output gap</td>
<td>$\gamma_y$</td>
<td>0.125</td>
<td>0.25</td>
</tr>
</tbody>
</table>

3.2 Estimation of the shocks processes

For each calibrated economy, we estimate separately the shocks processes, i.e. their volatilities and their persistences, by maximum likelihood\(^\text{12}\). The observed data are the following: GDP growth rate, hourly earnings growth rate in the private sector, hours worked per worker, unemployment rate, exit rate of unemployment, CPI inflation rate, 3-month money market interest rate. The estimation results are in table 5.

The productivity shock persistence estimate is lower than usually found in the literature. Indeed, it corresponds to the residual persistence when a random walk has already been extracted from the productivity series. Its estimated volatility is higher in the United States than in France. Except for the monetary shock, the other shocks have a high degree of persistence, namely the two shocks directly affecting the labor market: the shock on the vacancy posting cost and the shock on the job destruction rate. The cost-push shock is more persistent in the United States whereas the shock on the disutility of work has a higher persistence in France. For all the shocks, the volatilities are similar in the two economies.

In this section, we have calibrated the two models on French and American data and we have estimated the shocks processes. Now we compare the dynamics of the French and American economies in response to each estimated shock.

\(^{12}\)The estimation period is the same as in the calibration. We use the Dynare toolbox.
Table 5: Persistence and standard deviation of the shocks in the two economies

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>cost-push</td>
<td>0.65</td>
<td>0.91</td>
<td>8.10^{-4}</td>
<td>7.10^{-4}</td>
</tr>
<tr>
<td></td>
<td>(0.17)</td>
<td>(0.04)</td>
<td>(0.0003)</td>
<td>(0.0001)</td>
</tr>
<tr>
<td>vacancy posting cost</td>
<td>0.98</td>
<td>0.97</td>
<td>0.038</td>
<td>0.029</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.02)</td>
<td>(0.003)</td>
<td>(0.0023)</td>
</tr>
<tr>
<td>disutility of work</td>
<td>0.61</td>
<td>0.32</td>
<td>0.025</td>
<td>0.031</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.09)</td>
<td>(0.002)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>monetary</td>
<td>0.14</td>
<td>0.42</td>
<td>0.0022</td>
<td>0.0016</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(0.08)</td>
<td>(0.0002)</td>
<td>(0.0001)</td>
</tr>
<tr>
<td>preference</td>
<td>0.87</td>
<td>0.73</td>
<td>0.013</td>
<td>0.016</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.05)</td>
<td>(0.002)</td>
<td>(0.0017)</td>
</tr>
<tr>
<td>job destruction rate</td>
<td>0.87</td>
<td>0.89</td>
<td>0.035</td>
<td>0.033</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.02)</td>
<td>(0.0027)</td>
<td>(0.0026)</td>
</tr>
<tr>
<td>productivity</td>
<td>0.55</td>
<td>0.53</td>
<td>0.0042</td>
<td>0.0048</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.07)</td>
<td>(0.0003)</td>
<td>(0.0004)</td>
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</tbody>
</table>

Note: In parenthesis, we report the standard error of each estimate. The cost-push shock is unusually small, because it does not add directly to the real marginal cost. Our estimate is thus implicitly multiplied by the New Keynesian Phillips curve slope.

4 Comparison in dynamics between France and the United States: impulse response functions

To compare the dynamics of France and the US, we compute their impulse response functions (IRFs) to their estimated shocks. In this first exercise, IRFs may differ because shocks process are different or because structural parameters differ. So, in a second step, we perform counterfactual simulations to isolate the contribution of structural differences to differences in IRFs.

4.1 Impulse response functions of the two calibrated models to estimated shocks

There are basically three main kinds of shocks:

- usual supply and demand shocks: the technological shock on productivity trend $\mu_t^z$, the preference shock $\varepsilon^{pref}_t$ and the monetary policy shock $\varepsilon^m_t$;
- distorsive shocks: the shock to the disutility of work $\kappa_{ht}$ and the cost-push shock to the new Phillips curve real marginal cost $\varepsilon^{h}$;
- labor market-specific shocks: the shock to the vacancy posting cost $\kappa_t$ and the shock on the job destruction rate $\rho_t$.

All the IRFs graphs are reported in annex B. The simulation are set with the Dynare system. The figures 2, 3 and 4 are extracted from the annex. They present the IRFs of consumption.

\[^{13}\text{It can alternatively be understood as a shock to the wholesalers’ mark-up. This shock is proportional to a shock on the elasticity of substitution between the different varieties of the final good } \varepsilon^{cp}_t: \text{ noting } \mu_{t}^{p} \text{ the current mark-up rate, we get } \mu_{t}^{p} = -\frac{1}{\varepsilon^{cp}_t} \varepsilon^{p}_t.\]
unemployment rate and hours worked in response to a productivity shock, to a shock to the disutility of work and to a shock to the vacancy posting cost (each kind of shock is represented).

In response to the productivity shock, the dynamics of the consumption are comparable in the two economies (dotted line with ◦ for France and dotted line with + for the US). The two economies differ mainly by their unemployment rate responses. It is more deviated in the American economy and it goes back to its equilibrium level more quickly\[^1\]. However, this result is not so prominent when we consider the range of the unemployment rate deviation. Broadly speaking, the economies adjust on hours (on the labor intensive margin). Two reasons can be put forward. On the one hand, given the labor market flow specification, the number of employed workers stays unchanged at the impact of the shock. Consequently, all the needed adjustments are necessarily carried by first changing the number of hours worked. On the other hand, the low elasticity of the marginal disutility of work ensures that hours worked actually fit.

The differences in the consumption dynamics are greater in response to the shock on the labor disutility. For this shock, consumption decreases faster and more sharply in the US than in France. The return to the equilibrium is then faster in the US. The dynamics of the unemployment rates are as different from one another as in response to the productivity shock. The deviation of the American unemployment rate is more important and its return to the baseline faster. However both unemployment rate absolute deviation are quite limited. The consumption IRF is again driven by the dynamics of hours worked. As for the previous shock, the adjustment takes place on the labor intensive margin.

In response to the vacancy posting shock, there are greater differences between the French and the American dynamics. The deviation of the consumption in France is greater than in the US and it returns to the equilibrium much more slowly. As in the previous shocks, the unemployment rate deviates more in the US economy and goes back to the baseline more quickly. For this shock, the amplitude of the unemployment rate IRF is not as limited as for the previous shocks: the adjustment is made at both margins, extensive and intensive. This observation can be generalized to any shock directly affecting the labor market.

4.2 Counterfactual simulations

The differences in the dynamics between the two economies may have two origins. They come either from differences in the estimated shocks or from structural differences between France and the US. To distinguish between the two origins, we perform two types of counterfactual simulations.

First, we study the IRFs of the French calibrated model in response to the US estimated shocks - they are called *France II* IRFs - and we compare them to the US model IRFs. In this first set of counterfactual simulations, we ask whether the France-US differences are due to differences in the shocks affecting each economy. Second, we evaluate the influence of structural characteristics - labor market frictions, nominal rigidities and monetary policy - on the dynamics of the two economies. We set in the French model the degree of nominal rigidities and the monetary policy as in the US model. Therefore, the counterfactual French model and the US model only differ in the degree of labor market frictions. We compute the IRFs of the counterfactual French model in response to the US estimated shocks - they are called *France III* IRFs - and we compare them to the US IRFs. The *France II* and *France III* IRFs are presented in full and dashed lines respectively, in the figures 2, 3 and 4 (and in annex B).

Concerning the productivity shock, the *France II* and *France III* IRFs of consumption are the

\[^1\]In terms of half-life time to return to the steady state.
Figure 2: *Permanent productivity shock.*

Figure 3: *Shock on the disutility of work.*

Figure 4: *Vacancy posting shock.*

Reading the graphs: the lines represent the response in the case:
- dotted line with •: calibration "France" with France estimated shocks;
- dotted line with +: calibration "United States" with US estimated shocks;
- full line: calibration "France" with US estimated shocks (France II IRFs);
- dashed line: calibration "France" with US degree of nominal rigidities, US monetary policy and US estimated shocks (France III IRFs).

Impulse response functions, except the ones of unemployment rate \( u \), are expressed as relative deviation from the initial balanced growth path (percentage points). The responses of the unemployment rate are absolute deviations in points.
same as in the US model. In response to the productivity shock, the dynamics of consumption is not influenced by the degree of the labor market frictions, nor by the degree of nominal rigidities.

There are no differences between the France III and the American consumption responses to the shock on labor disutility. The labor market frictions in the two economies do not imply different dynamics in response to distortive shocks. On the contrary, the France II IRF and the US IRF are different. Indeed, a shock to labor disutility results in a rise in the marginal rate of substitution between consumption and leisure, and in an immediate increase in wages. When prices are more flexible, as in the US model, inflation rises faster, depressing demand. As a consequence, in response to an identical shock to labor disutility, consumption decreases faster and more sharply in the US economy than in France. Moreover the return to equilibrium is faster in the US model. Finally, the greater price flexibility induces a stronger leisure-related utility gains for the households. It is more generally the case for distortive shocks.

Concerning the vacancy posting shock, the France III and the US IRFs are greatly different. In response to the shocks directly affecting the labor market, the dynamics of the two economies are impacted by the differences in labor market frictions. Next we describe in details the mechanisms at work during the transition back to equilibrium in response to an increase in the vacancy posting cost.

We consider a positive and persistent shock to the vacancy cost. At impact, the effect of such a shock is the same as a negative supply shock. If the profit rate is held constant, searching for a new worker becomes more costly to firms. Consequently, the number of vacancies decreases, inducing a drop in the labor market tightness. For the unemployed, the probability of finding a job also decreases, and the unemployment rate increases. Although this reduction in employment is not contemporary to the initial impact, it is completely anticipated.

Assuming first that hours worked remain unchanged, the rise of unemployment reduces the intermediate goods supply. The demand for goods, due to consumption habits, is then in excess. The intermediate goods price increases, resulting in higher inflation. This growth coupled with rising unemployment tends to depress consumption. How do hours adjust to the change in demand? First we look at the wage behavior. From the intermediate firms’ point of view, the increase in the intermediate goods price raises profitability: employers are eager to pay higher wages. From the workers’ point of view, the unemployment rate increase raises the marginal utility of consumption, lowering the value of leisure and dampening wage claims in the bargaining process.

All in all, the first effect dominates the outcome of the bargaining process, and wages increase. However, as wages increase by less than the intermediate goods’ price, the demand for hours worked is stimulated. Ultimately, the intensive margin (hours) is preferred to the extensive margin (employment): as the relative price of a vacancy with respect to the marginal cost of hours worked increases, we observe a substitution effect. At impact, most of the effects are triggered by anticipations, whereas the following adjustment dynamics towards equilibrium are driven by the variations in unemployment.

For this job market-specific shock, the IRFs between the US model and the French model fed by US estimated shocks are rather dissimilar. There are differences in both amplitude and persistence. With regards to consumption, inflation and the nominal interest rate, the US economy shows a faster and smaller adjustment than the French economy. At first sight, those dissimilarities are surprising given the close similarity between the evolutions of the labor market tightness in both countries.

How can these differences be explained?
• First, the rate of separation has a mechanical influence on unemployment persistence. The low rate of separation in France implies a more gradual adjustment to changes in tightness.

• Moreover, differences in the separation rates create different reactions of intermediate firms to changes in the vacancy profitability. This implies different unemployment dynamics. If they are able to discard easily their employees, firms will react to variations in their profitability by creating or destroying jobs. An economy with a high separation rate (the US, here) is hence displaying steeper and larger fluctuations in its unemployment rate.

• Concerning hours worked, the intermediate goods price and real wages, the momentum of the first two variables is driven by the last one, i.e. by the dynamics of the wage equation. In particular, a vacancy cost shock directly hits the wage equation. The contemporary impact of this shock on wages is scaled by the steady-state probability of finding a job. As this probability is higher in the US than in France, the contemporary impact of a vacancy cost shock is naturally bigger in the US model. The difference in wage dynamics is then translated to inflation dynamics through the "new Phillips curve" and, ultimately, to nominal interest rate dynamics.

• Finally, the dynamics of consumption depends on wages, unemployment and hours worked. More importantly, it summarizes the capacity of substitution between hours and employment in each economy. The higher this substitution capacity, the more dampened the fluctuations around the steady state.

In summary, when the two economies are fed by their estimated shocks, the differences in dynamics, commented in the previous section, are not only due to differences in the shocks processes. The structural rigidities also have an influence on IRFs:

• the specification of the monetary policy and the degree of nominal rigidities imply different dynamics in response to the distorsive shocks - shock on labor disutility and cost-push shock. Because of a higher degree of flexibility in the US model, the IRF of consumption is more deviated at impact and returns to the equilibrium more quickly;

• concerning job market-specific shocks, the IRFs are strongly affected by the degree of labor market frictions. The United States prove to have a higher capacity of substitution between employment and hours;

• however, in response to usual supply and demand shocks, the dynamics of the two economies are not really influenced by quantitavely plausible differences in labor market frictions or in nominal rigidities.

Next we determine which shocks are quantitatively significant in the replication of the historical business cycle. If the great majority of the consumption volatility is explained by productivity shocks for both economies, the structural differences in labor frictions and nominal rigidities are not relevant to explain differences in business cycles. On the contrary, if the cyclical fluctuations are mostly explained by shocks directly affecting the labor market, the differences in the structure of our two models are highly relevant.

5 Empirical contributions of the different structural shocks to fluctuations

In the previous section, we have studied the impulse response functions of the two economies to the different types of shocks. We now focus on the empirical contributions of each shock to
the observed output gap fluctuations. First, the estimation of the shocks process enables us to compute a forecast error variance decomposition. We compute it for each endogenous variable of the model and at different forecast horizons. Moreover, with the historical chronicles of the shocks, one can study the contribution of each shock to the historical evolution of the output gap, hours worked, the unemployment rate, etc. The goal of this exercise is to quantify how the previously studied differences in short term behaviour have actually resulted in differences between the French and American output gap historical fluctuations.

With the various shocks processes already estimated, we calculate the variance of the forecast error at different forecast horizons\(^\text{15}\). Then, we decompose this variance on the different types of shocks (table 6).

### Table 6: Forecast error variance decomposition (in %)

<table>
<thead>
<tr>
<th></th>
<th>horizon</th>
<th>monetary</th>
<th>labor dis.</th>
<th>vacancy cost</th>
<th>product cost</th>
<th>cost-push</th>
<th>pref.</th>
<th>job distr.</th>
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<tr>
<td><strong>GDP growth rate</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>55.4</td>
<td>2.3</td>
<td>26.3</td>
<td>0.2</td>
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<tr>
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<td>56.0</td>
<td>4.0</td>
<td>23.9</td>
<td>0.3</td>
</tr>
<tr>
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<td>14.2</td>
<td>0.9</td>
<td>1.2</td>
<td>55.3</td>
<td>4.2</td>
<td>23.9</td>
<td>0.4</td>
</tr>
<tr>
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<td>0.2</td>
<td>52.8</td>
<td>3.9</td>
<td>35.7</td>
<td>0.3</td>
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<td>1.9</td>
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<td>4.5</td>
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<td>0.3</td>
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<tr>
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<td><strong>Unemployment rate</strong></td>
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<td></td>
<td></td>
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<td></td>
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<td>0.0</td>
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</tr>
<tr>
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<tr>
<td><strong>Hours worked</strong></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>1.0</td>
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<td>3.2</td>
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<td>4.0</td>
<td>9.3</td>
<td>3.8</td>
<td>8.6</td>
<td>49.4</td>
<td>14.0</td>
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<tr>
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<td>3.0</td>
<td>33.3</td>
<td>2.6</td>
<td>5.9</td>
<td>37.5</td>
<td>10.2</td>
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<tr>
<td>US</td>
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<td>2.8</td>
<td>1.1</td>
<td>10.9</td>
<td>6.3</td>
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<td>6.6</td>
</tr>
<tr>
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<td>22.0</td>
<td>46.1</td>
<td>5.6</td>
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</table>

\(^{15}\)For an endogenous variable \(x_t\), we determine the variance of the non expected component at the horizon \(h\), i.e. the variance of \(x_{t+h} - E_t(x_{t+h})\) where \(E_t(\cdot)\) is the conditional expected value operator given the set of information à time \(t\).
Concerning the GDP growth rate, the forecast error variance decomposition shows that for both France and the United States, the productivity and preference shocks are important determinants. These two shocks respectively explain more than 79% and 86% of the forecast error on the French and American GDP growth rates, both in the short and in the long run. In contrast, the contribution of the shocks that are specific to the labor market to the GDP growth rate is very small. However the shocks on the vacancy posting cost and on the job destruction rate are, non surprisingly, the main determinants of the unemployment rate variance. This result highlights the weak link between employment and the output gap volatility, which could have been inferred by the comparison of the impulse response functions. On the other hand, the variance of hours worked is mainly due to the preference and cost-push shocks in the United States, and only to the preference shock in France.

Next we compute the contributions of the shocks to the historical fluctuations of the GDP growth rate (figure 5). Between 1996 and 2007, the French and American output growth rates are mainly explained by productivity, preference and monetary shocks. The other shocks, namely the shocks on the vacancy posting cost and on the job destruction rate, have only a marginal contribution to the output fluctuations. The contra-cyclical nature of the monetary policy is visible in France in 1996 and for both economies at the beginning of the 2000s.

Finally, we focus on the recession in the beginning of the 2000s. The figure shows that the French and American economies are not affected by the same kinds of shocks. In the United States, the recession is mainly explained by the negative contribution of the preference shock whereas is is explained by the productivity shock in France. The importance of the preference shock to account for the slowdown of the American economy in the beginning of the 2000s is consistent with Smets and Wouters (2007). Moreover, the negative impact of the productivity shock in France is followed by a negative demand shock in 2002, when the contribution of the former shock turns over. In the United States, the negative impact of the demand shock disappears at the end of 2001 and is not immediately followed by any negative contributions from other shocks. The dynamics of the two economies on the period is thus characterized by different combinations of shocks, specific to each economy.

\footnote{We observe the same result on the period 1986-1995.}
Figure 5: Contributions to the historical GDP per worker growth rate

Reading the graphs: the black line is the historical GDP per worker growth rate. The contributions of the shocks are printed in the following way:

- yellow: cost-push shock;
- cyan-blue: shock on the vacancy posting cost;
- magenta red: shock on the labor disutility;
- red: monetary shock;
- green: preference shock;
- black: shock on the job destruction rate;
- blue: productivity shock.
6 Conclusion

In this paper, we have compared the dynamics between the French and American economies by using DSGE models including a search and matching model à la Diamond-Mortensen-Pissarides. In particular, we have computed counterfactual simulations of the impulse response functions of the two economies to various shocks. Four points can be stressed from these simulations:

1. French and American Impulse Response Functions differ: the US economy usually goes back faster to its potential.

2. The differences in response to usual shocks are not easily explained by differences in labor market flexibility between France and the United States (differences in job destruction rate and differences in the matching efficiency). Their only impact is on dynamics in response to job-market specific shocks, because those shocks directly influence the price of job creation compared to the marginal cost of hours worked. For these shocks, the greater capacity of substitution between employment and hours in the United States implies that the aggregate output returns to the equilibrium more quickly. Moreover, in response to all the shocks, the unemployment dynamics in the United States is more deviated at the impact of the shock and then goes back faster to the steady state.

3. The estimation of the shocks paths affecting each economy on the period 1986-2007 shows that, on the historical period, the output growth rate fluctuations are mainly explained by productivity shocks, preference shocks, and, to some extent, by monetary shocks. Job-market specific shocks - vacancy posting shock and shock on the job destruction rate - only marginally contribute to the output fluctuations. Thus the impact of differences in labor market flexibility is not only limited to some specific shocks, it is also of limited empirical relevance.

4. Finally, the difference in dynamics at the beginning of the 2000s between France and the United States is the result of different combinations of productivity shocks and preference shocks in each economy.

Our conclusion, according to which there is no empirically relevant link between labor market frictions and output fluctuations, surely depends on our model specification. In particular, the exogeneity of the job destruction seems to be a strong hypothesis. The mechanisms associated with a variable job destruction rate, as the variations of the physical or human capital obsolescence, are likely to be crucial. It could also be interesting to introduce a mechanism illustrating the depreciation of the human capital of unemployed. Such a depreciation is likely to be more costly when the rotation rate is low.

From a normative perspective, our result would imply that the gains of flexibility in terms of dynamic resilience are low. However a full analysis would be necessary. This analysis would lead to compute fluctuations costs. This exercise has been deeply criticized by Lucas (2003), who finds that, in DSGE models, fluctuations costs are close to 0.01 GDP points. Theses costs could be more important, had fluctuations an impact on long term growth. Thus, including human capital accumulation in our model would also be a promising direction of research from a normative perspective.
References


Institute for the Study of Labor (IZA).

A  Formal description of the model

We do not present the formal program of each agent, nor theirs solutions, nor the aggregation issues, they are available on demand. In the end, the model has:

- an Euler equation,
- an intermediate good production function,
- a free entry condition for intermediate firms,
- a Beveridge curve,
- a matching technology function,
- an effective wage equation and a notional wage equation (the second equation comes with a notional economy),
- the demand of hours by intermediate firms,
- a new Phillips curve, along with price index definition and price dispersion index,
- a global market clearing condition,
- a monetary rule.

Each of those blocks are detailed from now on:

Euler equation

\[
\lambda_t = \beta E_t \left[ \lambda_{t+1} \frac{R_t}{\Pi_{t+1}} \right]
\]

with

\[
\lambda_t = \varepsilon_t^{pref} U_t (C_t, C_{t-1})
\]

where \( \lambda_t \) is the marginal utility of consumption\(^{17}\).

Intermediate firms production function

\[
y^I_t = z_t h_t^\alpha
\]

Free entry condition

\[
\frac{\kappa_t}{\lambda_t} = q_t E_t \left[ \beta_{t,t+1} (1 - \rho_t) \left( \psi_{t+1} + \frac{\kappa_{t+1}}{\lambda_{t+1} q_{t+1}} \right) \right]
\]

with

\[
\beta_{t,t+1} = \beta \lambda_{t+1} / \lambda_t \\
\psi_t = x_t y^I_t - w_t h_t
\]

where \( \beta_{t,t+1} \) is the stochastic discount factor and \( \psi_t \) is the current profit of the intermediate firm.

\(^{17}\)\(U_t\) is the partial derivative.
Population dynamics

\[ u_t = 1 - (1 - \rho_t) n_t \]  
\[ n_{t+1} = (1 - \rho_t) n_t + m_t \]

where \( n_t \) is the employment rate.

Matching technology

\[ m_t = \sigma_m u_t^{\sigma_2} v_t^{1 - \sigma_2} \]  
\[ \theta_t = \frac{\nu_t}{u_t} \]  
\[ q_t = \sigma_m \theta_t^{1 - \sigma_2} \]  
\[ s_t = \sigma_m \theta_t^{1 - \sigma_2} \]

where \( \theta_t \) is the market tightness.

Wage equation  The effective wage is :

\[ w_t = w_{t-1}^{\gamma_w} (w_t^n)^{1 - \gamma_w} \]

where :

- \( w_{t-1} \) is the previous effective wage ;
- \( w^n_t \) comes from a notional economy, which shares the same features as the effective economy, which is hit by the same shocks, but in which wages are Nash-bargained. The notional wage equation is:

\[ w^n_t = \chi^n_t \left( \frac{x^n_t mpl^n_t}{\alpha} + \frac{\kappa_t}{\lambda^n_t q^n_t h^n_t} \right) + (1 - \chi^n_t) \left( \frac{mrs^n_t}{1 + \Phi} + \frac{h^n_t}{b^n_t} \right) - (1 - \chi^n_t) (1 - s^n_t) \frac{\kappa_t}{\lambda^n_t q^n_t h^n_t} \frac{\chi^n_{t+1}}{1 - \chi^n_{t+1}} \]

where

\[ mrs^n_t = \frac{g'(h^n_t)}{\lambda^n_t} \]  
\[ \chi^n_t = \frac{\eta \delta^{W,n}_t}{\eta \delta^{W,n}_t + (1 - \eta) \delta^{F,n}_t} \]  
\[ \delta^{W,n}_t = \frac{h^n_t}{\alpha - 1} \left( \alpha - \frac{mrs^n_t}{w^n_t} \right) \]  
\[ \delta^{F,n}_t = \frac{h^n_t}{\alpha - 1} \]

where the variables written as \( X^n \) are from the notional economy; \( mrs^n_t \) is the marginal rate of substitution, \( \chi^n_t \) is the dynamic bargaining power, \( \delta^{W,n}_t \) (respectively \( \delta^{F,n}_t \)) is the marginal value of being employed (resp. of job creation) when wages are increased.

Hours worked demand

\[ x_{mpl} = w_t \]

where \( mpl_t \) is the marginal productivity of labor, \( mpl_t = z_t \alpha h_t^{\alpha - 1} \).
New Phillips curve

\[ E_t \sum_{j=0}^{+\infty} \beta_{t,t+j} \varphi_p \left( (\varepsilon^p_{t+j} - 1) \prod_{k=0}^{j-1} \left( \frac{\Pi_{t+k}}{\Pi_{t+k}} \right)^{1-\gamma_p} \prod_{k=0}^{j-1} \frac{\Pi_{t+k}}{\Pi_{t+j}} p_t^* \right) \left( \prod_{k=0}^{j-1} \left( \frac{\Pi_{t+k}}{\Pi_{t+j}} \right)^{1-\gamma_p} \right)^{-\varepsilon^p_{t+j}} y_{t+j} = 0 \]  

(14)

with \( \beta_{t,t+j} = \beta^j \lambda_{t+j} / \lambda_t \) and \( p_t^* \) the relative price of reoptimization.

Aggregated price index and dispersion index are:

\[ 1 = (1 - \varphi_p) (p_t^*)^{1-\varepsilon^p_t} + \varphi_p \left( \frac{\Pi_t^{1-\gamma_p} \Pi_t^{\gamma_p}}{\Pi_t} \right)^{1-\varepsilon^p_t} \]  

(15)

\[ a_t = (1 - \varphi_p) (p_t^*)^{-\varepsilon^p_t} + \varphi_p \left( \frac{\Pi_t^{1-\gamma_p} \Pi_t^{\gamma_p}}{\Pi_t} \right)^{-\varepsilon^p_t} \]  

(16)

Market clearing condition  

\[ (1 - u_t) y_t^I = a_t y_t \]  

(17)

\[ C_t = y_t \]  

(18)

Monetary policy rule

\[ \frac{R_t}{\bar{R}} = \left( \frac{R_{t-1}}{\bar{R}} \right)^{\gamma_m} \left( \frac{\Pi_t}{\Pi} \right)^{\gamma_m (1-\gamma_m)} \left( \frac{y_t}{y_t^m} \right)^{\gamma_p} \exp(\varepsilon^m_t) \]  

(19)

where \( \Pi \) is the target, \( \bar{R} \) is the natural interest rate and \( y_t^m \) is the balanced growth path.

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\(^{18}\)Vacancy posting costs do not enter in the market clearing condition. They are of the same type as the disutility of work.
B  Impulse response functions
Figure 6: Response to a permanent productivity shock.

Reading the graphs: the lines represent the response in the case:

- dotted line with \(\circ\): calibration “France” with France estimated shocks;
- dotted line with \(+\): calibration “United States” with US estimated shocks;
- full line: calibration “France” with US estimated shocks (France II irfs);

Impulse response functions, except the ones of rates (unemployment \(u\), job finding rate \(s\), inflation \(\Pi\), interest rate \(R\)), are expressed as relative deviation from the initial balanced growth path (percentage points). The responses of rates are absolute deviations in points.
Figure 7: Response to a preference shock.

Reading the graphs: as the previous graph:
- dotted line with ○: calibration "France" with France estimated shocks;
- dotted line with +: calibration "United States" with US estimated shocks;
- full line: calibration "France" with US estimated shocks (France II irfs);
Figure 8: Response to a shock on the disutility of work.

Reading the graphs: as the previous graph:
- dotted line with •: calibration "France" with France estimated shocks;
- dotted line with +: calibration "United States" with US estimated shocks;
- full line: calibration "France" with US estimated shocks (France II irfs);
Figure 9: Response to a monetary shock.

Reading the graphs: as the previous graph:
- dotted line with o: calibration "France" with France estimated shocks;
- dotted line with +: calibration "United States" with US estimated shocks;
- full line: calibration "France" with US estimated shocks (France II irfs);
Figure 10: Response to a cost push shock.

Reading the graphs: as the previous graph:
- dotted line with \(\circ\): calibration "France" with France estimated shocks;
- dotted line with \(+\): calibration "United States" with US estimated shocks;
- full line: calibration "France" with US estimated shocks (France II irfs);
Figure 11: *Response to a vacancy posting shock.*

Reading the graphs: as the previous graph:
- dotted line with o: calibration "France" with France estimated shocks;
- dotted line with +: calibration "United States" with US estimated shocks;
- full line: calibration "France" with US estimated shocks (France II irfs);
Figure 12: Response to a shock on the job destruction rate.

Reading the graphs: as the previous graph:
- dotted line with \( \circ \): calibration "France" with France estimated shocks;
- dotted line with \( + \): calibration "United States" with US estimated shocks;
- full line: calibration "France" with US estimated shocks (France II irfs);