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ABSTRACT

The Phillips Curves Across the Atlantic: It is the Price Curves that Differ

The Paper highlights one critical difference between Europe and the US regarding the Phillips curve: the behaviour of prices. While they are quickly restored to an equilibrium level in the US, European prices are driven by highly counter-cyclical mark-ups. In bad times, European firms manage to keep their price high relative to cost, while their US counterparts are pressed into cuts and discounts of various forms. We show that this behaviour is the critical reason why Phillips curves look different across the Atlantic, much more than because of differences arising on the labour markets.

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Keywords: labour market, mark-up and Phillips curve

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I INTRODUCTION

The Phillips-curve, in its augmented version, is one of the workhouse of modern macroeconomics. Newspapers articles are speaking fluently the NAIRU syntax and academic research still makes use of it when pressed to assess the sustainability of economic performances (see eg Katz and Krueger (1999), and more generally the Journal of Economic Perspective (1999) symposium on the topic). The problem with the notion is that it usually does not work in Europe, which is often taken to be a problem for European labor markets, rather than for the concept itself. On the other hand, "wage curve" approaches (such as the benchmark study by Blanchflower and Oswald (1994)) are quite often finding similar elasticities of wages to unemployment across the Atlantic. Although not all is settled in this domain (see Blanchard and Katz (1999)) rough similarities in wage equations and wide divergences in the Nairu framework are puzzling.

Our answer to this puzzle is that the key differences do not originate in the wage equation but rather in the price equation. Specifically, we shall argue that the mark up of prices over wages is much more counter-cyclical in Europe than in the US, blurring altogether the impact of unemployment on inflation. One picture will illustrate our key point, namely the average inflation rate over the past three decades across the Atlantic. As one sees on the figure "Inflation" in appendix, the two curves are experiencing the same pattern. One key difference emerges however: after each peak the return to the mean is more rapid in the US and more sluggish in Europe. Although the standard explanation is that wages are less responsive in Europe to a bad environment, we shall argue that the picture is in fact driven by the difference of cyclicality of mark-ups. As we shall argue in the paper, the more pronounced counter-cyclicality of European mark-ups is consistent with the view proposed by Rotemberg and Woodford according to whom mark-ups are driven by the collusive behavior of firms and from which one can readily derive that the less competitive an industry the more counter-cyclical the equilibrium mark-up will be.

The paper will proceed as follows. In section 2, we first run a number of relatively conventional wage and price equations in Europe and in the US by which we seek to demonstrate that it is the price equation which is markedly different across the Atlantic. We then run a VAR analysis which confirm the findings of section 2, namely that demand shocks are accomodated in opposite fashion across the Atlantic so far as mark-ups are concerned. We show that this seems to be the reason why a recession in Europe appears

to have lasting effect on unemployment. We finally suggest a model, in the spirit of Rotemberg and Woodford which demonstrates the correlation between lack of competition and counter cyclically of mark-up, and compare its prediction to other models in the literature.

II Wage and price curves

A casual observation of the augmented Phillips Curve in Europe makes it look like a slopeless curve which intersects the horizontal line almost all over the place, while the US curve, albeit not spectacularly precise, lends itself to the hypothesis of a trade-off between accelerating inflation and unemployment (see figure "Nairu" in appendix 2).

As the simplest illustration of the logic that we want to present, let us write the following model. Assume that wages are written as:

$$w_t - w_t^* = p^e(t) - \beta(u - u_t^*) + \varepsilon_t \tag{1}$$

in which w_t is nominal wages, u_t is the unemployment rate, w_t^* is a "reference" point for $real$ wages, u_t^* a "reference" point for unemployment (see below), and $p^e(t)$ is the expected price level for the period t. In the sequel, we shall approximate $p^e(t)$ through $p(t-1) + \pi_p(t-1)$, in which $p(t-1)$ is past price and $\pi_p(t-1)$ is lagged inflation. To the extent that inflation follows a random walk, this adaptative formation of expectation is in fact rational.

One first simple benchmark that we shall analyze is the wage curve approach by Blanchflower and Oswald, in which real wages are a solution to

$$w_t - p^e(t) = -\beta u_t + \varepsilon_t \tag{2}$$

To the extent that prices are rationnaly forecasted, this can be turned (up to a change of the definition of the residual) into a similar relationship for past values of wages and unemployment. Take w_t^* and u_t^* to be referring to some reference value of real wages and unemployment, we can then correspondingly write:

$$w_t^* = -\beta u^* + \varepsilon_t^* \tag{3}$$

Substracting (3) from (2) yields (1) with obvious notations.

Another particular case of equation (1) can be derived from the Philipps curve approach of Blanchard and Katz. In their formulation, wages are determined as a function of current unemployment and of a reservation wage. If one assumes that past real wage is a good proxy for the reservation wage of workers, the wage equation can then be transformed into :

$$\pi_w - \pi_p(-1) = -\beta u + C_w + \varepsilon_w$$

which is the standard model commonly used for estimating the NAIRU.

Let us now add to the model a specific equation referring to the formation of price. Assume that prices are set through a mark-up over prices. We write:

$$p = w - x + \gamma \tag{4}$$

in which x is labor productivity and γ is a mark-up. Assume that productivity has a trend g and a cyclical component. Assume that γ is a constant plus another cyclical component. Call z a measure of the business cycle ($z > 0$ is above average), θ_1 z the cyclical component of productivity (we will expect $\theta_1 < 0$ in the cases when the cycle is demand driven) and θ_2 z the cyclical component of the mark-up (we expect $\theta_2 \leq 0$ if it is counter cyclical). We can then write

$$\pi_p - \pi_w = -g + (-\theta_1 + \theta_2)\Delta z \tag{5}$$

We shall perform two estimates of these wage and price equations, with a view to elucidate the determinants of the standard Phillips curve. One follows is the wage curve approach, the other one the Phillips curve model.

The wage curve model

Let us first follow the wage curve model in which, in equation (1), $w^*$and u^* represent a HP filter of real wage and unemployment. Let us furthermore make the simplifying assumption that Δz is colinear to the measure $(u - u^*)$ (with a negative coefficient). Say that $\Delta z = -\lambda(u - u^*)$.

One can then write the system as :

$$w - p(t-1) - \pi_p(-1) - w^* = -\beta(u - u^*) + C_w + \varepsilon_w$$

$$\pi_p - \pi_w = \gamma(u - u^*) + C_p + \varepsilon_p$$

in which $\gamma = \lambda(-\theta_1 + \theta_2)$.

We then run this regression on a quarterly basis from 1971 to 1997, taking account of the price of energy (π_{oil}). We then get:

Europe

$$w - p(t-1) - \pi_p(-1) - w^* = C_w - \underset{(-4.45)}{1.82}\,(u - u^*) + \underset{(3.7)}{0.09}\pi_{oil};\ R^2 = 0.33$$

$$\pi_p - \pi_w = C_\pi + \underset{(3.1)}{0.88}(u - u^*) + \underset{(3.30)}{0.05}\pi_{oil}; \quad R^2 = 0.78$$

U.S.

$$w - p(t-1) - \pi_p(-1) - w^* = C_w - \underset{(-10.6)}{2.49}\,(u - u^*) - \underset{(-1.7)}{0.06}\ \pi_{oil};\ R^2 = 0.33$$

$$\pi_p - \pi_w = C_\pi - \underset{(-3.38)}{0.73}\,(u - u^*) + \underset{(2.93)}{0.10}\pi_{oil}; \quad R^2 = 0.12$$

The results could not be more contrasted. While the wage equation is only marginally steeper in the US than in Europe, the inflation curve are of *opposite* signs across the Atlantic. Ceteris paribus prices rise (relative to costs) in the Europe when in a recession, while they fall in the U.S. With the previous notation in which the coefficient in the price equation can be interpreted as $\lambda(\theta_1 - \theta_2)$ in which $\lambda > 0$, $\theta_1 < 0$ and $\theta_2 < 0$ this suggest that the European coefficient θ_2 (which measure the mark-up counter-cyclicality) is so large in absolute value as to over turn the impact of θ_1(which measure the elasticity of productivity) while the opposite holds true in the US.

Phillips curve model

Let us now run similar equations, relying on the Phillips curve model of Blancard and Katz. In order to make the two equations consitent, we run both the wage and price equation against u rather than against $(u-u^*)$. We then get the following regressions:

Europe

$$\pi_w - \pi_p(-1) = \underset{(4.4)}{4.6} - \underset{(-4.45)}{0.46}\, u + \underset{(0.2)}{0.0}\pi_{oil}; \quad R^2 = 0.24$$

$$\pi_p - \pi_w = -\underset{(-9.0)}{4.5} + \underset{(6.7)}{0.33}u + \underset{(5.9)}{0.09}\pi_{oil}; \quad R^2 = 0.33$$

U.S.

$$\pi_w - \pi_p(-1) = \underset{(6.6)}{5.9} - \underset{(-7.2)}{0.99}\, u + \underset{(1.2)}{0.04}\pi_{oil}; \quad R^2 = 0.54$$

$$\pi_p - \pi_w = \underset{(1.88)}{1.76} - \underset{(-2.25)}{0.31}\, u + \underset{(3.33)}{0.12}\, \pi_{oil}\ ; \quad R^2 = 0.17$$

which has a similar feature: the price curve is positively correlated to unemployment in Europe, while the correlation negative in the US.

We can then get a familiar augmented Phillips curve by adding up these two regressions, namely:

<u>EUROPE</u> :

$$\pi_p - \pi_p(-1) = -\underset{(-1.7)}{0.13}\, u\ + \underset{(4.3)}{0.1}\pi_{oil}; \quad R^2 = 0.32$$

<u>US</u>

$$\pi_p - \pi_p(-1) = -\underset{(-10.1)}{1.3}\ u\ + \underset{(4.9)}{0.16}\pi_{oil}; \quad R^2 = 0.52$$

which now makes the two augumented Phillips Curve totally at odds across the Atlantic. One finds a steep and significant one in the US, and barely anything in Europe, for the critical reason that the price curve destroys the relationship which is indeed significant for the wage curve. This is the kind of relationship which is usually tested and fail to pass the test of significance in Europe.

III A structural VAR approach

In order to investigate further the logic of wages and prices, we have run a number of structural VAR, relating price, wages, and unemployment.We present here only of them and will refer later on to alternative modelling test that we performed (all pointing essentially to the same conclusion; see Farhi (2001) for further details).

Let us consider a VAR which contains three variables, π_p, π_w and u. All variables are integrated of order 1. In the case of the US, this is more debatable with respect to u (Dickey Fuller test rejects the non-stationarity assumption at the 5% threshold for US unemployment, although not at the 1% level, but do not reject it at the 5% threshold for European unemployment). We take $\pi_p - \pi_w$ to be stationary as the cointegrating relationship and estimate a VAR of order 4 (one year lag altogether). In order to stay as close as possible to the logic of the data, we simply identify the structural shocks by running a Cholesky decomposition following the order (u, π_w, π_p) of rising endogeneity. We interpret the shock on u as a shock on demand; the (residual) shock on π_w as a shock on the bargaining power of workers; the (residual) shock of prices as a supply shock. This corresponds to a Keynesian view where short run (here quarterly) variations of u are interpreted as demand shocks along the Phillips curve, while longer run variations may originate from wage (bargaining) or price (supply) shocks.

The results come as follows (and are shown in appendix 2). In response to a negative demand shock, we find an hysteresis effect on European unemployment and a return to the mean in the US. Meanwhile real wages are falling in Europe, while they are rising in the US! The result is entirely driven by the distinct price mechanism. In the US, prices fall ahead of wages, hence generating rising real wages while in Europe instead, wages fall ahead of prices and real wages never recover. The failure of prices to adjust rapidly sustain higher unemployment in Europe, which, paradoxically sustains lower inflation.We view this as a confirmation of our intuition: in bad times, markups increase and productivity of labor also increases because of decreasing returns to scale in labor. The first effect pushes real wages downards while the second effect drives them upwards. In Europe, mark-ups are very counter-cyclical so that the former overcomes the latter, whereas the contrary is true in the US.

A similar picture emerges when dealing with a bargaining shock. In response to a positive shock, real wages are driven up in both countries, but

almost twice as much in the US than in Europe. In Europe unemployment cripples up, while it rises and falls in the US. The interpretation is similar: rising unemployment in Europe knocks off the increase of real wages because inflation shoots up more rapidly than in the US (relatively to wages). Eventually and somehow paradoxically higher unemployment and lower real wage produce a lower inflationary steady state in Europe.

We finally examine the impact of a supply shock. The results are different. In response to a negative shock, rising prices are not an offsetting factor in the US. As a consequence, real wages are now falling faster in the US than in Europe, and unemployment rises almost twice as much. One interpretation may be that the difference in the pricing mechanism is primarily driven by the response to demand fluctuation, although this cannot be quite right in view of the response to wage shock. Overall, real variables are more sensitive to a supply shock in the US than in Europe.

We have played with a number of variants to this simplest VAR model. Following King and Watson (1994) (KW), we have tried another formulation in which the innovation on unemployment and the innovation on inflation are correlated in a way which restores the long run sacrifice ratios which are observed in the US. More specifically, we have identified a demand shock, a bargaining shock and a supply shock with the following constraints:

-the innovation in u does not depend on the bargaining shock

-the innovation in π_w is a linear combination of the innovation in y and of the bargaining shock

-the innovation in $u - \lambda\pi$ is independent of the demand shock, λ being the short run inflation unemployment tradeoff. We choose λ in order to get the same long run sacrifice ratios as King and Watson in the US in their rational expectation model.

The KW model yields a more balanced view on the variance of unemployment. In the first model that we present, it is predominantly explained by demand shocks (confirming the more Keynesian flavor of the model). In the KW instead the variance is about equally divided between supply and demand shocks in Europe, while they are more predominantly determined by supply shocks in the US. The results are essentially identical to the previous model, except for the responses to a supply shocks which now appear almost identical in the two countries.

IV Theoretical background

As noted by Rotemberg and Woodford (1991) the idea that mark-ups are counter-cyclical dates back to Joan Robinson (1932) and Michael Kalecki (1938) who both noticed that mark ups would be counter-cyclical if the elasticity of demand is pro-cyclical. This idea was recently caught up by Bils (1989), Farrel and Shapiro (1988), Klemperer (1995), Okun (1981) and Stiglitz (1984) who gave a list of reasons why this should be so, ranging from switching costs to the supply of new varieties of products during booms.

Rotemberg and Woodford have presented an alternative paradigm based on the collusise behavior of an oligopolistic industry. It is harder, according to their model, for firms to keep a collusive strategy in good times, when the market to reap from free riding is high. Consequently, the equilibrium mark-up must fall in good times. In order to give the intuition behind the results, consider an industry which faces a downward sloping curve characterized by:

$$D_i = p_i^{\frac{1}{\rho-1}} \tilde{X} \qquad 0 \leq \rho \leq 1$$

in which $\tilde{X}$ is some stochastic parameter driving demand, which is supposed to be known to the producers at the time when prices are set. Producers are assumed to face a CRS cost function that is written:

$$C(Q_i) = C.Q_i.$$

In the simple case of a monopoly, the optimal pricing will be

$$p_i^* = \frac{C}{\rho}$$

and the profits:

$$\tilde{\pi}^* = (1-\rho)(\frac{C_0}{\rho})^{\frac{\rho}{\rho-1}}.\tilde{X} \equiv a^*\tilde{X}$$

Assume that there exist N firms in the sector, which manage to collude and evenly split the optimal output among themselves. They will each get a fraction of total profits worth

$$\tilde{\pi}_N^* = \frac{a^*}{N}.\tilde{X}$$

We now turn to the analysis of the repeated game where firms compete in prices à la Bertrand, the products of the different firms being a perfect substitutes. Following Rotemberg and Woodford, we concentrate on the optimal subgame perfect equilibrium (the one that gives the highest profit per period per firm). Let F be the discounted value of future profits for a firm in equilibrium. Then the equilibrium strategy for each individual firm is as follows:

-if every firm has been playing the equilibrium strategy so far, then if

$$a^*X - F \leq X\frac{a^*}{N}$$

set

$$p = p^* - \frac{C}{p}.$$

Otherwise, set p such that

$$\bar{\pi}^* - (p - C)p^{\frac{\rho}{p-T}}\tilde{X} - \frac{N}{N-1}F.$$

-if a firm has played off its equilibrium strategy in the past, set

$$p = C$$

This can be understood as follows. The collusive outcome is attainable in equilibrium as long as

$$a^*X - F \leq \frac{a^*}{N}X$$

i.e.

$$a^*\frac{N-1}{N}X \leq F$$

When this condition is met the optimal pricing $p^* = \frac{C_0}{\rho}$ can be sustained. This is bound to occur for low values of $\tilde{X}$. For high values of $\tilde{X}$ instead, the equilibrium pricing will have to be lower so as to meet the requirement that:

$$\hat{a}\frac{N-1}{N}\tilde{X} = F$$

in which $\hat{a}\tilde{X}$ is the sustainable level of aggregate profits. This is the essence of the Rotemberg and Woodford argument: in periods of booms firms must slash their prices in order to sustain their collusive behavior.

To close the model, we must now solve for F. Let d be the discount factor. F is a solution of the following fixed point equation:

$$F = \frac{d}{1-d}E\left[\frac{a^*\tilde{X}}{N}1_{X<\frac{FN}{a^*(N-1)}} + \frac{F}{N-1}1_{X>\frac{FN}{a^*(N-1)}}\right]$$

The model is solved in the appendix in which we also demonstrate that the larger N and the lower the volatility of prices as they are more likely to be flattened to the competitive level.

The same basic model can give rise to a number variations on the same theme. If one takes that some firms are liquidity constrained, this can be taken as implying that current profits must exceed a critical threshold G; in that case one needs to check that:

$$G \leq (\hat{a}/N)\tilde{X}$$

and now the larger G the *more* counter-cyclical the mark-up will be. This is the essence of the argument of Chevalier and Scharfstein who have presented a few interesting empirical findings in support of their theory. For instance they expect the pricing strategy of highly leveraged firm to be less responsive to recessions: this is indeed what happens. Similarly, they expect regions or cities where national chains dominate the market over regional stores (which are more likely to be cash constrained) to experience more severe price reductions in periods of recession: this is again what happens. On will note however than in this case the larger N the more counter-cyclical the mark-ups will be. Two conflicting effects are then perhaps at work when comparing Europe and the US whose net effect is dominated by G.

V Conclusion

This paper has highlighted one critical dimension of the difference between Europe and the US regarding the Phillips curve: the behavior of prices. While they are quickly restored to an equilibrium level in the U.S., European prices are highly counter-cyclical. European firms in bad times manage to keep their prices high, while their US counterparts are pressed into cuts and discounts of various forms. This has critical policy implications. European monetary policy should perhaps be less concerned by inflation when the economy dips down: the inflationary pressure are artificially higher as firms try to keep their profits high despite the economic downturn. But a word of caution is also needed here. Perhaps the advent of the euro, by freeing competitve pressure across the eurozone, will also change the current situation towards a more americanized product market.

At any rate our findings highlight the fact that the past emphasis on labor market reforms in Europe might be misplaced compared to the need to foster competition policies.

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Appendix 1

Let us analyze here the equilibrium that is reached in the model that is presented in section 4. Call:

$$y = \frac{FN}{a^*(N-1)}$$

We can rewrite the fixed point equation as:

$$y = \frac{1}{N-1}\frac{d}{1-d}E\left[\tilde{X}1_{X<y} + y1_{X>y}\right]$$

Let

$$f(y) = \frac{1}{N-1}\frac{d}{1-d}E\left[\tilde{X}1_{X<y} + y1_{X>y}\right] - y$$

We have:

$$f(0) = 0$$

and

$$f'(y) = \frac{1}{N-1}\frac{d}{1-d}P(\tilde{X}1 > y) - 1$$

As is readily seen, f' is decreasing, so that f is a convex function. In order to get a solution, we need to make the following assumption:

$$f'(0) = \frac{1}{N-1}\frac{d}{1-d} - 1 > 0$$

This implies that f is strictly positive for every small enough $y > 0$. This puts an upper bound on the number of firms in order for the strategies we have described to be an equilibrium. This upper bound is an increasing function of d, and goes to the infinity as d goes to 1.

Since the limit of f' as y goes to infinity is -1, this implies that the equation $f(y) = 0$ has a unique strictly positive solution

$$y^* = \frac{F^* N}{a^*(N-1)}$$

Since f is decreasing function of N, it is clear that $y^* - \frac{F^* N}{a^*(N-1)}$ is also a decreasing function of N.

It is now straightforward here to show that the larger N and the lower the volatility of prices as they are more likely to be flattened to the competitive level. The proof in our example comes as follows. Call $\hat{\gamma}$ the mark-up that is reached when the constraint is binding. We get:

$$(\hat{\gamma} - 1)\hat{\gamma}^{\frac{1}{\rho - 1}} = a^* B \frac{F^* N}{a(N-1)} \frac{1}{\tilde{X}} = a^* B y^* \frac{1}{\tilde{X}}$$

in which $B - C^{\frac{\rho - 1}{\rho}}$. Since $y^*$is a decreasing function of N, this formula shows that $\tilde{\gamma}$ is decreasing in N.

Let us write $\varepsilon = \varepsilon(m, X)$ the elasticity of the mark-up. We have:

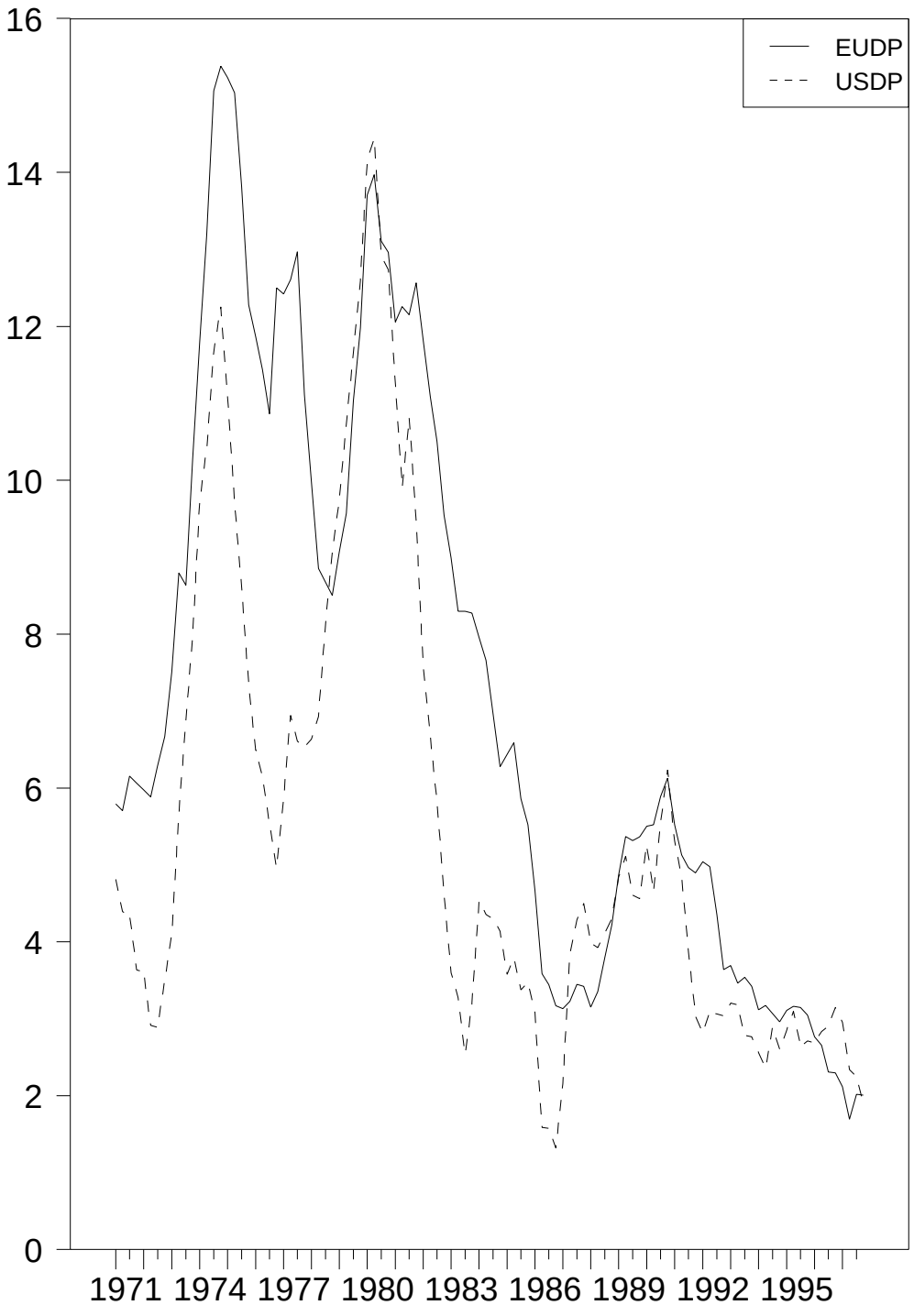
$$\varepsilon \left[\frac{1}{\rho - 1} + \frac{\tilde{\gamma}}{\tilde{\gamma} - 1} \right] - 1$$

Since $\tilde{\gamma} \leq \frac{1}{\rho}$ which is the monopoly pricing, one gets that ε is indeed negative. Since $\tilde{\gamma}$ is a decreasing function of N, one also sees that ε is also a decreasing function of N: we then get that the larger the number of firms to compete, the less counter cyclical the mark-up will be.

Appendix 2

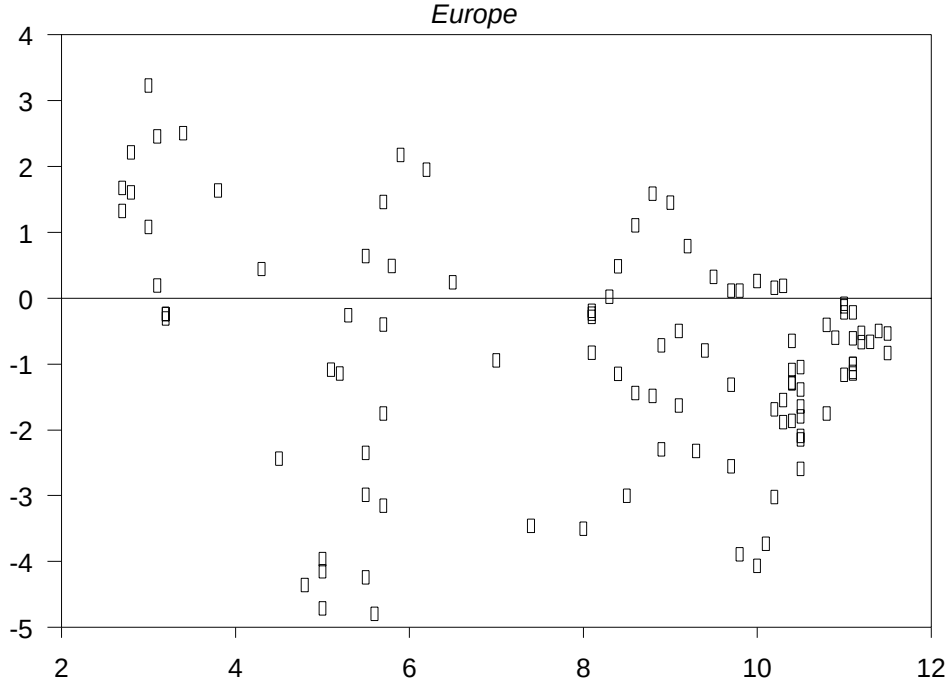
Figure 1: Inflation
Figure 2: Nairu
Figures 3: Cholesky decomposition

Inflation

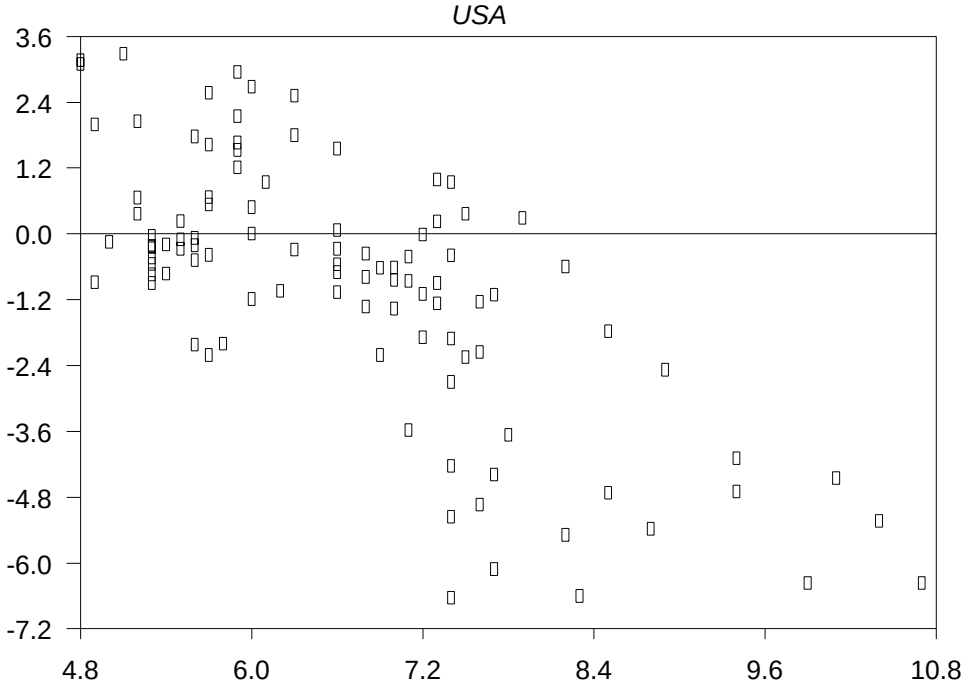

EUDP
USDP
16
14
12
10
8
6
4
2
0
1971 1974 1977 1980 1983 1986 1989 1992 1995

NAIRU Curves

Europe

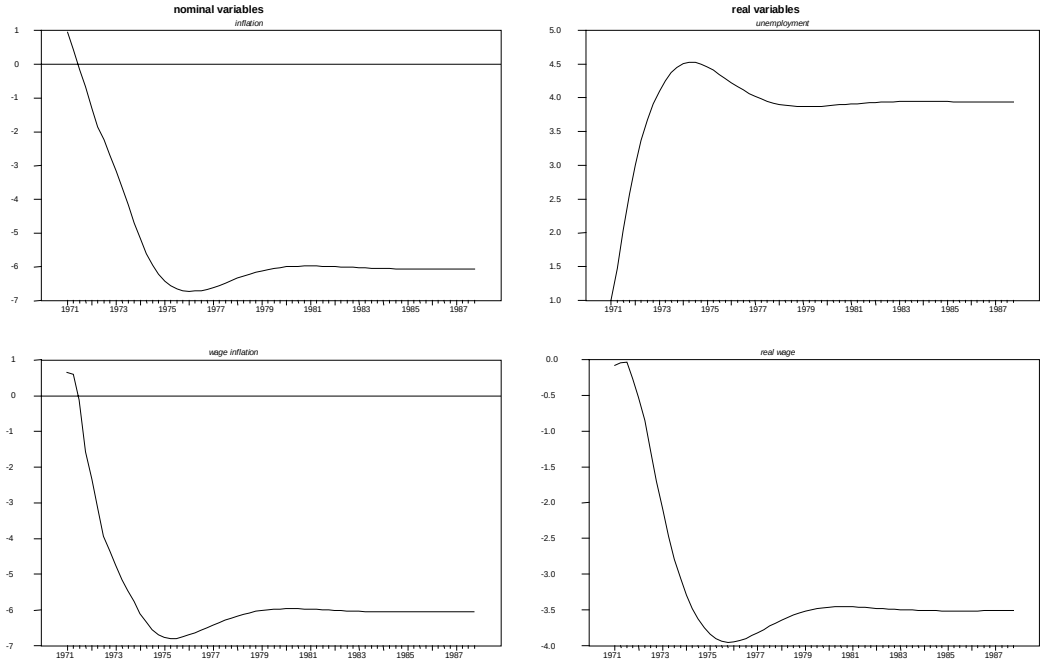


USA



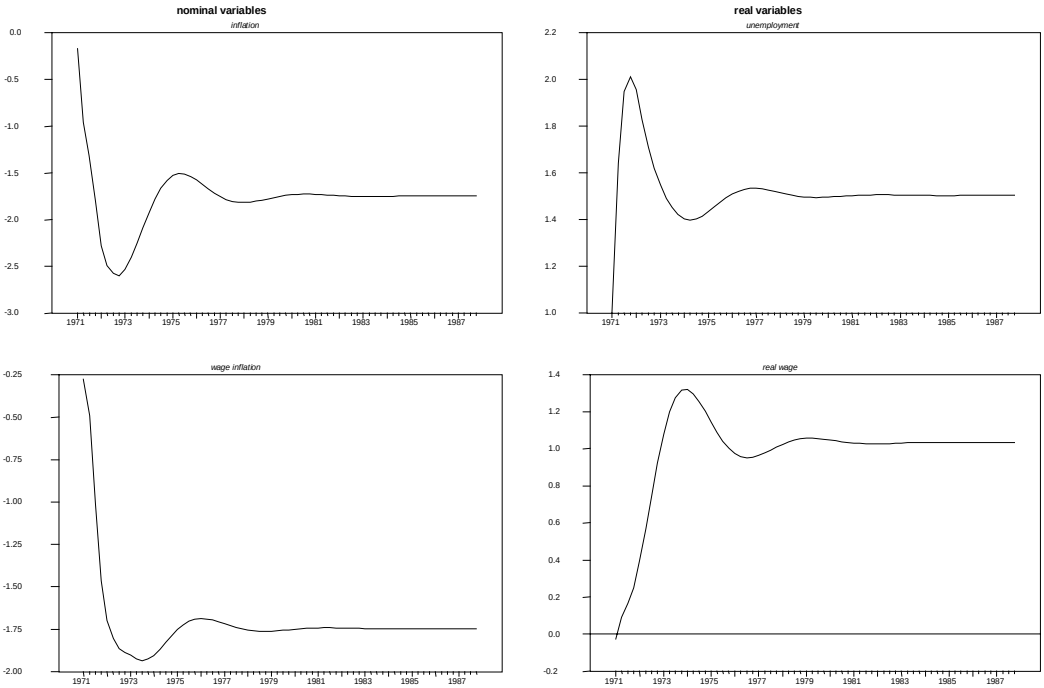
Cholesky decomposition : reaction to a demand shock

Europe



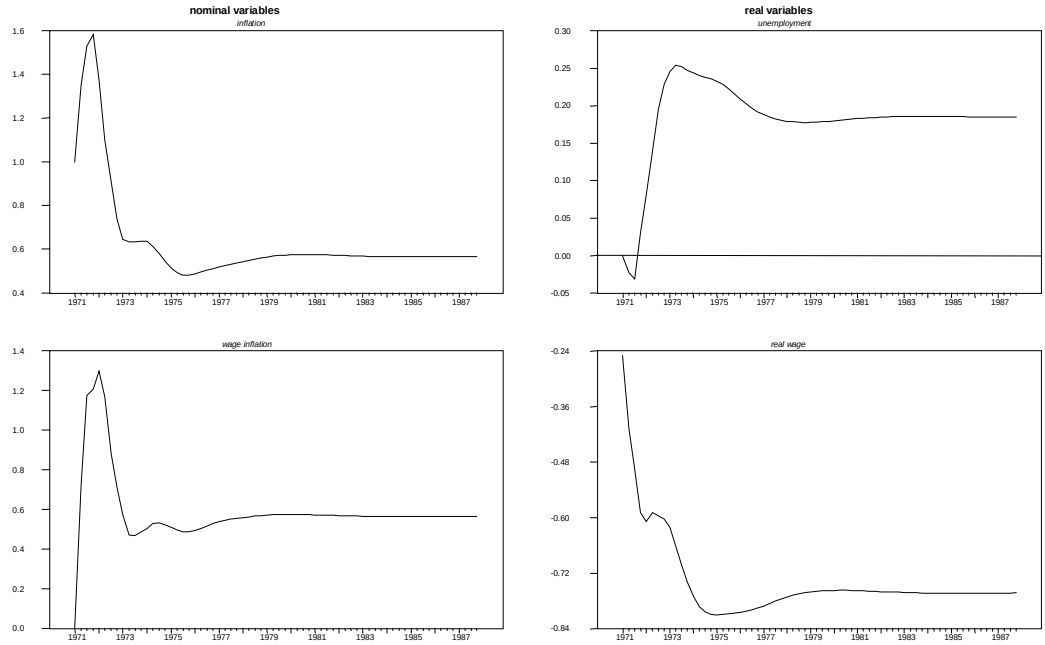
Cholesky decomposition : reaction to a demand shock

USA



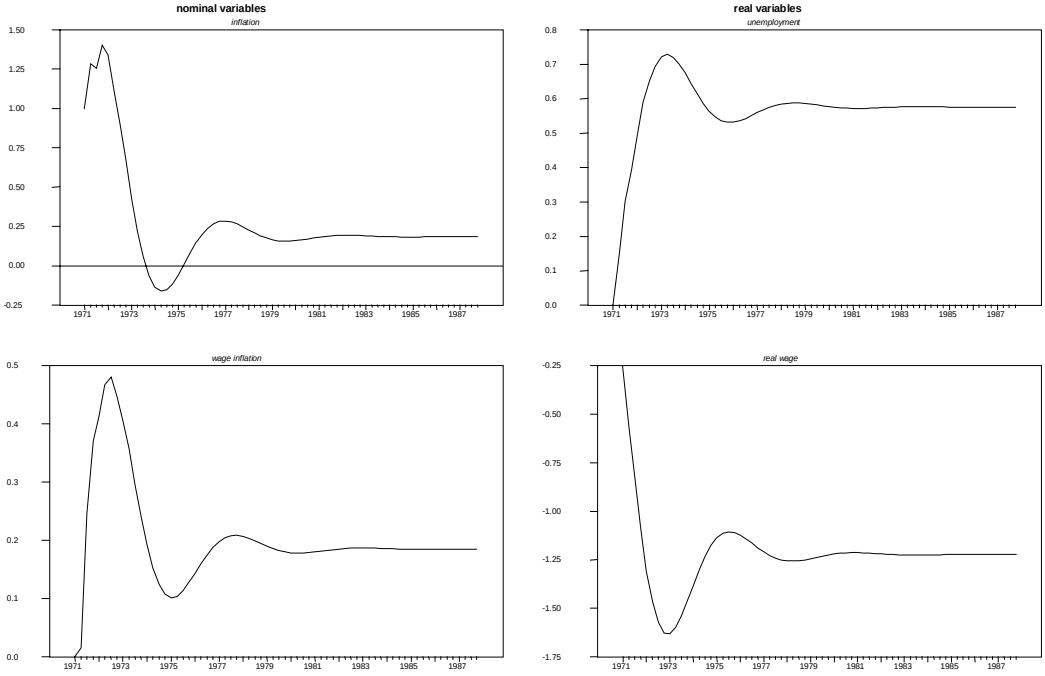
Cholesky decomposition : reaction to a supply shock

Europe



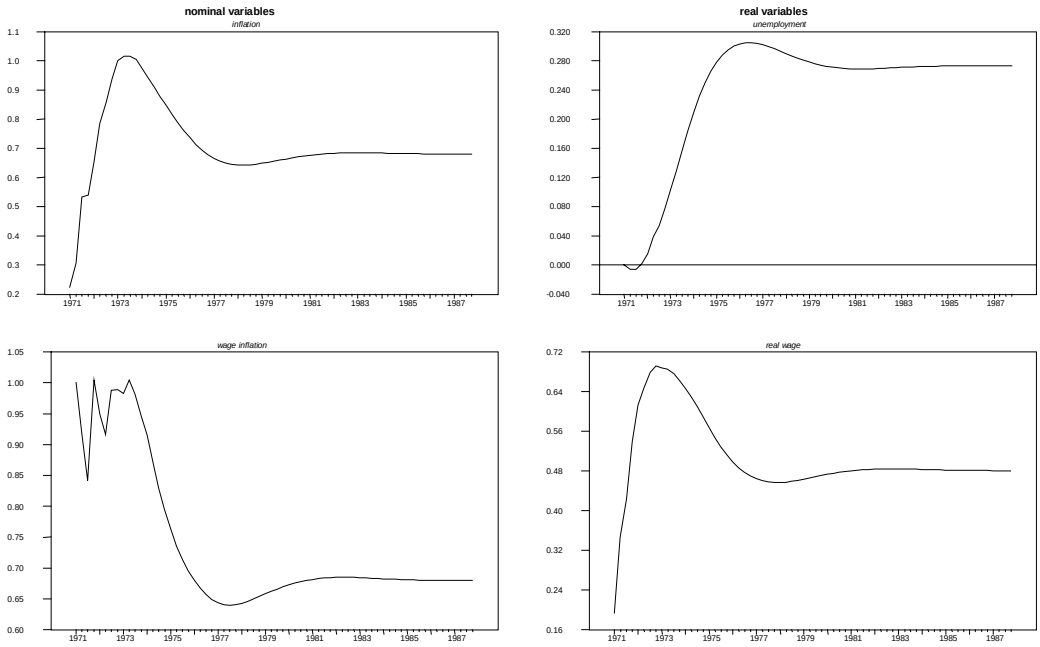
Cholesky decomposition : reaction to a supply shock

USA



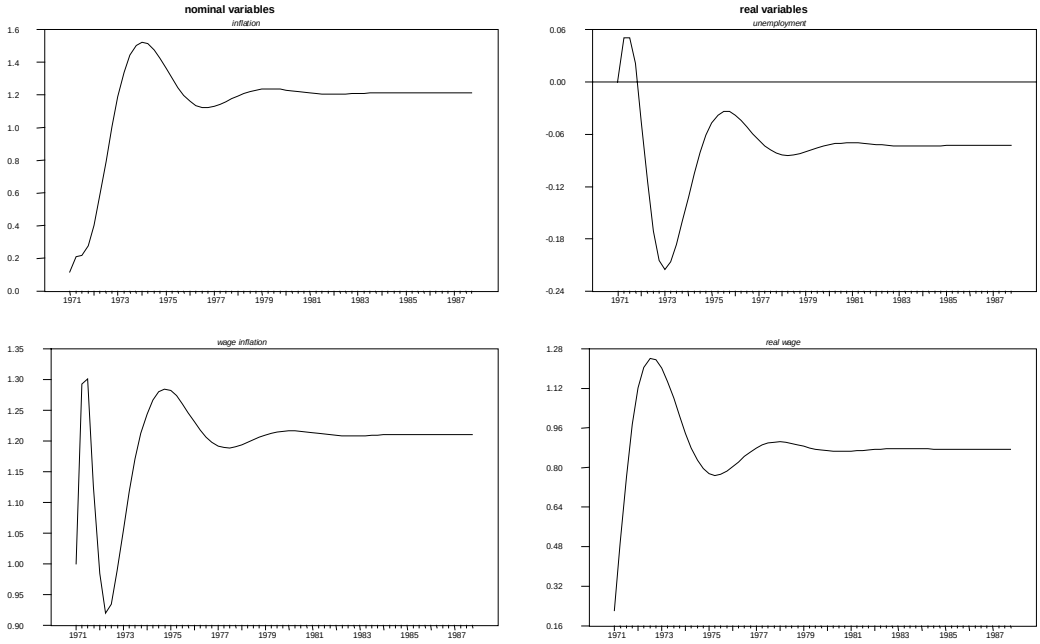
Cholesky decomposition : reaction to a bargaining shock

Europe



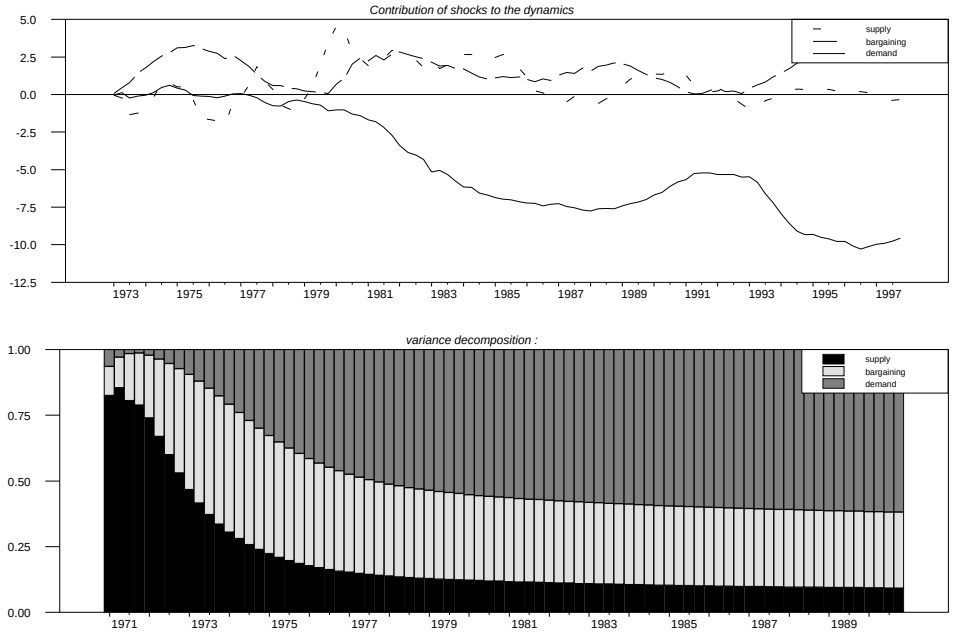
Cholesky decomposition : reaction to a bargaining shock

USA



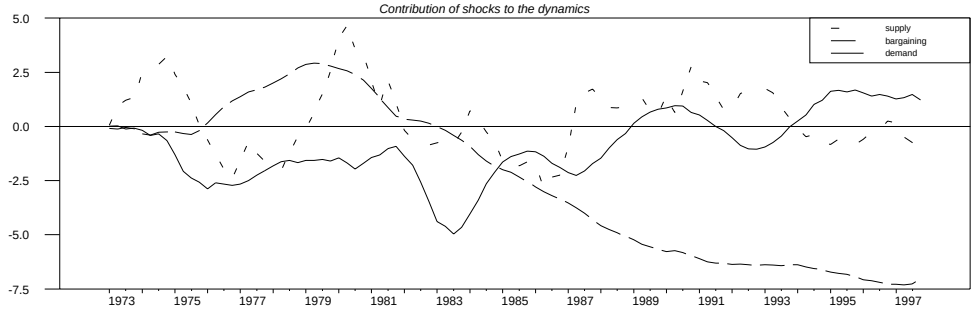
Cholesky decomposition : inflation

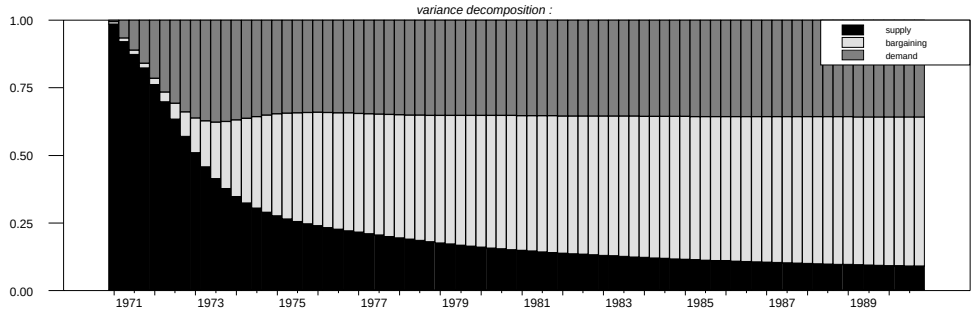
Europe



Cholesky decomposition : inflation

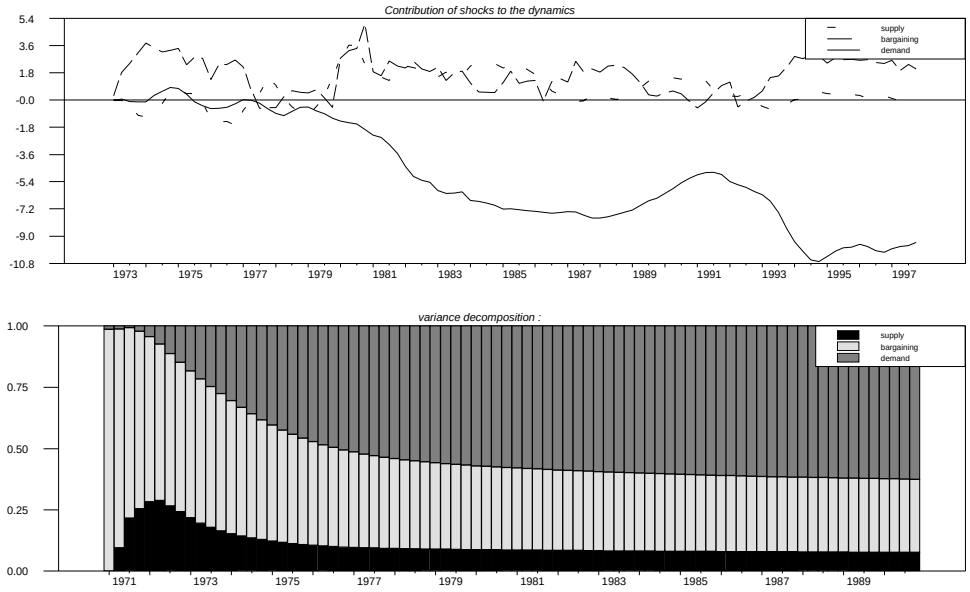
USA





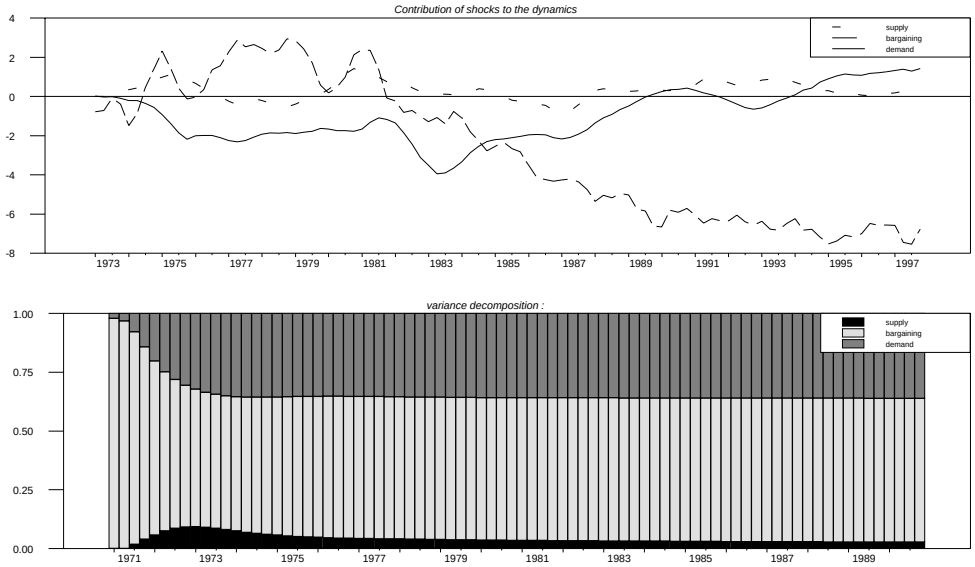
Cholesky decomposition : wage inflation

Europe



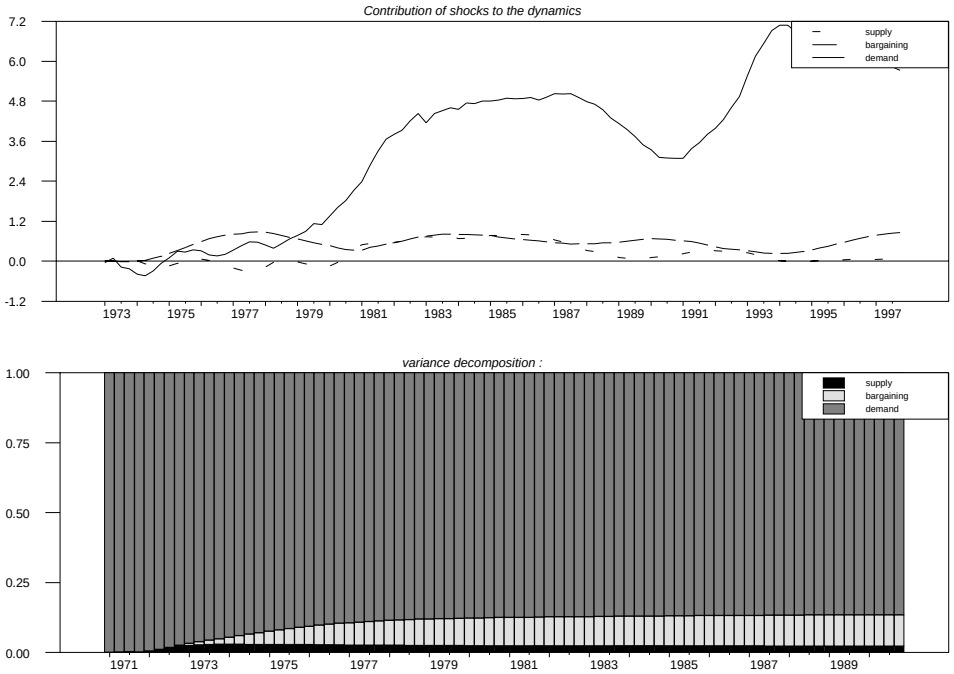
Cholesky decomposition : wage inflation

USA



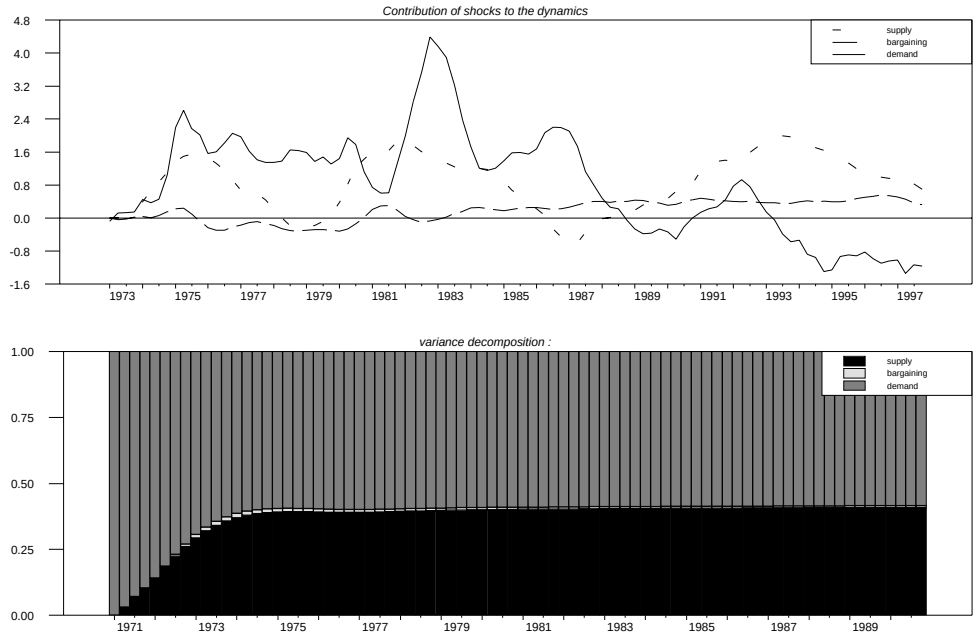
Cholesky decomposition : unemployment

Europe



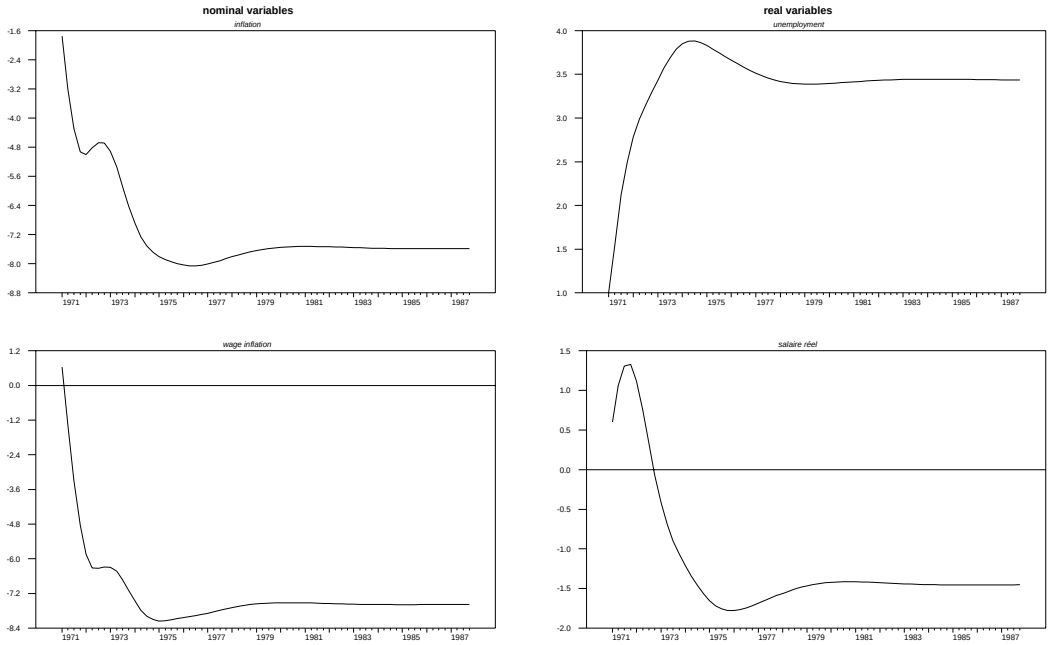
Cholesky decomposition : unemployment

USA



King and Watson, l=-0.57 : réaction to a shock demand

Europe



King and Watson, l=-0.57 : réaction to a shock demand

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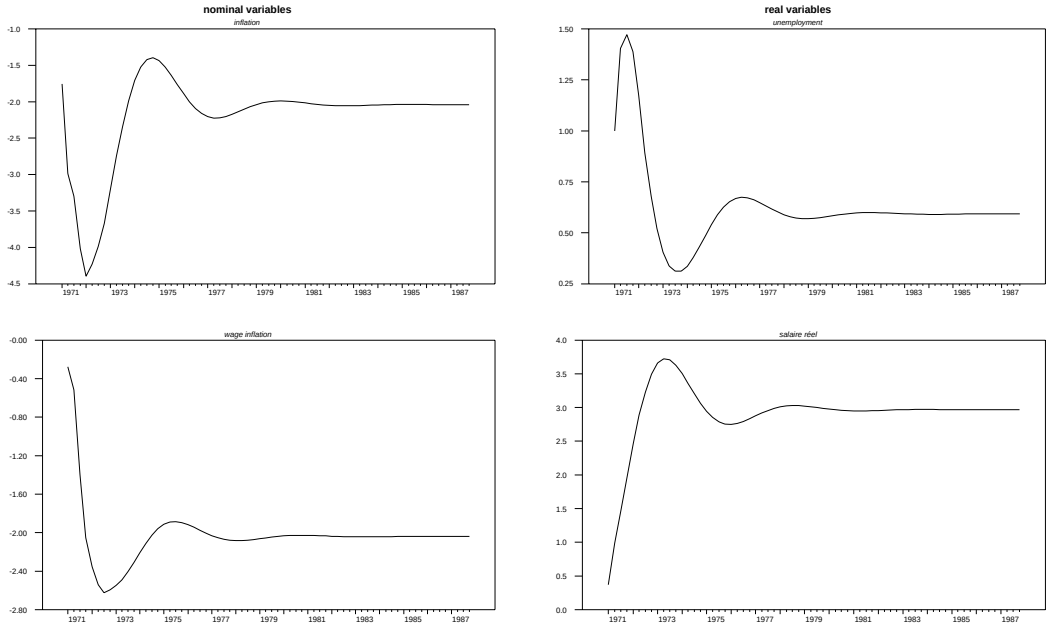
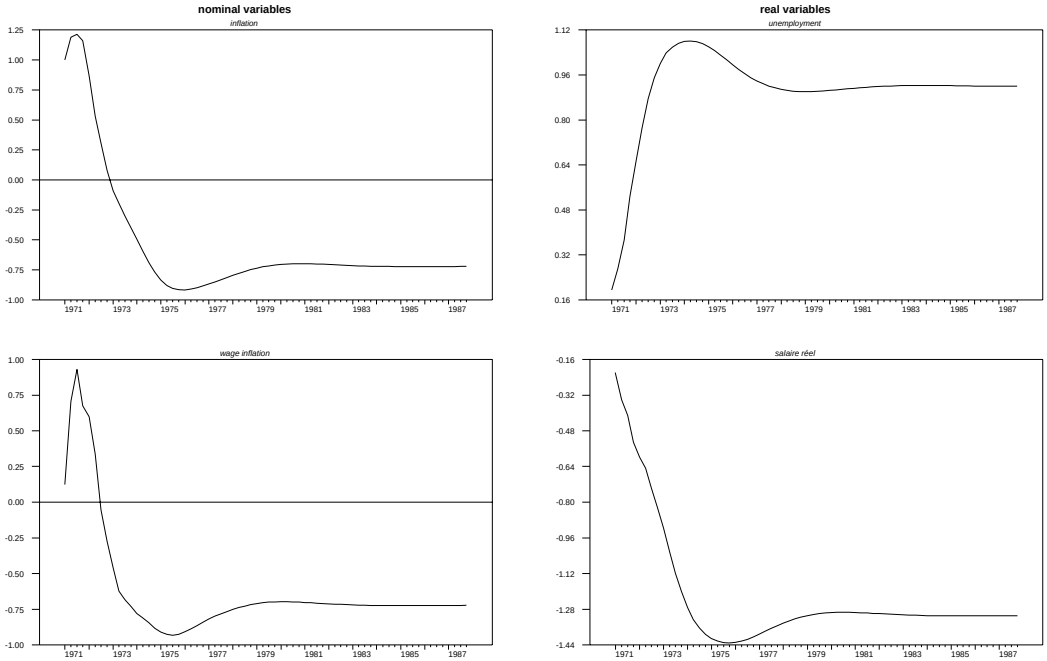


King and Watson, l=-0.57 : réaction to a shock supply

Europe



King and Watson, l=-0.57 : réaction to a shock supply

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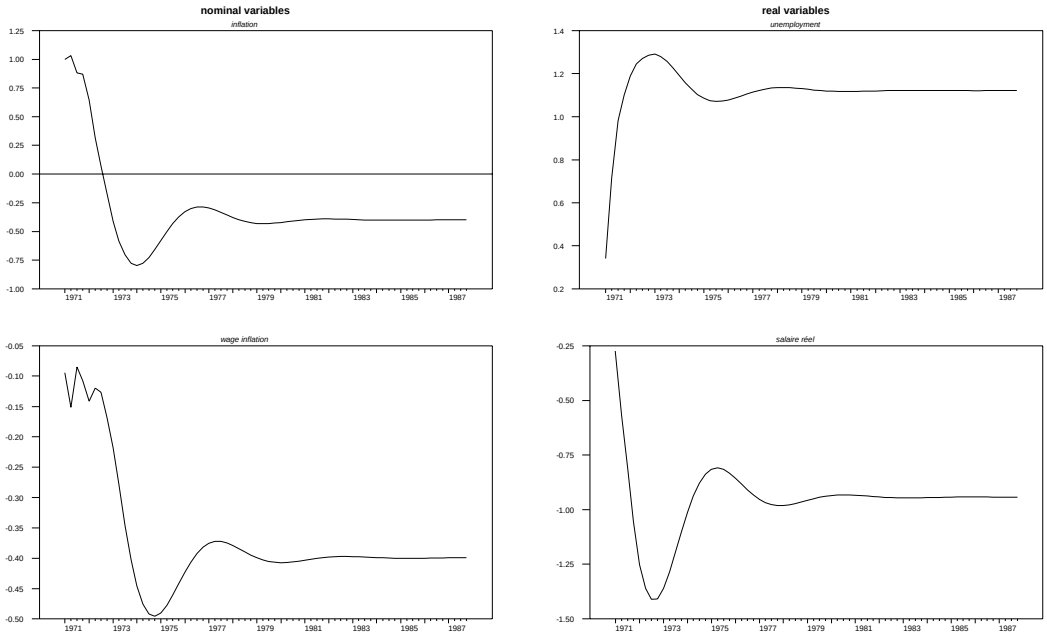
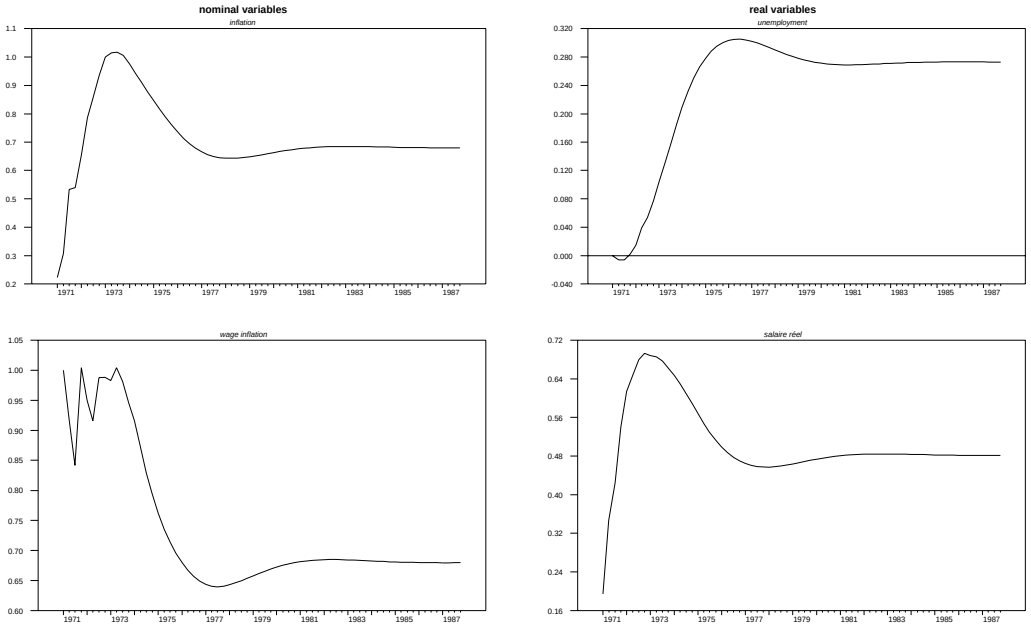


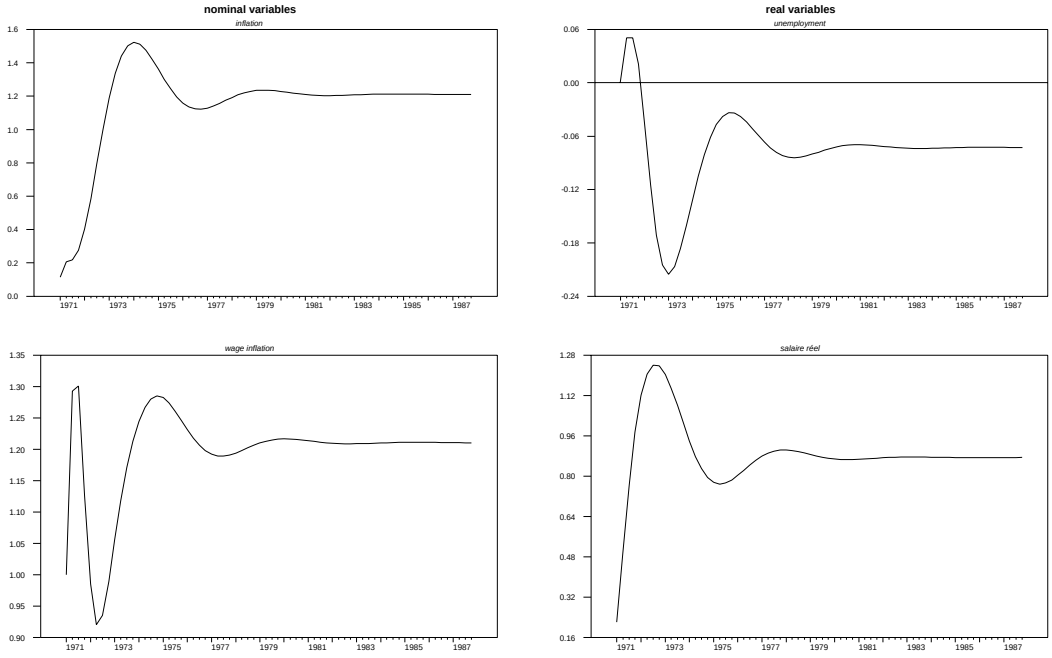
King and Watson, l=-0.57 : réaction to a shock bargaining

Europe



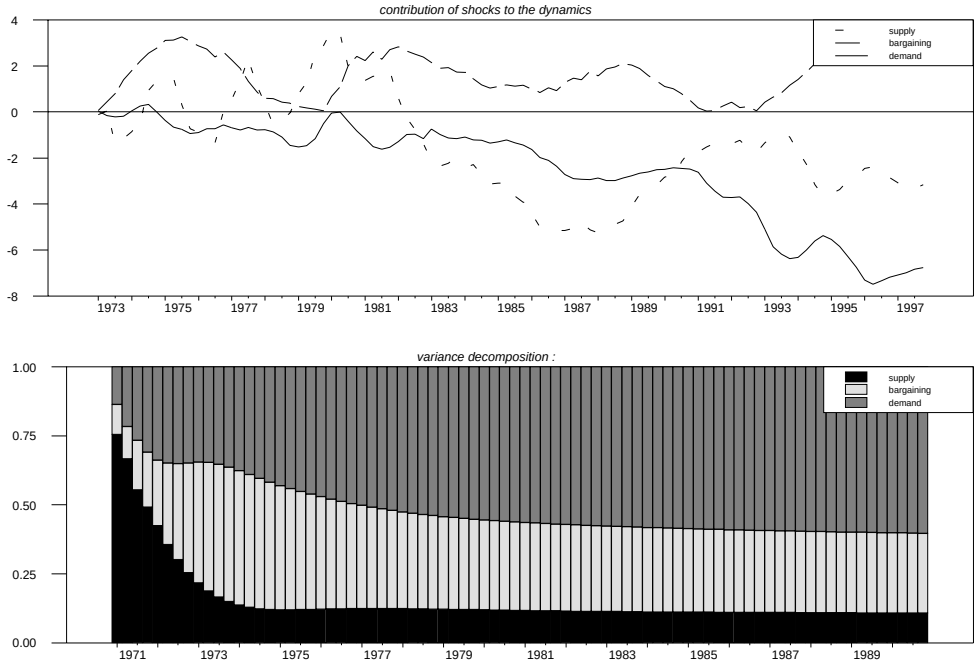
King and Watson, l=-0.57 : réaction to a shock bargaining

USA



King and Watson, l=-0.57 : inflation

Europe



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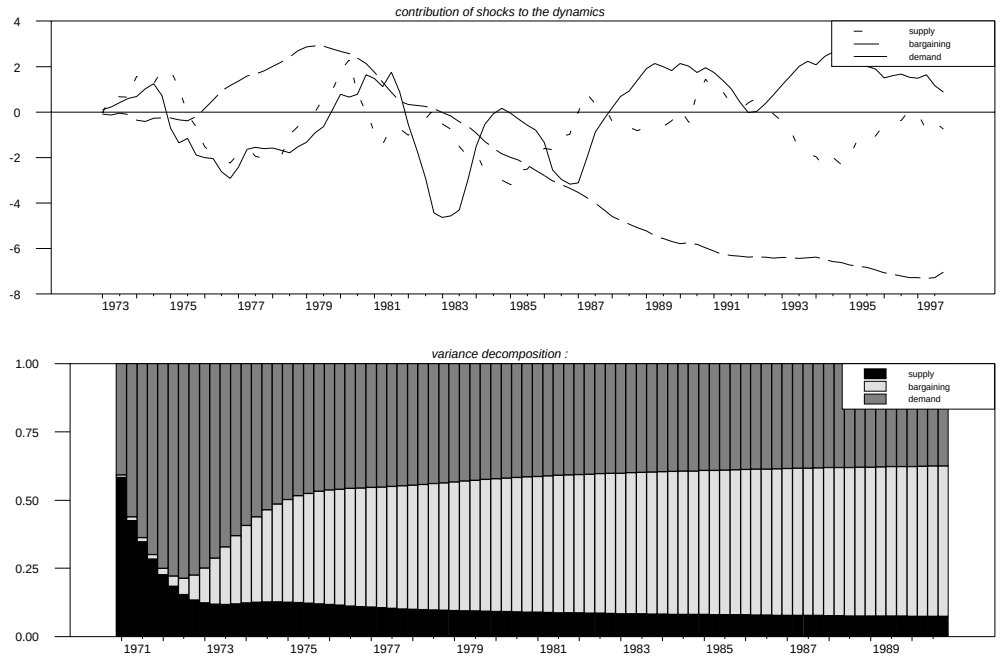
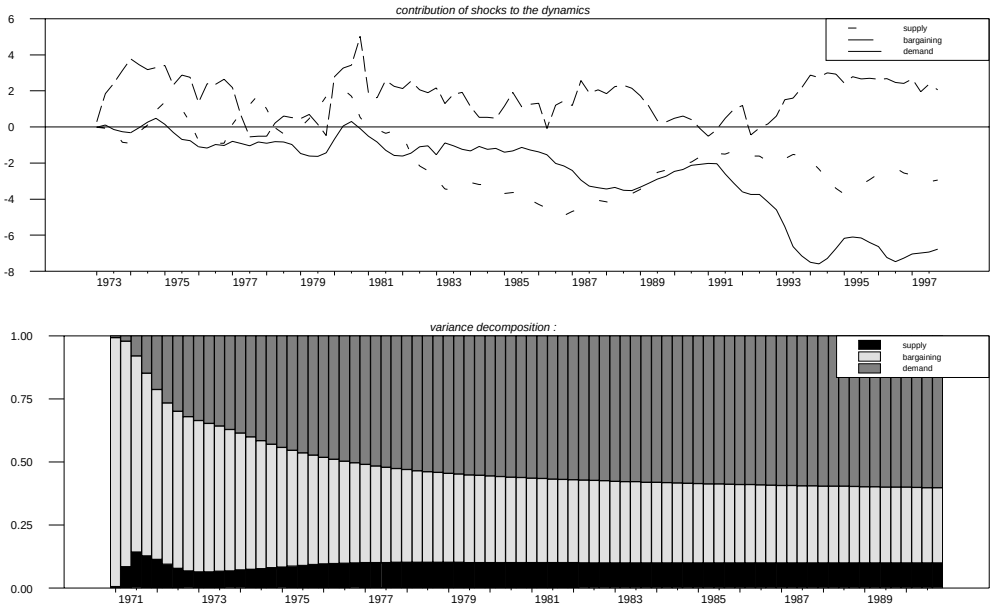


King and Watson, l=-0.57 : wage inflation

Europe



King and Watson, l=-0.57 : wage inflation

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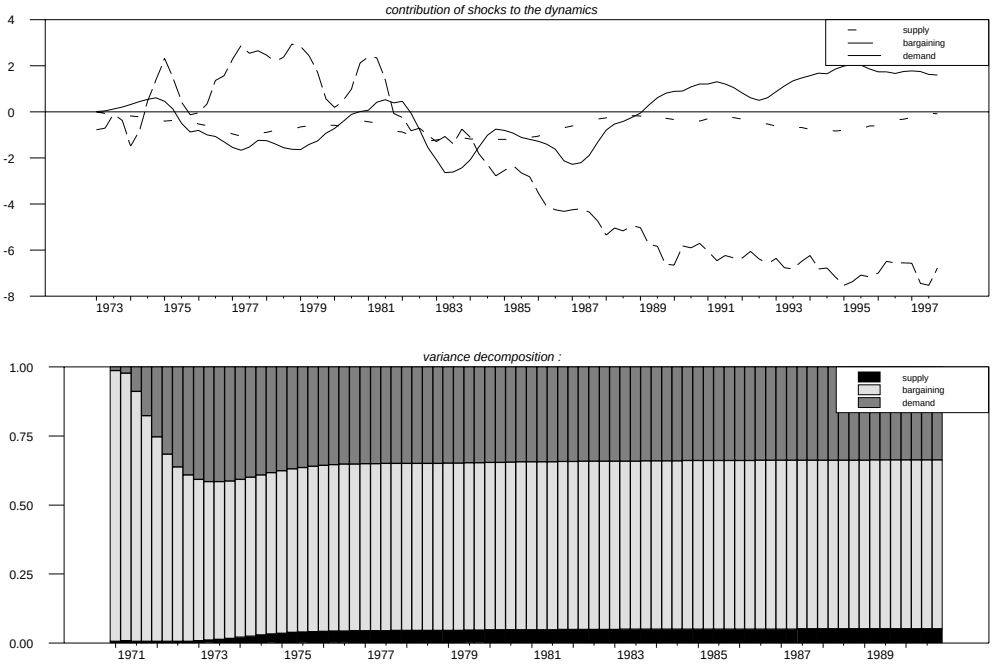
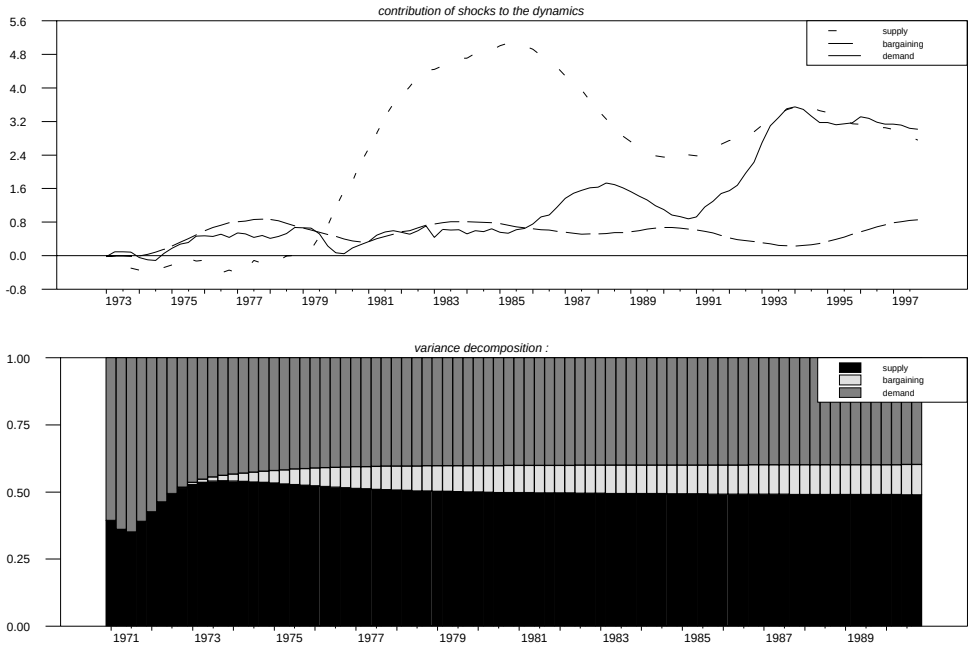


King and Watson, l=-0.57 : unemployment

Europe



King and Watson, l=-0.57 : unemployment

USA