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International Macroeconomics

Columbia University
Exchange Rate Policy and Unemployment
Topic: Sudden Stops and Unemployment in a Currency Union

Case Study: The Great Recession in Peripherical Europe: 2008-2011
Claim: In a Currency Union Sudden Stops Lead to Unemployment Rather than Real Depreciations
Sudden Stops in Peripherical Europe: 2000-2011
Data Source: Eurostat. Data represents arithmetic mean of Bulgaria, Cyprus, Estonia, Greece, Lithuania, Latvia, Portugal, Spain, Slovenia, and Slovakia
Some Observations:

- Peripherical Europe experienced a sudden stop in 2008.
- Large current account reversals
- Sudden Stops lead to unemployment

Question: What about the Real exchange rate (RER)?

Next graph plots the real exchange rate: \( e = \frac{SP^*}{P} \)

A RER depreciation is when \( e \uparrow \)

RER scaled so that 2008 is 100

example: a 5 percent real depreciation between 2008 and 2014 would be reflected in an increase in the RER index from 100 to 105
Real Exchange Rate, $e$, \((2008 = 100)\)
Observations on the figure:

Even 6 years after the sudden stop we see very little real depreciation, of less than 5 percent.

Compare this with the large real depreciations that we saw for the Sudden Stops in Chile, 1979-1985, (close to 100%) and in Argentina, 2001-2002, (about 200%).
Why Do Sudden Stops lead to Unemployment in a Currency Union?

Possible Answer: Because nominal wages are downwardly rigid

Formally, assume $W_t \geq \gamma W_{t-1}$

$W_t =$ nominal wage rate in period $t$

We will argue that $\gamma = 1$
Empirical Evidence on Downward Nominal Wage Rigidity

- Downward wage rigidity is a widespread phenomenon:
  - Evident in micro and macro data.
  - Rich, emerging, and poor countries.
  - Developed and underdeveloped regions of the world.

- **Byproduct:** Will obtain an estimate of the parameter $\gamma$ governing wage stickiness in the model (useful for quantitative analysis).
Probability of Decline, Increase, or No Change in Wages

U.S. data, SIPP panel 1986-1993, between interviews one year apart.

<table>
<thead>
<tr>
<th>Interviews One Year apart</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decline</td>
<td>5.1%</td>
<td>4.3%</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>53.7%</td>
<td>49.2%</td>
</tr>
<tr>
<td>Increase</td>
<td>41.2%</td>
<td>46.5%</td>
</tr>
</tbody>
</table>

Source: Gottschalk (2005)

- Large mass at ‘Constant’ suggests nominal wage rigidity.
- Small mass at ’Decline’ suggests downward nominal wage rigidity.
Distribution of Non-Zero Nominal Wage Changes
United States 1996-1999

Source: Barattieri, Basu, and Gottschalk (2012)
Evidence From The Great Contraction Of 2007
Distribution of Nominal Wage Changes, U.S. 2011

Figure 2
Distribution of observed nominal wage changes

Source: Daly, Hobijn, and Lucking (2012).
Micro Evidence On Downward Nominal Wage Rigidity From Other Developed Countries

- Switzerland: Fehr and Goette (2005).
Evidence From Informal Labor Markets

• Kaur (2012) examines the behavior of nominal wages, employment, and rainfall in casual daily agricultural labor markets in rural India (500 districts from 1956 to 2008).

• Finds asymmetric nominal wage adjustment:
  — $W_t$ increases in response to positive rainfall shocks
  — $W_t$ fails to fall in response to negative rain shocks. Instead, labor rationing and unemployment are observed.

• Inflation (uncorrelated with local rain shocks) tends to moderate rationing and unemployment during negative rain shocks, suggesting downward rigidity in nominal rather than real wages.
Evidence From the Great Depression, 1929-1933

- Enormous contraction in employment: 31% between 1929 and 1931.

- Nonetheless, during this period nominal wages fell by 0.6% per year, while consumer prices fell by 6.6% per year. See the figure on the next slide.

- A similar pattern is observed during the second half of the Depression. By 1933, real wages were 26% higher than in 1929, in spite of a highly distressed labor market.
Nominal Wage Rate and Consumer Prices, United States
1923:1-1935:7

Evidence From the Great Depression In Europe

- Countries that left the gold standard earlier recovered faster than countries that remained on gold.

— Left Gold Early (sterling bloc): United Kingdom, Sweden, Finland, Norway, and Denmark.

— Countries That Stuck To Gold (gold bloc): France, Belgium, the Netherlands, and Italy.

- Think of the gold standard as a currency peg (a peg not to a currency, but to gold).

- When sterling-bloc left gold, they effectively devalued, as their currencies lost value against gold.

- Look at the figure on the next slide. Between 1929 and 1935, sterling-bloc countries experienced less real wage growth and larger increases in industrial production than gold-bloc countries.
Changes In Real Wages and Industrial Production, 1929-1935

Evidence From Emerging Countries

- Argentina: pegged the peso at a 1-to-1 rate with the dollar between 1991 and 2001.

- Starting in 1998, the economy was buffeted by a number of large negative shocks (weak commodity prices, large devaluation in Brazil, large increase in country premium, etc.).


- Nonetheless, nominal wages remained remarkably flat.

- This evidence suggests that nominal wages are downwardly rigid, and that $\gamma$ is about 1.

- Why $\gamma \approx 1$? The slackness condition $(\bar{h} - h_t)(W_t - \gamma W_{t-1})$ (recall $\epsilon_t = 1$ during this period), implies that if unemployment is growing, wages must grow at the gross rate $\gamma$. 
Argentina 1996-2006

Nominal Exchange Rate ($E_t$)

Unemployment Rate + Underemployment Rate

Nominal Wage ($W_t$)

Real Wage ($W_t/E_t$)

Implied Value of $\gamma$: Around unity.
Evidence From Peripheral Europe (2008-2011)

• Look at the table on the next slide.

• Between 2008 and 2011, all countries in the periphery of Europe experienced increases in unemployment. Some very large increases.

• In spite of this context of extreme duress, nominal hourly wages experienced significant increases in most countries and modest declines in very few.

• The slide following the table explains how to use the information in the table to infer a range for $\gamma$. 
## Unemployment, Nominal Wages, and $\gamma$
### Evidence from the Eurozone

<table>
<thead>
<tr>
<th>Country</th>
<th>Unemployment Rate 2008Q1 (in percent)</th>
<th>Unemployment Rate 2011Q2 (in percent)</th>
<th>Wage Growth $\frac{W_{2011Q2}}{W_{2008Q1}}$ (in percent)</th>
<th>Implied Value of $\gamma$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulgaria</td>
<td>6.1</td>
<td>11.3</td>
<td>43.3</td>
<td>1.028</td>
</tr>
<tr>
<td>Cyprus</td>
<td>3.8</td>
<td>6.9</td>
<td>10.7</td>
<td>1.008</td>
</tr>
<tr>
<td>Estonia</td>
<td>4.1</td>
<td>12.8</td>
<td>2.5</td>
<td>1.002</td>
</tr>
<tr>
<td>Greece</td>
<td>7.8</td>
<td>16.7</td>
<td>-2.3</td>
<td>0.9982</td>
</tr>
<tr>
<td>Ireland</td>
<td>4.9</td>
<td>14.3</td>
<td>0.5</td>
<td>1.0004</td>
</tr>
<tr>
<td>Italy</td>
<td>6.4</td>
<td>8.2</td>
<td>10.0</td>
<td>1.007</td>
</tr>
<tr>
<td>Lithuania</td>
<td>4.1</td>
<td>15.6</td>
<td>-5.1</td>
<td>0.996</td>
</tr>
<tr>
<td>Latvia</td>
<td>6.1</td>
<td>16.2</td>
<td>-0.6</td>
<td>0.9995</td>
</tr>
<tr>
<td>Portugal</td>
<td>8.3</td>
<td>12.5</td>
<td>1.91</td>
<td>1.001</td>
</tr>
<tr>
<td>Spain</td>
<td>9.2</td>
<td>20.8</td>
<td>8.0</td>
<td>1.006</td>
</tr>
<tr>
<td>Slovenia</td>
<td>4.7</td>
<td>7.9</td>
<td>12.5</td>
<td>1.009</td>
</tr>
<tr>
<td>Slovakia</td>
<td>10.2</td>
<td>13.3</td>
<td>13.4</td>
<td>1.010</td>
</tr>
</tbody>
</table>

How To Infer $\gamma$

The model implies that if unemployment increases from one period to the next, then nominal wages must be growing at the rate $\gamma$.

How to calculate $\gamma$:

$$\gamma = \left(\frac{W_{2011:Q2}}{W_{2008:Q1}}\right)^{\frac{1}{13}}$$

Subtract 0.6% per quarter to adjust for foreign inflation and long-run growth (because they are not explicitly incorporated in the model) to obtain the estimate:

$$\gamma \in [0.99, 1.022]$$
A Model with Unemployment Due to Downward Nominal Wage Rigidity
Model
small open economy
free capital mobility
2 periods
2 goods, traded and nontraded

\[ P_t^N = \text{nominal price of nontraded goods in period } t \]
\[ P_t^T = \text{nominal price of traded goods in period } t \]
\[ P_t^* = \text{foreign price of traded goods in period } t \]
\[ S_t = \text{nominal exchange rate} \]

Law of one price holds for tradables: \[ P_t^T = S_t P_t^* \]
Assume that \( P_t^* = 1 \), hence \( P_t^T = S_t \)

\[ p_t = \frac{P_t^N}{P_t^T} \] relative price of nontradables, or RER in period \( t \)
\[ B_1^* = \text{international bonds held by household at end of period } 1, \]
denominated in traded gods.
The Problem of Households

\( C^N_t \) = nontraded good consumption in period \( t \)
\( C^T_t \) = traded good consumption in period \( t \)
\( Y_t \) = income, in terms of tradables, of the household in period \( t \)
\( r_t \) = interest rate on assets held from \( t \) to \( t+1 \)

The household takes income, \( Y_1 \) and \( Y_2 \), as exogenously given.
Preferences:

\[ U(c^T_1, c^N_1) + U(c^T_2, c^N_2) \]

Budget constraint in period 1:

\[ P^T_1 c^T_1 + P^N_1 c^N_1 + P^T_1 B^*_1 = P^T_1 Y_1 + (1 + r_0) P^T_1 B^*_0 \]

Budget constraint in period 2:

\[ P^T_2 c^T_2 + P^N_2 c^N_2 = P^T_2 Y_2 + (1 + r_1) P^T_2 B^*_1 \]
Write budget constraint in terms of tradables, that is, divide by $P_t^T$:

Budget constraint in period 1:
$$c_1^T + p_1 c_1^N + B_1^* = Y_1 + (1 + r_0) B_0^*$$

Budget constraint in period 2:
$$c_2^T + p_2 c_2^N = Y_2 + (1 + r_1) B_1^*$$

For simplicity, assume that initial assets are zero, $B_0^* = 0$.

Then obtain the single present value budget constraint:
$$c_1^T + p_1 c_1^N + \frac{c_2^T + p_2 c_2^N}{1 + r_1} = Y_1 + \frac{Y_2}{1 + r_1}$$
So we can state the household problem as follows: Pick \(c^T_1, c^N_1, c^T_2, c^N_2\), taking as given \(p_1, p_2, Y_1, Y_1,\) and \(r_1\), to maximize:

\[
U(c^T_1, c^N_1) + U(c^T_2, c^N_2)
\]

subject to the budget constraint:

\[
c^T_1 + p_1 c^N_1 + \frac{c^T_2 + p_2 c^N_2}{1 + r_1} = Y_1 + \frac{Y_2}{1 + r_1}
\]

One first-order condition to this problem is that the marginal rate of substitution between traded and nontraded good consumption in period 1 has to be equal to the relative price, that is, at the utility maximizing allocation it must be the case that:

\[
\frac{U_2(c^T_1, c^N_1)}{U_1(c^T_1, c^N_1)} = p_1
\]
How can we interpret this optimality condition. Suppose the household has 1 unit of traded good in period 1 and wants to decide to either consume it now or to sell it and buy nontraded goods for it. The marginal utility of consuming the one unit of traded good in period 1 is: $U_1(c^T_1, c^N_1)$. If the household sells the unit of consumption and buys nontradables for it, how many nontraded good does he get? He obtains $1/p_1$ units of nontradables. How much additional utility do these nontraded goods generate? They increase utility by $U_2(c^T_1, c^N_1)/p_1$. At the optimum the additional utility of consuming one more traded good must be the same as that of exchanging the traded good for a nontraded one and then consuming the nontraded good. Hence it must be the case that $U_2(c^T_1, c^N_1)/p_1 = U_1(c^T_1, c^N_1)/p_1$, which is the same as the above first-order condition.

We interpret this first-order condition as a demand function for nontradables as a function of the real exchange rate, or the
relative price of nontradables, $p_t$, for a given level of traded consumption $c_T^1$. Let’s plot this demand function in the space $(c_N^1, p_1)$. See figure xxx. This demand function is downward sloping as long as both consumption of tradables and consumption of nontradables are normal goods. For example, suppose the period 1 utility function is of the form: $U(c^T, c^N) = a \ln c^T + (1 - a) \ln c^N$. Then the marginal rate of substitution is:

$$\frac{U_2(c_T^1, c_N^1)}{U_1(c_T^1, c_N^1)} = \frac{(1 - a) c^T}{a c^N}$$

In this case the demand function for nontradables thus becomes:

$$p_1 = \frac{(1 - a) c_T^1}{a c_N^2}$$

We will consider a sudden stop, which we interpret as an increase in the world interest rate, $r_1$. Recall that in the model with only a single good a rise in the world interest rate in period 1, lowers consumption in period 1 and increases it in period
2. We will show below that the same holds in the two-good model considered currently. For the moment we just take it as given that when there is a sudden stop, i.e., \( r_1 \uparrow \), then \( c_T \downarrow \). Our question is how does a sudden stop affect the demand for nontradables. Figure xxx shows that a decline in \( c_T \) shifts the demand schedule down and to the left. That is, for the same price agents now demand less nontradables.

The Supply of Nontradables
• Workers supply $\bar{h}$ hours inelastically, but may not be able to sell them all. They take $h_t \leq \bar{h}$ as given.
• One first-order condition (Demand for Nontradables):

\[
\frac{A_2(c^T_t, c^N_t)}{A_1(c^T_t, c^N_t)} = p_t
\]

Traded goods, stochastic endowment: \( y^T_t \)

Nontraded goods, produced with labor: \( y^N_t = F(h_t) \)
Firms in the Nontraded Sector

$$\max_{\{h_t\}} p_t F(h_t) - w_t h_t,$$

taking as given $p_t$ and $w_t$,

where $w_t \equiv W_t/S_t$ is the real wage in terms of tradables.

Optimality condition (or the Supply of Nontradables):

$$p_t = \frac{W_t/S_t}{F'(h_t)}$$
The Supply of Nontraded Goods

\[ \frac{W_0/E_0}{F'(h)} \]
$S_t \uparrow$: A Devaluation Shifts The Supply Schedule Down

\[
\frac{W_0}{P_0^* M \bar{E}} F'(h) \quad \text{and} \quad \frac{W_0}{P_1^* M \bar{E}} F'(h)
\]

$(S_1 > S_0)$
The Demand for Nontraded Goods

\[
p = \frac{A_2(c_0^T, F(h))}{A_1(c_0^T, F(h))}
\]
A Contraction in Traded Absorption, $c^T_t \downarrow$, Shifts the Demand for Nontradables Down and to the Left

\[
\begin{align*}
A_2(c^T_0, F(h)) & \quad \frac{A_2(c^T_0, F(h))}{A_1(c^T_0, F(h))} \\
A_2(c^T_1, F(h)) & \quad \frac{A_2(c^T_1, F(h))}{A_1(c^T_1, F(h))}
\end{align*}
\]

$(c^T_1 < c^T_0)$