Exchange Rate Policies at the Zero Lower Bound

Manuel Amador
U Minnesota and Minneapolis Fed

Javier Bianchi
Minneapolis Fed

Luigi Bocola
Northwestern University

Fabrizio Perri
Minneapolis Fed

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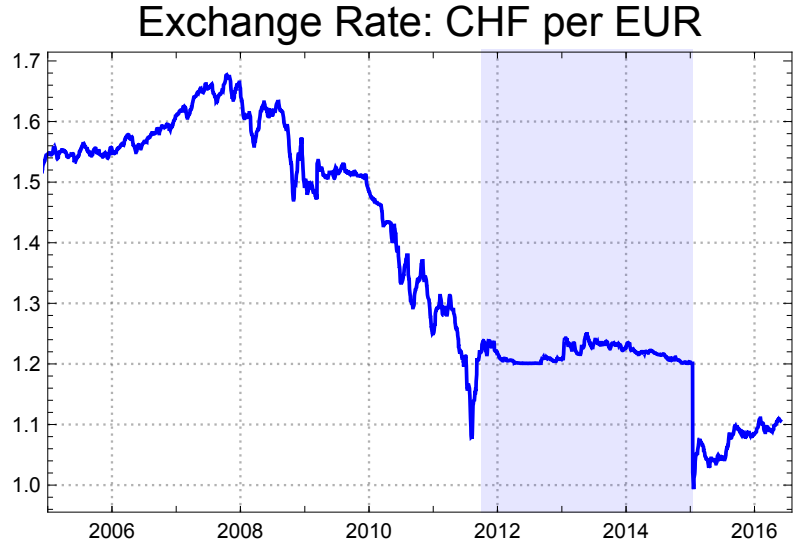
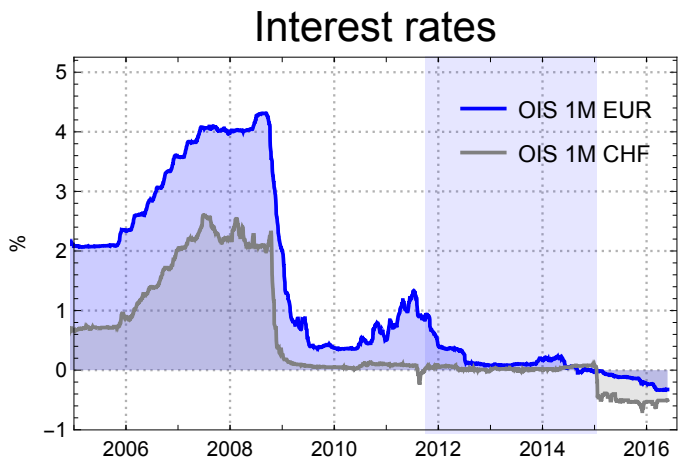
Motivation

- Global financial crisis of 2008, shift toward safe assets
- Massive appreciations of “strong" currencies
- Exchange rate interventions to prevent those appreciations
  - Difficulties in maintaining these exchange rate objectives
- Example: the Swiss franc
  - Went from 1.6 to 1.10 francs per euro (2007-2011)
  - Swiss National Bank established a currency floor with the euro in 2011
  - Eventually abandoned the floor on January 15 2015

The Swiss Currency Floor





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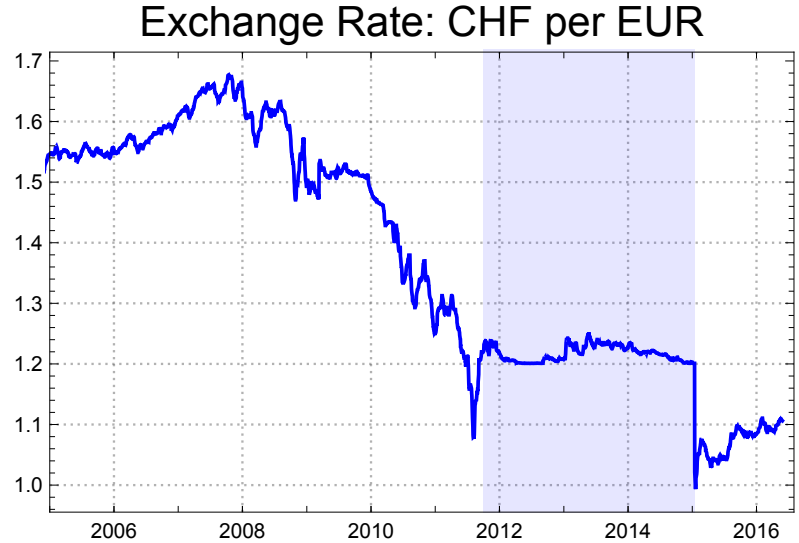

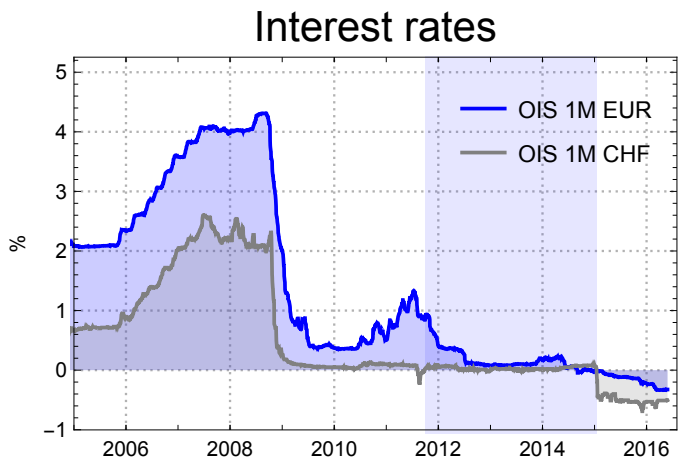

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What we do

- Simple model of exchange rate policy
  - Zero lower bound (ZLB) constraint on nominal interest rates
  - Limited international arbitrage
- Consider two cases: Away from ZLB and At the ZLB
- Away from ZLB: country can implement exchange rate objective, loses monetary independence. Mundellian Trilemma
- At the ZLB: country can implement exchange rate objective, but interest rates cannot adjust. Interest rate parity violated, capital inflows
  - Central Bank ***has to*** accumulate foreign reserves, and this is ***costly***
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Environment

- Two period small open monetary economy
- Three agents (excluding fiscal authority)
  1. Households: have endowments, standard consumption/saving problem, utility benefits for holding money (m), money satiation
  2. Foreign investors: They have limited wealth $\overline{w}$, buy domestic/foreign assets
  3. Central Bank: issues money (M), buys domestic/foreign assets (A, F). Assume no fiscal support from government in period 1
- Central bank has a plan for the exchange rate, (s_1, s_2)
  - For simplicity, think $s_1 > s_2$
- We ask under what conditions the Central bank can implement its plan, and the implications of such policy

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Interest Rate Parity

Domestic households can borrow/save in domestic assets a. They can also save in foreign assets f. Hence, in any equilibrium we must have

$$(1+i) \geq (1+i^*)\frac{s_2}{s_1},$$

When holding with equality, we have the standard interest rate parity

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If inequality strict, domestic interest rates high relative to foreign

- Households buy only domestic bonds ($f = 0$)
- Foreigners invest all their wealth $\overline{w}$ in domestic assets (bonds and/or money) and make arbitrage profits

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Intertemporal Resource Constraint

Consolidating households, government, and central bank budget constraint

$$c_1 - y_1 = \underbrace{\frac{m^* + a^*}{s_1}}_{\text{Foreign liabilities}} - \underbrace{[f + F]}_{\text{Foreign assets}}$$

$$c_2 - y_2 = (1 + i^*)(f + F) - \frac{m^* + a^*(1 + i)}{s_2}$$

Substituting for a^* and assuming that foreigners have no liquidity benefit from domestic currency ($m^* = 0$), we obtain

$$\underbrace{\left(c_1 + \frac{c_2}{(1+i)\frac{s_1}{s_2}}\right)}_{\text{Present value of consumption}} = \underbrace{\left(y_1 + \frac{y_2}{(1+i)\frac{s_1}{s_2}}\right)}_{\text{Present value of income}} - \underbrace{\left[1 - \frac{(1+i^*)\frac{s_2}{s_1}}{(1+i)}\right] F}_{\text{Intervention losses}} \quad \text{([IRC])}$$

If [IP] holds, last term disappears (classic [IRC])

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If [IP] does not hold, accumulation of foreign reserves entails resource costs

Away from ZLB: The Trilemma

Suppose that $(1+i^*)\frac{s_2}{s_1} > 1$. There exists an $i > 0$ that makes [IP] hold

Theorem

If $\overline{w}$ large enough, [IP] *holds in every monetary equilibrium*

Idea $\Rightarrow$ Away from ZLB, the Central Bank cannot sustain [IP] deviations

- Foreign investors strictly prefer bonds to money. Central Bank cannot issue interest paying liabilities and balance sheet limited by domestic money satiation

Exchange rate policy (s_1, s_2) can be sustained

- Central Bank loses monetary independence

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The unique equilibrium features $i = 0$, *and deviations from* [IP]

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Exchange rate policy (s_1, s_2) can be sustained, but there are **costs**

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$$\left[1 - \frac{(1+i^*)\frac{s_2}{s_1}}{(1+i)}\right] \times F$$

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Some Interesting Results

1. An increase in $\overline{w}$ or a decline in i^* while economy is at the ZLB
   - Increases foreign reserves of the Central Bank under the current exchange rate policy
   - Always welfare reducing

   Idea: interest rate fixed by exchange rate policy and ZLB. More financial integration raises capital inflows and intervention losses

2. Suppose $i = 0$. Then, a tax on money allows the Central Bank to achieve (s_1, s_2) without [IP] deviations
   - Negative nominal interest rates allow the Central Bank to restore [IP]
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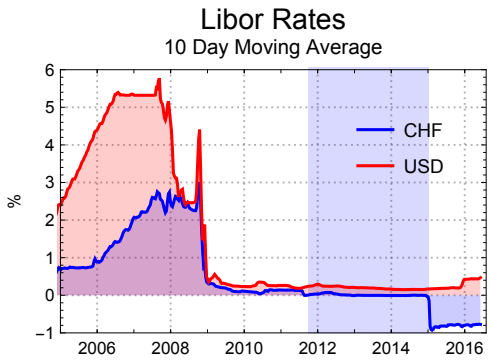
Measuring the Losses from Exchange Rate Policies

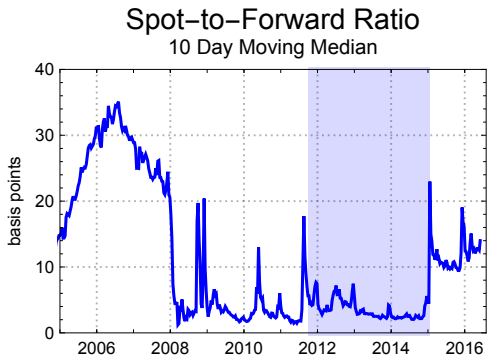
- Sufficient statistic to measure losses associated to exchange rate policies

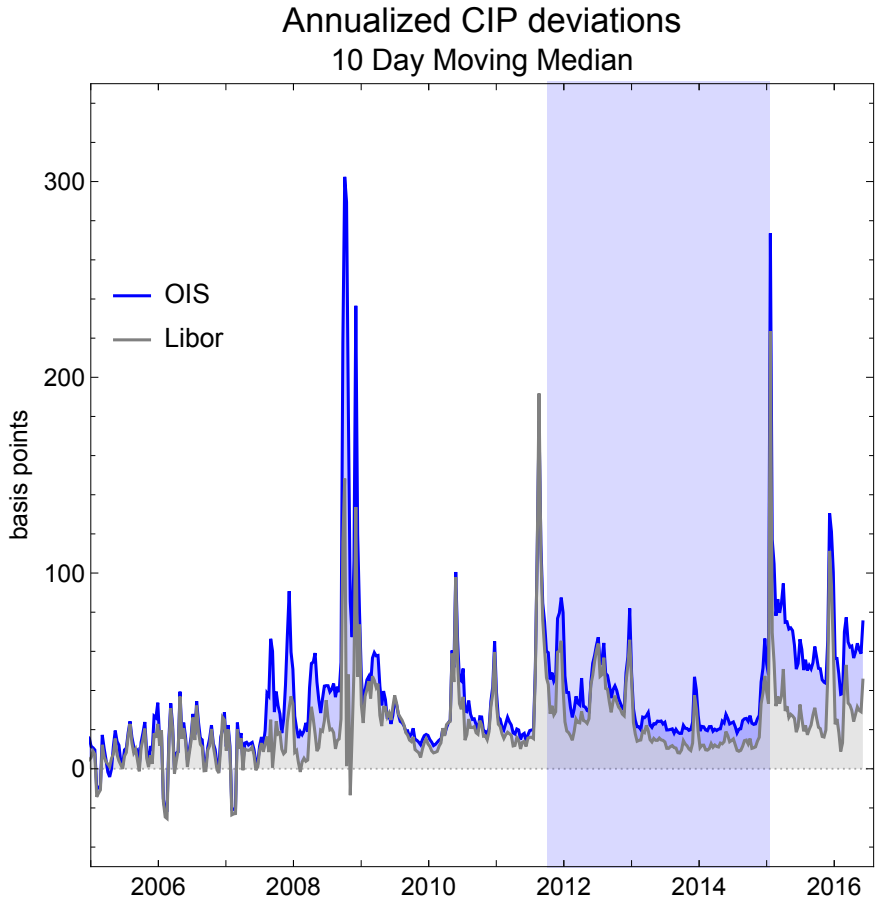
$$\text{Losses}_t = \underbrace{\left[1 - \frac{(1+i_t^*)\frac{s_{t+1}}{s_t}}{(1+i_t)}\right]}_{\text{Deviations from [IP]}} \times \underbrace{F_t}_{\text{Foreign reserves}}$$

- We construct empirical counterparts to both terms
  - Measure daily deviations from covered interest rate parity (CIP) as a proxy to arbitrage profits
- Questions
  - Do we observe deviations from CIP?
  - Are deviations from CIP associated to strong demand for assets denominated in Swiss franc?
  - How sizable are the measured losses?

Deviations from CIP

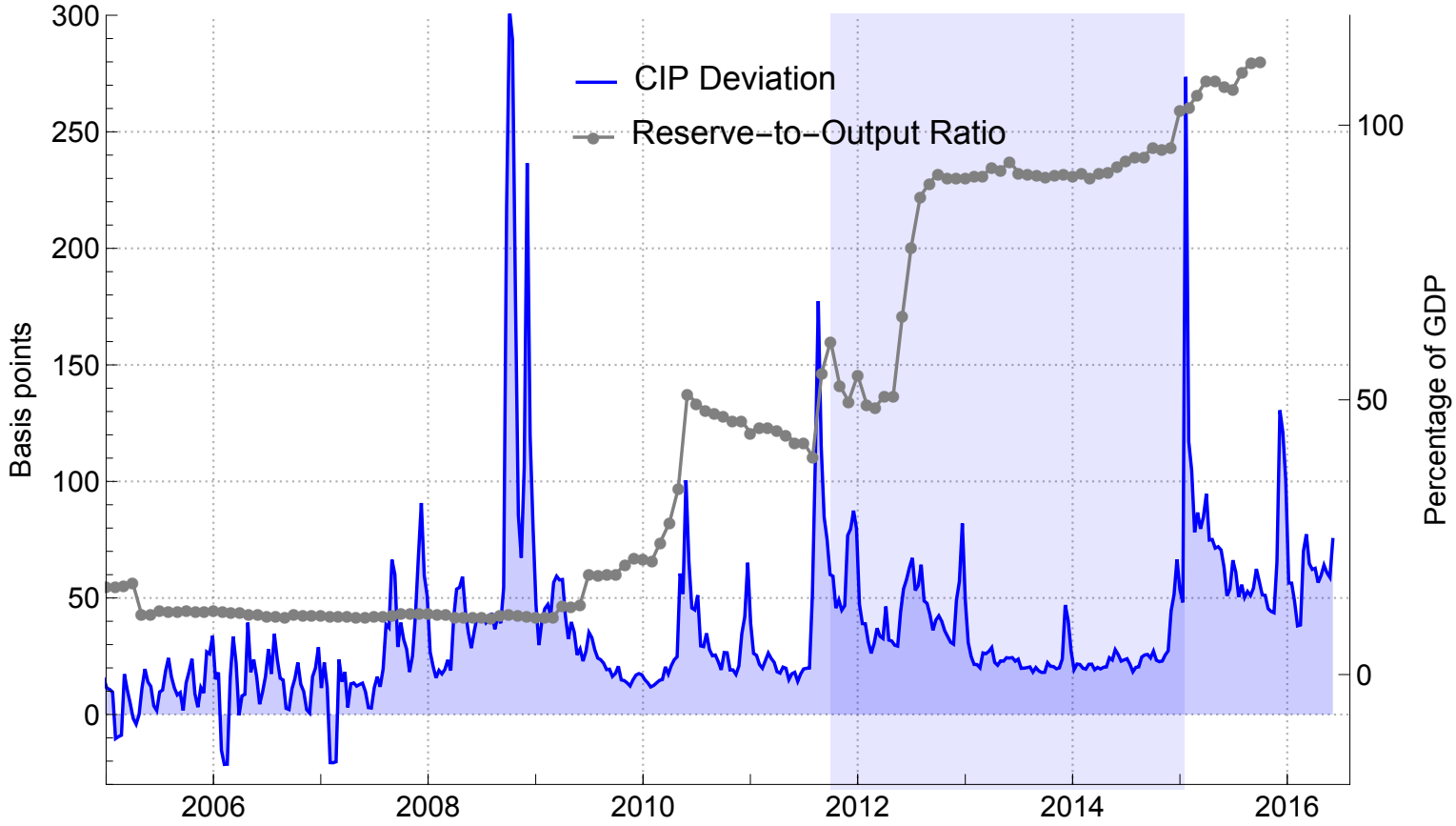






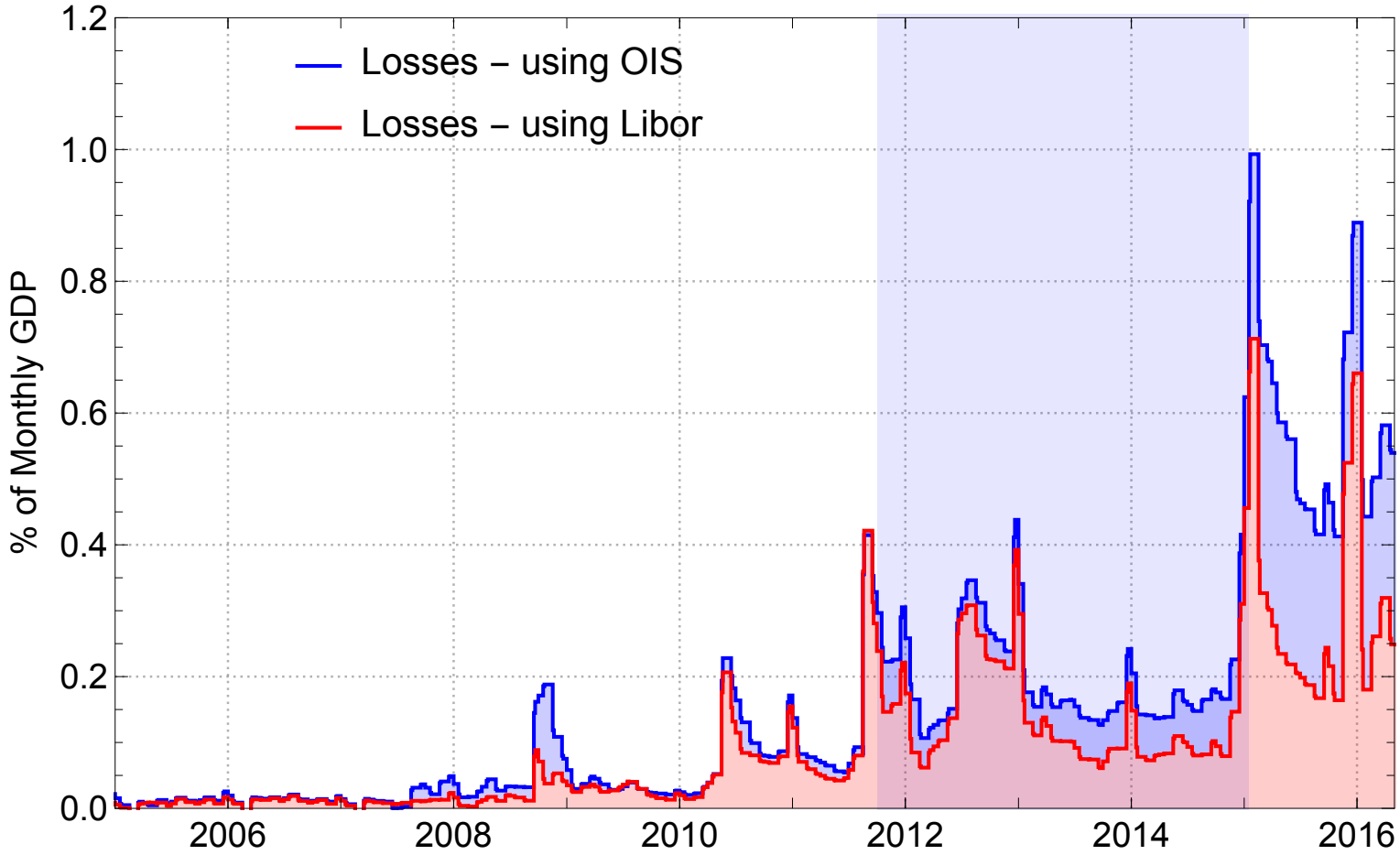
- Starting from 2008, persistent CIP deviations (Du et al., 2016)
- Positive deviations $\rightarrow$ investing in Swiss denominated assets profitable

CIP Deviations and Demand for Swiss Francs



- SNB accumulates foreign reserves when CIP deviations are large
- Demand for assets denominated in francs sensitive to CIP deviations

Measuring the Losses



- We can measure losses as the product of CIP deviations and reserves
- Flow cost of 0.2%-1% of real GDP

Conclusion

- Mundellian Trilemma at the zero lower bound
- Exchange rate objectives can be implemented, but
  - Expect capital inflows and costs from FX interventions
- Simple sufficient statistic to measure costs of interventions
  - In the case of Switzerland, flow losses between 0.2%-1% of GDP
- Framework for understanding recent events
  - Costs of intervention increase in foreign capital
    - Swiss currency floor abandoned just before the ECB QE was announced
  - Negative nominal interest rates could complement exchange rate policies
    - Switzerland and Denmark first to experience with negative rates