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Sanctions and the Exchange Rate

Oleg Itkhoki
UCLA

23. June 2022

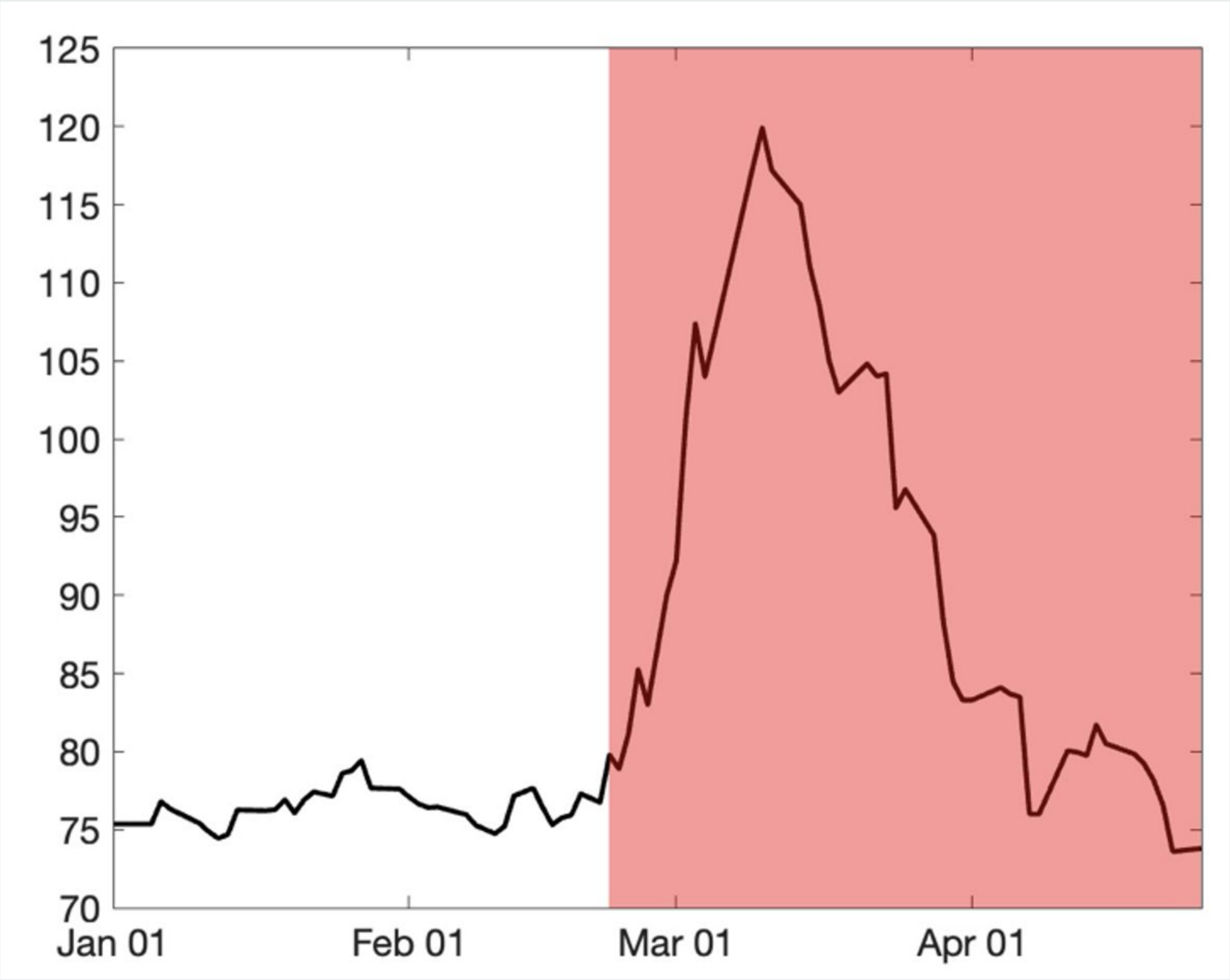
P R I N C E T O N

Markus Brunnermeier

Webinars on Sanctions

- Sergei Guriev *Russian Economy*
- Jim Hamilton *Oil*
- David Bacaas /Ben Moll *German Economy*
- Elina Ribakova *Details*
- Oleg Itskhoki *Exchange Rate*

Rubble-US$ exchange rate



Trade Sanctions vs. Financial Sanctions

Poll

1. End of the year **ruble per US$ exchange rate** (was initially 75, depreciating to 125 and then to 55)
   a. Stronger: < 65: stronger rubles per USD;
   b. Similar: 65-80;
   c. Weaker; > 80.
2. The West concentrated **sanctions on Russian imports** rather than exports. This made it ___ for Russia to fund the war
   a. easier;
   b. equally effective;
   c. Didn’t matter as it is independent of short-run fiscal deficit.
3. Three statements: The West does
   a. **no**t have sufficient economic **leverage** against Russia, and should **no**t use **sanctions**.
   b. **no**t have sufficient economic **leverage** against Russia, and nonetheless should **use sanctions**.
   c. have sufficient economic **leverage** against Russia, but should **not use** it

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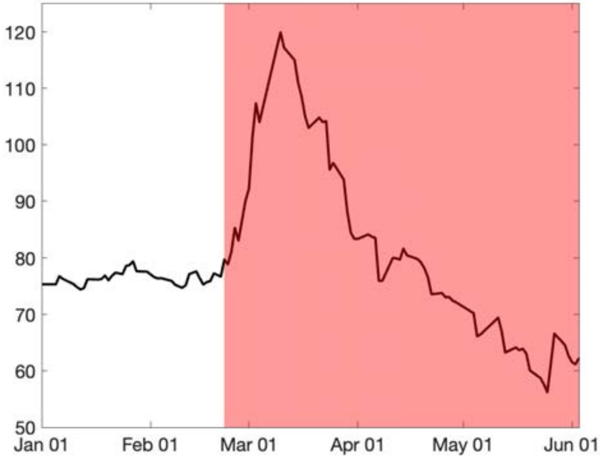
Oleg Itskhoki
itskhoki@econ.UCLA.edu

Dmitry Mukhin
d.mukhin@LSE.ac.uk

Princeton, June 2022

Ruble-USD Exchange Rate



This Paper

- Positive and normative questions:
  1. why did Ruble depreciate initially and appreciate thereafter?
  2. are sanctions "not working"?
  3. is the exchange rate irrelevant under financial constraints?
  4. what implications for government revenues?

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  - small open economy version streamlined to focus on exchange rate, real cost of living, government revenues
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- Dual role of foreign currency:
  1. goods market (exports and imports)
  2. asset market (official reserves and private savings)

MODEL

Model

- Endowment Small Open Economy with tradables and non-tradables and demand for foreign currency savings
- **Households**:

$$\max \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \Big[u(C_{Ht}, C_{Ft}) + v\Big(\frac{B^*_{t+1}}{P^*_{t+1}}; \psi_t\Big)\Big]$$

$$\text{s.t.} \quad P_t C_{Ht} + \mathcal{E}_t P^*_t C_{Ft} + \frac{B_{t+1}}{R_t} + \frac{\mathcal{E}_t B^*_{t+1}}{R^*_{Ht}} \leq B_t + \mathcal{E}_t B^*_t + W_t,$$

$$u(C_H, C_F) = (1-\gamma)^{1/\theta} C_H^{\frac{\theta-1}{\theta}} + \gamma^{1/\theta} C_F^{\frac{\theta-1}{\theta}}, \;\; v(b;\psi) = -\frac{\kappa}{2} \cdot (b-\psi)^2$$

— precautionary savings (Diamond '65, Aiyagari '94, CFG '08)

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- **Government, Firms & Financial sector**

$$\mathcal{E}_t\Big(\frac{F^*_{t+1}}{R^*_t} - F^*_t\Big) - \mathcal{E}_t\Big(\frac{B^*_{t+1}}{R^*_{Ht}} - B^*_t\Big) = \overbrace{\mathcal{E}_t Y^*_t + P_t Y_t}^{\equiv TR_t} - W_t,$$

— NFA F^*_t; FX deposits B^*_t; official FX reserves $F^*_t - B^*_t$

Equilibrium

- Market clearing: $C_{Ht} = Y_t$ and $B_{t+1} = 0$

1. Import demand (expenditure switching):

$$\frac{C_{Ft}}{C_{Ht}} = \frac{\gamma}{1-\gamma}\left(\frac{\mathcal{E}_t P_t^*}{P_t}\right)^{-\theta}$$

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3. Demand for foreign currency savings (Euler equation):

$$\beta R_{Ht}^* \mathbb{E}_t \left\{ \frac{P_t^*}{P_{t+1}^*} \left[\left(\frac{C_{Ft}}{C_{Ft+1}} \right)^{1/\theta} + \tilde{\kappa} C_{Ft}^{1/\theta} \left(\psi_t - \frac{B_{t+1}^*}{P_{t+1}^*} \right) \right] \right\} = 1$$

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— Equil. system in $\{C_{Ft}, \mathcal{E}_t, B_{t+1}^*\}$ given policy $\{P_t, R_{Ht}^*, F_{t+1}^* - B_{t+1}^*\}$

Sanctions and Policies

1. Export sanctions: $Y_t^* \downarrow$
2. Import sanctions: ration C_{Ft} or increase P_t^*
3. Exit of foreign MNC/withdrawal of intermediates: $Y_t \downarrow$
4. Foreign asset freeze: $F_0^* \downarrow$
5. Exclusion from international financial market:

$$F_{t+1}^* - F_t^* = NX_t^*, \qquad F_{t+1}^* \geq 0, \qquad B_{t+1}^* \leq F_{t+1}^*.$$

6. Household precautionary demand for foreign currency: $\psi_t \uparrow$

---

1. transfers W_t
2. monetary policy P_t (via choice of R_t)
3. FX reserves $F_{t+1}^* - B_{t+1}^*$
4. financial repression $R_{Ht}^* < R_t^*$

TRADE SANCTIONS

Stationary Equilibrium

- Assume $\beta R_t^* = 1$, $\psi_t = 0$, $\theta = 1$ and δ imports are rationed
- Steady state equilibrium system: import demand and country budget constraint

$$C_F = \frac{\gamma}{1-\gamma}\frac{PY}{\mathcal{E}\hat{P}^*}, \qquad \hat{P}^* = \frac{\gamma}{\gamma-\delta}P^*$$

show

$$P^* C_F = Y^* + (1-\beta)F^*$$

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- Wage commitment of the government (fiscal balance):

$$W \leq (1-\beta)(F^* - B^*) + \mathcal{E}Y^* + PY$$

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$$P \geq \left[1 + \frac{\gamma-\delta}{1-\gamma}\frac{Y^*}{Y^*+(1-\beta)F^*}\right]^{-1}\cdot\frac{W-(1-\beta)(F^*-B^*)}{Y}$$

Results I

Comparative statics

1. Consider the foreign reserves freeze $F^* \downarrow$ or sanctions on exports $Y^* \downarrow$. This depreciates the exchange rate, $\mathcal{E} \uparrow$, and results in a reduction in imports, $C_F \downarrow$.

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2. Sanctions that limit domestic non-tradable output $Y \downarrow$ appreciate the exchange rate $\mathcal{E} \downarrow$.
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- sanctions generally tighten the gov't fiscal constraint and may trigger inflation $P \uparrow$ and monetary devaluation $\mathcal{E} \uparrow$

GENERAL EQUIVALENCE

Import Sanctions=Export Sanctions

- General Lerner (1936) symmetry result (FGI 2004)
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  1. same allocation and welfare, including reduced imports $\{C_{Ft}\}\downarrow$

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$$\frac{F_{t+1}^*/P_t^*}{R_t^*} - F_t^*/P_t^* = \frac{Y_t^*}{P_t^*} - C_{Ft}$$

  ❷ opposite changes in the exchange rate

$$\mathcal{E}_t = \frac{P_t}{P_t^*}\left(\frac{\gamma}{1-\gamma}\frac{Y_t}{C_{Ft}}\right)^{\frac{1}{\theta}}$$

  — export sanctions $Y_t^*\downarrow \Rightarrow C_{Ft}\downarrow \Rightarrow$ depreciation $\mathcal{E}_t\uparrow$
  — import sanctions $P_t^*\uparrow \Rightarrow C_{Ft}\downarrow \Rightarrow$ appreciation $\mathcal{E}_t\downarrow$

Government Revenues I

- **Corollary**: The import and export sanctions of $x\%$ have **identical** effects on gov't revenues and cost of living:

$$\mathrm{d}\log TR = -\frac{XR}{TR} \cdot \frac{\theta - 1}{\theta} \cdot x\%, \qquad \mathrm{d}\log CPI = \frac{\text{Import}}{GDP} \cdot \frac{1}{\theta} \cdot x\%,$$

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- Lerner symmetry for revenues (BFGI 2019):

  1. export sanctions

$$Y_t^*\downarrow\Rightarrow\ \mathcal{E}_t^*\uparrow\Rightarrow\ \mathrm{d}\log(\mathcal{E}_t Y_t^*) = \quad \left(1-\frac{1}{\theta}\right)\mathrm{d}\log Y_t^*$$

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  2. import sanctions

$$P_t^* \uparrow \Rightarrow \mathcal{E}_t^* \downarrow \Rightarrow \mathrm{d}\log(\mathcal{E}_t Y_t^*) = -\left(1 - \frac{1}{\theta}\right) \mathrm{d}\log P_t^*$$

FINANCIAL SHOCK

Currency Market

- Two competing foreign currency uses:
  - imports $P_t^* C_{Ft}$ and savings B_{t+1}^*
- Two source of foreign currency:
  - exports Y_t^* and foreign reserves F_t^*
- Exchange rate balances the two
  - depreciates when currency is scarce
  - appreciates when currency is abundant
- Conventional models vs segmented markets (or "convenience yield")

Exchange Rate Policy

- **Proposition**: Consider an increase in private FX demand $\psi_t \uparrow$

  1. Passive gov't ($F_t^* = B_t^*$, $R_{Ht}^* = R_t^*$): imports fall $C_{Ft} \downarrow$, exchange rate depreciates $\mathcal{E}_t \uparrow$, both gradually mean reverts

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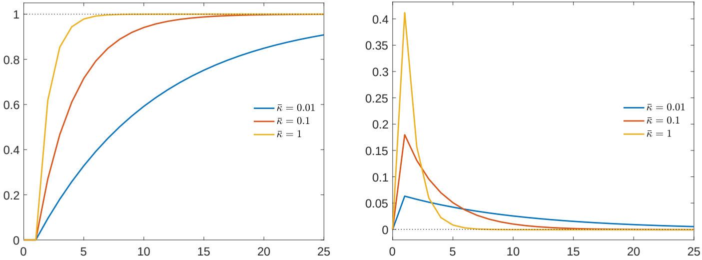
(a) Net foreign assets, $\frac{B_t^*}{P_t^* Y^*}$ (b) Exchange rate, $\log \mathcal{E}_t$



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     — *synthetic* FC deposits if reserves are not available

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$$\beta R_{Ht}^* \mathbb{E}_t \left\{ \frac{P_t^*}{P_{t+1}^*} \left[\left(\frac{C_{Ft}}{C_{Ft+1}} \right)^{1/\theta} + \tilde{\kappa} C_{Ft}^{1/\theta} \left(\psi_t - \frac{B_{t+1}^*}{P_{t+1}^*} \right) \right] \right\} = 1$$

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     — (weakly) relaxes the gov't budget constraint

     — applies under financial autarky as well

     — *implicit* repression: risk of expropriation, limits on withdrawals

     — *explicit* repression: tax on purchasing FC ▸ show

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- Representative agent: Financial repression reduces welfare

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  3. financial repression redistributes from RA to HtM (FS'21)

$$R^*_{Ht} < R^*_t \quad \Rightarrow \quad B^*_{t+1}\downarrow,\ \mathcal{E}_t\downarrow \quad \Rightarrow \quad C_t^{HtM}\uparrow$$

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- Other motive: anchoring inflation expectations

Government Revenues II

- Can ER depreciation rebalance gov't budget without inflation?

- FX interventions $F_t^* - B_t^* \uparrow$:

$$B_t^* \downarrow \quad \Rightarrow \quad \mathcal{E}_t \uparrow \quad \Rightarrow \quad C_{Ft} \downarrow \quad \Rightarrow \quad F_t^* \uparrow$$

- Gov't budget:

$$\underbrace{\left(\frac{F_{t+1}^*}{R_t^*} - F_t^*\right)}_{\uparrow} - \underbrace{\left(\frac{B_{t+1}^*}{R_{Ht}^*} - B_t^*\right)}_{\downarrow} = Y_t^* - \underbrace{\frac{W_t/P_t - Y_t}{\mathcal{E}_t/P_t}}_{\downarrow}$$

- Policy changes in Russia:
  - FX sold by exporters $\downarrow$ from 80% to 50%
  - allowed monthly transfers abroad $\uparrow$ from \$5k to \$150k

CONCLUSION

Conclusion

- Why did the ruble depreciate initially?
  - — overnight freeze of gov't reserves + threat of blocking exports
  - — high home demand for foreign currency as a store of value
- Why did the exchange rate reverse in mid-March?
  - — tougher sanctions on imports than exports $\Rightarrow$ **supply of FX**$\uparrow$
  - — capital controls + financial repression $\Rightarrow$ **demand for FX**$\downarrow$
- Are sanctions "not working"?
  - — effectiveness cannot be inferred from ER dynamics alone
  - — **equivalence** of M & X sanctions for welfare & gov't revenues
- Is the exchange rate irrelevant?
  - — affects **imports** and **gov't revenues**
  - — financial repression benefits consumers at the expense of savers

APPENDIX

Model of Rationing

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- Continuum varieties of imported goods $[0, \gamma]$
- Varieties $[0, \delta]$ are banned under import sanctions ($\delta < \gamma$)

Model of Rationing

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- Cobb-Douglas: $u_t = (1-\gamma)\log C_{Ht} + \int_0^\gamma \log c^*_{it} \mathrm{d}i$, $p^*_{it} = P^*_t$

$$c^*_{it} = \frac{1}{1-\gamma}\frac{P_t C_{Ht}}{\mathcal{E}_t p^*_{it}}$$

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- Without rationing:

$$P_t^* C_{Ft} = \int_0^\gamma p_{it}^* c_{it}^* \mathrm{d}i = \frac{\gamma}{1-\gamma}\frac{P_t C_{Ht}}{\mathcal{E}_t} \quad \text{and} \quad C_{Ft} = \gamma c_{it}^*$$

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- Finite shadow price $\hat{P}^*_t$ (ideal price is ∞):

$$C_{Ft} = \frac{\gamma-\delta}{1-\gamma}\frac{P_t C_{Ht}}{\mathcal{E}_t P^*_t} = \frac{\gamma}{1-\gamma}\frac{P_t C_{Ht}}{\mathcal{E}_t \hat{P}^*_t}, \qquad \hat{P}^*_t = \frac{\gamma}{\gamma-\delta}P^*_t$$

Model of Rationing

Back to slides

- CES case:

$$u_t = (1-\gamma)^{1/\theta} C_H^{\frac{\theta-1}{\theta}} + \gamma^{1/\theta} \int_0^1 c_{it}^{*\,\frac{\theta-1}{\theta}} \mathrm{d}i, \quad C_{Ft} = \left[\int_0^1 c_{it}^{*\,\frac{\theta-1}{\theta}} \mathrm{d}i \right]^{\frac{\theta}{\theta-1}}$$

Model of Rationing

◂ Back to slides

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- Ration fraction $\hat{\delta} = \delta/\gamma \in [0,1)$ of import varieties:

$$P_t^* = \left[\int_{\hat{\delta}}^1 p_{it}^{*1-\theta} \mathrm{d}i \right]^{1/(1-\theta)} = (1-\hat{\delta})^{\frac{1}{1-\theta}} p_{it}^* = \left(\frac{\gamma}{\gamma - \delta} \right)^{\frac{1}{\theta-1}} p_{it}^*$$

  — import expenditure $P_t^* C_{Ft}$ and demand $\frac{C_{Ft}}{C_{Ht}} = \frac{\gamma}{1-\gamma} \left(\frac{\mathcal{E}_t P_t^*}{P_t} \right)^{-\theta}$

Model of Rationing

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- Equivalent to a tax $\tau > 0$ on every import variety:

$$1+\tau = (1-\hat{\delta})^{\frac{1}{1-\theta}} = \left(\frac{\gamma}{\gamma-\delta} \right)^{\frac{1}{\theta-1}}$$

Multiple Foreign Currencies

- March 4–April 11: 12% tax on USD, euros, GBP in Russia
  - $\Rightarrow$ overvalued Swiss franc relative to foreign exchanges
  - $\Rightarrow$ larger purchases of Swiss franc as a safe asset

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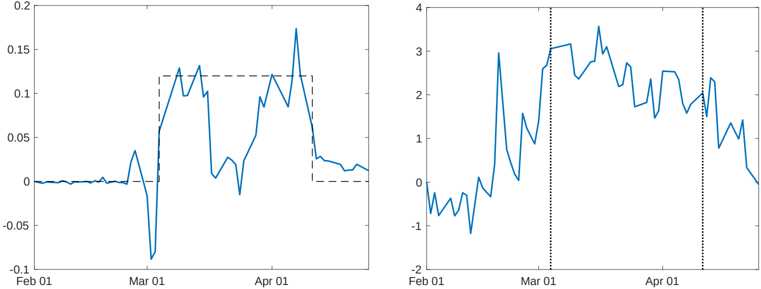
Figure: Swiss franc vs U.S. dollar

(a) Exchange rates (b) Relative turnover



Note: (a) exchange rate at the Moscow Exchange relative to its international value, (b) Swiss franc turnover relative to the dollar at the Moscow Exchange.

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