# Tariffs, trade deficits, and other effects. S-I=CA $\ensuremath{\mathsf{S}}\xspace$

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Irump administration: tariffs to target the trade balance.

- A stupid target
- Is there logic to the mechanism?
- Now and also back when: "A typical argument for protectionist legislation emphasizes two supposed results from higher tariffs. First, by making foreign goods more expensive, tariffs cause imports to fall and thus improve the current account. Second, as domestic residents shift expenditure patterns from foreign to domestic goods, home employment and production are stimulated. Fewer Americans driving Toyotas and BMW's mean more jobs for blast furnace operators in Gary, for tire producers in Akron, and for assembly line workers in Flint."— Aschauer (1987).

#### But identities:

$$S(W?) - I(r?) = CAS(TT?) = \Delta NFA;$$
  
W for wealth, TT : terms of trade; r:i - rate

- **2** Tariffs have direct effect on CAS, not (obvious) on *S*, *I*.
- Needed: a model to disentangle
- Thought experiment: change tariffs, see what happens in GE

Trump: essentially imposed tariffs across the entire spectrum of sectors comprising Chinese imports, representing a seismic increase in the value of trade affected and the scope of sectors drawn into the tariff catchment.

tranche	announced	enacted	t	Value	]
1	6_04_18	20_06_18	D+25%	34B	]
2	20_06_18	16_08_18	D+25%	16B	]
3	17_07_18	21_09_18	D+10%;+25%	200B	]
4	10_05_19	20_08_19	D+10%:+15%	300B	]
Source: Federal Register Vol. 83 No. 119, Vol. 83 No. 159, Vol. 83 No.					

184, Vol. 84 No. 161. Announcements from the Office of the US Trade Representative.

# Intro: Prices and quantities

Goal: empirical impulse responses to tariff shocks in the US economy.
We collect a time series for the purposes of estimating the following structural vector autoregression (sVar) model:

$$B_0 y_t = c + \sum_{j=1}^{p} B_{1j} y_{t-j} + \varepsilon_t;$$
  
$$y_t : \left[ T_i^C, TT_i^w, S_t^d, Inv_t^d, TB_t^C \right]$$

where  $T^{C}$  is tariff revenue from Chinese imports,  $TT^{W}$  is US terms of trade vis a vis the world,  $S^{d}$  is real US domestic sales,  $Inv^{d}$  is real inventories of US producers, and  $TB^{C}$  is the real bilateral trade balance surplus between US and China.

Salient results: estimated impulse response functions show-among other things-sharp initial *TT* appreciation, followed by depreciation, negligible effect on *TB<sup>C</sup>*.

- Other models could be used, e.g., Chari, Kehoe, McGratten (1999).
- Ø For this purpose, we want a model in which
  - Savings behavior not directly-behaviorally- affected by tariff; trade balance not directly affected by variables that affect savings behavior.
  - O There is a steady state, with unique level of net indebtedness.
  - Include capital flows.
- Itence, a variant of continuous-time OLG (Buiter)

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  - Permits analysis of long-run net indebtedness
  - More tractable that other approaches, e.g., Daniels.

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- The home country residents consume the non-traded good and the good exported from the foreign country, M. They do not consume the good produced at home and exported to the foreign country, X.

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1. Consider a model with three goods, an importable, an exportable, and a non-traded good. The importable is not produced domestically, and the exportable is not consumed domestically. The economy has at least three factors of production, one of which is labor. These factors of production a supplied inelastically and full employment prevails. Write down the system equations that determines the following endogenous variables: the wage rate, the price of non-tradables, and welfare.

2. For a small open economy, the <u>real exchange rate</u> is defined as the inver of the relative price of home goods to tradables. In our model, two potenti

# Lynchburg TN



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• Relative prices:

$$\pi_x \equiv \frac{P_X}{P_N}, \ \pi_m \equiv \frac{P_M}{P_N}; \pi_x^* \equiv \frac{P_X^*}{P_N^*}, \ \pi_m^* \equiv \frac{P_M^*}{P_N^*}.$$

• Big Mac exchange rate (a real rate):

$$e\equiv\frac{EP_N^*}{P_N},$$

where E is the domestic currency price of foreign currency.

$$X^{s} = \chi\left(\frac{P_{X}}{P_{N}}\right);$$
  

$$M^{s} = \mu^{*}\left(\frac{P_{M}^{*}}{P_{N}^{*}}\right);$$
  

$$N^{s} = \nu\left(\frac{P_{X}}{P_{N}}\right); N^{*,s} = \nu^{*}\left(\frac{P_{M}^{*}}{P_{N}^{*}}\right);$$

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- Income Y includes profits form the X industry, and any transfers of tariff revenue from the govt.
- Hence, the demands for the traded goods are:

$$M^d = \mu(\pi_m);$$
  
 $X^d = \chi^*(\pi_x^*);$ 

# Equilibrium in traded-goods markets

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• Can write relative prices traded vis a vis non-traded as

$$\frac{P_M}{P_N} = \frac{EP_M^*}{(1-t)P_N} \times \frac{P_N^*}{P_N^*} = \left(\frac{EP_N^*}{P_N} \times \frac{1}{1-t}\right) \times \frac{P_M^*}{P_N^*};$$

$$\pi_m = \left(\frac{e}{1-t}\right) \pi_m^*;$$

$$\frac{P_X}{P_N} = \frac{EP_X^*}{P_N} \times \frac{P_N^*}{P_N^*} = \left(\frac{EP_N^*}{P_N}\right) \times \frac{P_X^*}{P_N^*};$$

$$\pi_x = e\pi_x^*$$

# Equilibrium in traded goods markets

Equating demand to supply in the markets for M and X, we can solve for the equilibrium prices and quantities as functions of e and t:

$$\begin{aligned} \widehat{\pi}_{m}^{*} &= \pi_{m}^{*} \left(\frac{e}{1-t}\right); \\ \widehat{\pi}_{m} &= \pi_{m} \left(\frac{e}{1-t}\right); \\ \widehat{M}^{d} &= M\left(\frac{e}{1-t}\right); \\ \widehat{\pi}_{x}^{*} &= \pi_{x}^{*}(e); \\ \widehat{\pi}_{x}^{*} &= \pi_{x}(e); \\ \widehat{\pi}_{x}^{*} &= \pi_{x}(e); \\ \widehat{\chi}^{*} &= X(e). \end{aligned}$$

Lagniappe!

Thus, as a function of e, we have the following expression for the trade surplus along with associated derivatives:

$$\begin{split} T &= C_{x} e^{\frac{k_{x}^{d}(1+k_{x}^{s})}{k_{x}^{s}+k_{x}^{d}}} - D_{m}\left(e\right)^{\frac{k_{m}^{s}\left(1-k_{m}^{d}\right)}{k_{m}^{s}+k_{m}^{d}}} \left(1-t\right)^{\frac{k_{m}^{d}(1+k_{m}^{s})}{k_{m}^{s}+k_{m}^{d}}};\\ C_{x} &\equiv \left(A_{x}^{s}\right)^{\frac{k_{x}^{d}-1}{k_{x}^{s}+k_{x}^{d}}} \left(A_{x}^{d}\right)^{\frac{1+k_{x}^{s}}{k_{x}^{s}+k_{x}^{d}}}; \ D_{m} \equiv \left(A_{m}^{d}\right)^{\frac{1+k_{m}^{s}}{k_{m}^{s}+k_{m}^{d}}} \left(A_{m}^{s}\right)^{\frac{k_{m}^{d}-1}{k_{m}^{s}+k_{m}^{d}}}\\ \frac{\partial T}{\partial e} &= \frac{k_{x}^{d}\left(1+k_{x}^{s}\right)}{k_{x}^{s}+k_{x}^{d}} \left(C_{x}e^{\frac{k_{x}^{s}\left(k_{x}^{d}-1\right)}{k_{x}^{s}+k_{x}^{d}}}\right) - \frac{k_{m}^{s}\left(1-k_{m}^{d}\right)}{k_{m}^{s}+k_{m}^{d}} \left(D_{m}\left(e\right)^{\frac{-k_{m}^{d}\left(k_{m}^{s}+1\right)}{k_{m}^{s}+k_{m}^{d}}}\left(1-k_{m}^{s}\right)^{\frac{1+k_{m}^{s}}{k_{m}^{s}+k_{m}^{d}}}\right)\\ \frac{\partial T}{\partial t} &= \left(\frac{k_{m}^{d}\left(1+k_{m}^{s}\right)}{k_{m}^{s}+k_{m}^{d}}\right) D_{m}\left(e\right)^{\frac{k_{m}^{s}\left(1-k_{m}^{d}\right)}{k_{m}^{s}+k_{m}^{d}}} \left(1-t\right)^{\frac{k_{m}^{s}\left(k_{m}^{d}-1\right)}{k_{m}^{s}+k_{m}^{d}}} > 0 \;. \end{split}$$

Lagniappe!

As an aside, we note that this development of the trade balance, in which the elasticities  $k_i^j$  play such a prominent role, is much like what was emphasized in the "elasticities approach" to the balance of trade. We also note that in our model the condition for  $\frac{\partial T}{\partial e} > 0$  is the same as the so-called Bickerdike-Robinson-Metzler expression:

$$\left(\frac{k_x^d\left(1+k_x^s\right)}{k_x^s+k_x^d}-\frac{k_m^s\left(1-k_m^d\right)}{k_m^s+k_m^d}\right)>0.$$

It is straightforward to show that a sufficient condition for this to be satisfied is the perhaps better known Marshall-Lerner condition:

$$1-k_m^d-k_x^d<0.$$

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• People can borrow and lend abroad at  $r^*$  or at home at r.

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$$N_{S}^{D} = (\theta + \rho) W \tag{4}$$

where

$$W = -F + H;$$
  

$$H = \frac{[\overline{L}_{S} (\beta_{N} + \tau)]}{R + \theta},$$
  

$$\frac{1}{R} = \int_{v=t}^{v=\infty} \exp(-\int_{\mu=t}^{\mu=v} r(\mu) d\mu) dv.$$

- *F* is net foreign indebtedness measured in units of domestic non-traded goods, and is equal to  $f + ef^*$ .
- H is human wealth, the PDV of lifetime income flows; L<sub>S</sub> is measure of population that are savers, β<sub>N</sub> is the (constant) MPL<sub>N</sub>, and τ is the per capita government transfer (which comes as a fraction (1 - Γ) of tariff revenue)

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- Implication:

$$r \approx r^* + \dot{e};$$
  
 $\frac{\dot{R}}{R} = R - r.$ 

Supply is a decreasing function of *e*:

$$N^s = N^s(\overline{e}).$$

Demand by non-savers: an increasing function of e and of  $\Gamma$ .

$$N_{NS}^{d} = N_{NS}^{d} \begin{pmatrix} + & + \\ e, \Gamma \end{pmatrix}$$

Demand by savers is

$$N_{S}^{d} = N_{S}^{d} \left( \stackrel{+}{t}, \stackrel{-}{\Gamma}, \stackrel{-}{R} \right)$$

Equilibrium:

$$R = \chi(e, t, \Gamma)$$

$$\dot{F}=rF-T(e).$$

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• Note: a long-run RER theory found by setting  $\dot{F} = 0$ .

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- Note: a long-run RER theory found by setting  $\dot{F} = 0$ .
  - Niehan's "static deviations from PPP."
  - Question answered here (and in Buiter): How to determine long-run F (and e) in optimizing model.

#### Proposition

If the home country is characterized vis a vis the foreign country by a rate of time preference greater than the exogenous foreign-country rate of interest, i.e., is characterized by  $\rho > r^*$ , then the home country in the steady state is a net borrower, i.e.,  $\overline{F} > 0$ .

#### Proposition

If the home country is characterized vis a vis the foreign country by a rate of time preference less than the exogenous foreign-country rate of interest, i.e., is characterized by  $\rho < r^*$ , and if  $(r^* - \theta - \rho) < 0$ , then the home country in the steady state is a net lender, i.e.,  $\overline{F} < 0$ .

Image: Image:

# Steady state solution: example

$$k_i^j=1$$
,  $\mathcal{A}_i^j=1$ 

$$\Gamma = .5, t = 0, .1, \rho = .1, r^* = R = \theta = .05;$$
  

$$r^* - \rho = -.05, R + \theta = .1;$$
  

$$\overline{L}_S = 1, \overline{L}_{NS} = 1, \beta_N = \frac{1}{2}.$$

• t = 0:  $\overline{e} = 1.125; \overline{F} = 2.5; T = .125.$ • t = .1: $\overline{e} = 1.0375; \overline{F} = .2.75; T = 0.1375.$ 

The imposition of the tariff has increased net indebtedness and appreciated the currency. The trade balance surplus is bigger as it must be to pay for the increased net factor payments to the foreign country.

Coupled differential equations, linearized arounf steadt state:

$$\dot{e} = a_{11}e - a_{11}\overline{e};$$
 (13a)

$$\dot{F} = a_{21}e + a_{22}F - a_{21}\overline{e} - a_{22}\overline{F}, \qquad (13b)$$

where

$$\frac{e\left(\left(\chi_{e}\right)\left(r^{*}\right)+\chi_{F}\frac{\partial T}{\partial e}\right)}{\left(e\chi_{e}+\chi_{F}F+\chi\right)} \equiv a_{11}; \qquad (14a)$$

$$F\chi_{e}r^{*}-e\chi_{e}\frac{\partial T}{\partial e}-\chi\frac{\partial T}{\partial e} = 0 \qquad (14b)$$

$$\frac{\kappa e}{(e\chi_e + \chi_F F + \chi)} = a_{21}; \qquad (14b)$$

$$r^* = a_{22}. \qquad (14c)$$

All expressions in (14) are evaluated at their steady-state values. The key simplification in the model that makes (13a) independent of F is the assumption that savers only consume the non-traded good.



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- For a net debtor country (we argue this is the case for the US despite some controveries over this):
  - Tariffs are predicted by our (special) model to have small effects on the trade balance, and the data supports this (both imports and exports fall).
  - Tariffs lead to sharp immediate appreciation of the real exchange rate, followed by a slow depreciation (the behavior of the terms of trade suggest this is the response).