

Finance in a global CGE model



presentation by Peter B. Dixon

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Based on:

Dixon, P.B., J.A. Giesecke, J. Nassios and M.T. Rimmer (2021), “Finance in a global CGE model: the effects of financial decoupling between the U.S. and China”, *Journal of Global Economic Analysis*, Vol. 6(2), pp.1-30.

What we did

- (1) Added a financial module to an 18-region, 57-commodity version of a GTAP model that had already been extended to include:**
 - **Year-on-year dynamics;**
 - **Sticky-wage adjustments; and**
 - **Industry-specific capital**

- (2) Applied the model to investigate the effects of financial decoupling between the U.S. and China**

The Global Trust: starting point for the financial module

We made 3 improvements on Ianchovichina and McDougall's Global Trust[#] by:

- introducing bilateral relationships
- allowing for funds allocated by region s to region r to then flow to region k

Means that investments by s in r don't necessarily terminate in r .

This makes best use of the available data which refer to holdings by s of financial assets in r , not holdings of physical capital in r .

- specifying optimizing rate-of-return sensitive behavior by financial agents in their decisions on where to place their money

We built the financial module around an 18-region asset-liability-capital (ALC) table based on data from the IMF, U.S. and Chinese statistical agencies & GTAP

What is an ALC table?

[#] Ianchovichina E. and R.A. McDougall (2012), "Theoretical structure of Dynamic GTAP", chapter 2, pp. 13-70 in E. Ianchovichina and T. Walmsley (eds) *Dynamic Modeling and Applications in Global Economic Analysis*, Cambridge University Press.

ALC table for the start of 2015 (\$US\$)

3-region version

Asset region	USA	China	RoW	Total
Liability region				
USA	53.85	3.00	24.26	81.11
China	1.14	40.79	7.70	49.64
RoW	19.97	7.62	161.74	189.33
Total	74.96	51.42	193.70	

Diagonal components are values of physical capital in each region

Off diagonals are values of foreign financial assets (column) and liabilities (row)

Key idea: we specify a financial agent for each region who allocates the region's financial budget across alternative assets, that is, determines the composition of the region's column in the ALC matrix

How is the financial budget determined?

Determination of end-of-year financial budget for **CoPS** agent in region r [**FB1(r)**]

$$\mathbf{FB1(r)} = [\mathbf{VK0(r)} * \mathbf{V(r)} + \mathbf{FA0(r)}] + \mathbf{SAVE(r)} + [\mathbf{FL1(r)} - \mathbf{FL0(r)}] \quad (1)$$

Connects financial module to standard GTAP via net saving [SAVE(r)], VK0(r) and V(r).

Given the financial budget, what does the financial agent in region r do?

Behavior of financial agents

Each year the financial agent in region r

chooses $Z1(s,r)$ for all s

to maximize a CES function of the form

$$\left[\sum_s \delta(s,r) * (R(s,r) * Z1(s,r))^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \quad (5)$$

subject to
$$\sum_s Z1(s,r) = FB1(r) \quad (6)$$

where

$Z1(s,r)$ is the end-of-year value of r 's assets in s (components of r -column of ALC table);

$FB1(r)$ is region r 's end-of-year financial budget expressed in U.S. dollars;

$R(s,r)$ is the rate of return that r 's financial agent expects on assets in s (including r); and

$\delta(s,r)$ and σ are positive parameters, with $\sigma > 1$

In percentage change form, optimization gives:

$$z1(s,r) = fb1(r) + (\sigma - 1) * \left(r(s,r) - \sum_j SH1(j,r) * r(j,r) \right) \text{ for all } s,r \quad (7a)$$

How are expected rates of return, $R(s,r)$, determined?

The rate of return expected by agent in region r on finance entrusted to agent in region s [$R(s,r)$]

$$R(r,r) = \text{RORE}(r) \quad \text{for all } r \quad (8)$$

$\text{RORE}(r)$ is the standard GTAP variable for the rate of return expected by capital creators on their investments in region r .

When region r sends funds to region s , $s \neq r$, it does so through the financial agent in region s . Thus the rate of return r expects on these funds reflects the expected rate of return on the portfolio managed by the agent in s :

$$R(s,r) = \left[R(s,s) * S(s,s) + \sum_{k \neq s} R(k,s) * S(k,s) \right] * T(s,r) \quad \text{for all } s, r, s \neq r \quad (9)$$

where

$S(k,s)$ is the share of agent s 's portfolio accounted for by assets managed by the financial agent in k

$T(s,r)$ is a shift variable that can be used in simulating the effects of financial decoupling. A reduction $T(s,r)$ reduces r 's investment in s .

What about foreign income flows?

Foreign income flows for inclusion in net national product [**RFA(r)** & **PFL(r)**]

Receipts for region r on its foreign assets are given by:

$$\mathbf{RFA(r)} = \sum_{s \neq r} \mathbf{CR(s)} * \mathbf{Z0(s,r)} \quad \text{for all r} \quad (12)$$

Payments for region r on its foreign liabilities are given by:

$$\mathbf{PFL(r)} = \sum_{s \neq r} \mathbf{CR(r)} * \mathbf{Z0(r,s)} \quad \text{for all r} \quad (13)$$

where $\mathbf{CR(s)}$ is income per dollar of assets managed by financial agent s:

$$\mathbf{CR(s)} = \frac{\mathbf{NR(s)} + \sum_{r \neq s} \mathbf{Z0(r,s)} * \mathbf{CR(r)}}{\sum_r \mathbf{Z0(r,s)}} \quad \text{for all s} \quad (11)$$

and $\mathbf{NR(s)}$ is the rental on physical capital in s, net of depreciation (standard GTAP variable)

We include $\mathbf{RFA(r)} - \mathbf{PFL(r)}$ in r's net national product [$\mathbf{INCOME(r)}$ in GTAP notation]

Application: U.S.–China financial decoupling

Simulation 1. U.S. cuts assets entrusted to China by 50%:

exogenize the path of $Z1(\text{China}, \text{US})$ and endogenize the path of $T(\text{China}, \text{US})$

Simulation 2. China cuts assets entrusted to U.S. by 50%:

exogenize the path of $Z1(\text{US}, \text{China})$ and endogenize the path of $T(\text{US}, \text{China})$

Simulation 3. Both cut assets entrusted to the other by 50%:

exogenize the paths of $Z1(\text{China}, \text{US})$ & $Z1(\text{US}, \text{China})$ and endogenize the paths of $T(\text{China}, \text{US})$ & $T(\text{US}, \text{China})$

The 50% cuts are relative to baseline and are phased in over 3 years, 2016, 2017 & 2018

Simulation setup with:

initial coefficient values in the financial module determined from start- and end-year ALC tables for 2015; and

the substitution elasticity, σ , set at 2 and subsequently subject to sensitivity analysis

Sim 1. U.S. cuts assets entrusted to China by 50%: end-year values of assets/liabilities and wealth (% deviations from baseline)

Asset Region	2016			2017			2018				2025		
	USA	China	RoW	USA	China	RoW	USA	China	RoW		USA	China	RoW
Simulation 1. U.S. cuts assets held in China by 50%													
Liability region													
USA	0.09	-1.64	-0.46	0.18	-2.72	-0.77	0.26	-3.43	-0.98	...	0.30	-2.83	-1.07
China	-20.63	-0.26	0.71	-37.00	-0.45	1.17	-50.00	-0.57	1.46	...	-50.00	-0.43	0.97
RoW	0.26	-1.20	0.02	0.54	-1.99	0.02	0.79	-2.51	0.03	...	0.86	-1.77	0.03
<i>Wealth</i>	<i>0.08</i>	<i>-0.21</i>	<i>0.02</i>	<i>0.15</i>	<i>-0.33</i>	<i>0.02</i>	<i>0.19</i>	<i>-0.38</i>	<i>0.02</i>	...	<i>0.14</i>	<i>-0.17</i>	<i>0.01</i>

Reduction in U.S. assets in China phased in over 3 years [-50 = (1-0.2063)³]

U.S. redirects funds towards domestic capital (0.30% in 2025) and ROW (0.86% in 2025)

U.S. wealth increases (0.14%) reflecting favorable macro effects

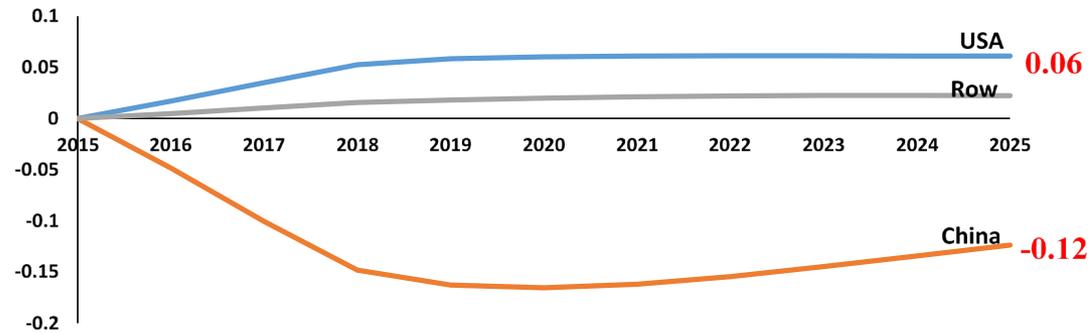
China's financial budget is reduced leading to reduced domestic capital and foreign assets

Chinese wealth decreases (-0.17% in 2025) reflecting unfavorable macro effects

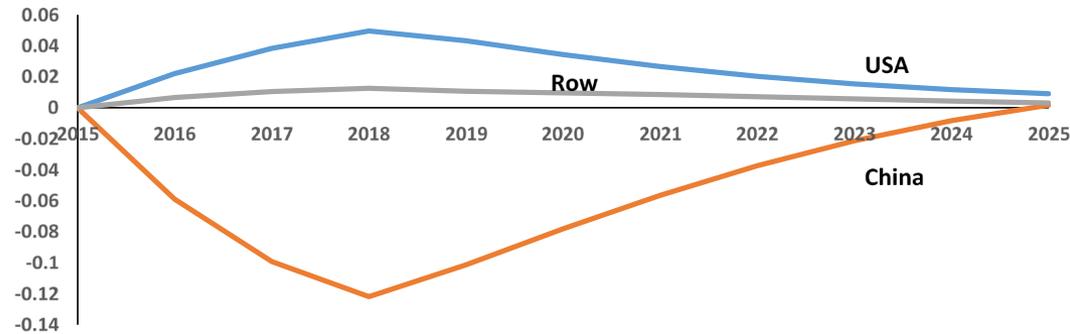
What are these favorable and unfavorable macro effects?

Sim 1. U.S. cuts assets to China: macro effects

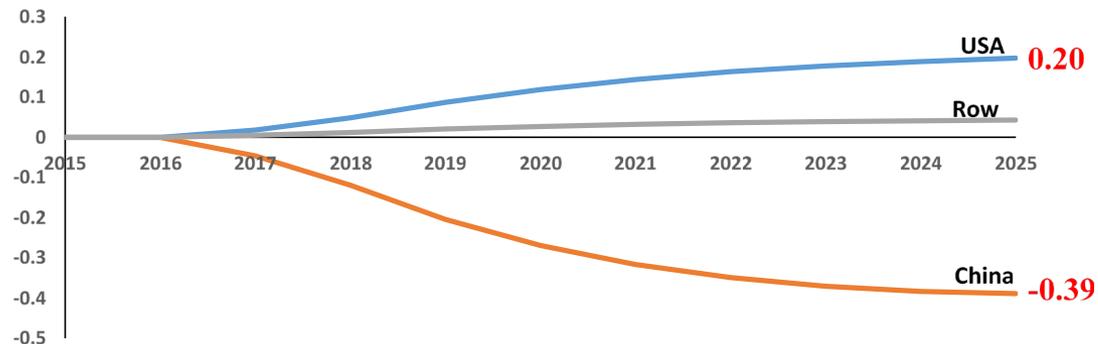
A. GDP: percentage deviations from baseline



B. Employment: percentage deviations from baseline



C. Capital: percentage deviations from baseline



Sim 2. China cuts assets entrusted to U.S. by 50%: end-year values of assets/liabilities and wealth (% deviations from baseline)

	2016			2017			2018				2025		
Asset Region	USA	China	RoW	USA	China	RoW	USA	China	RoW		USA	China	RoW
Simulation 2. China cuts assets held in the U.S. by 50%													
Liability region													
USA	-0.43	-20.63	0.91	-0.87	-37.00	1.72	-1.25	-50.00	2.44	...	-1.63	-50.00	3.15
China	-5.18	0.83	-3.49	-8.85	1.53	-5.78	-11.46	2.06	-7.25	...	-11.56	1.81	-6.17
RoW	-1.79	3.53	-0.02	-3.29	6.52	-0.02	-4.56	8.92	-0.03	...	-5.87	7.68	-0.10
<i>Wealth</i>	<i>-0.39</i>	<i>0.66</i>	<i>-0.01</i>	<i>-0.73</i>	<i>1.11</i>	<i>0.00</i>	<i>-0.96</i>	<i>1.38</i>	<i>0.00</i>	...	<i>-0.72</i>	<i>0.62</i>	<i>0.01</i>

Reduction in Chinese assets in U.S. phased in over 3 years

China redirects funds towards domestic capital (1.81% in 2025) and ROW (7.68% in 2025)

Chinese wealth increases (0.62%) reflecting favorable macro effects

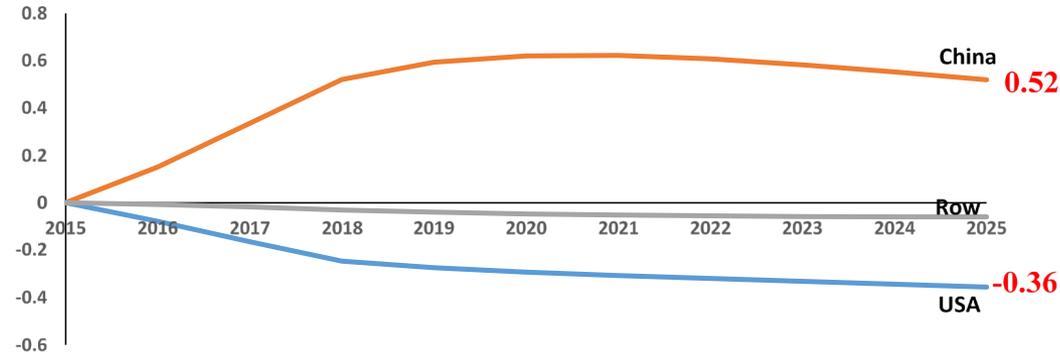
U.S.'s financial budget is reduced leading to reduced domestic capital and foreign assets

U.S. wealth decreases (-0.72% in 2025) reflecting unfavorable macro effects

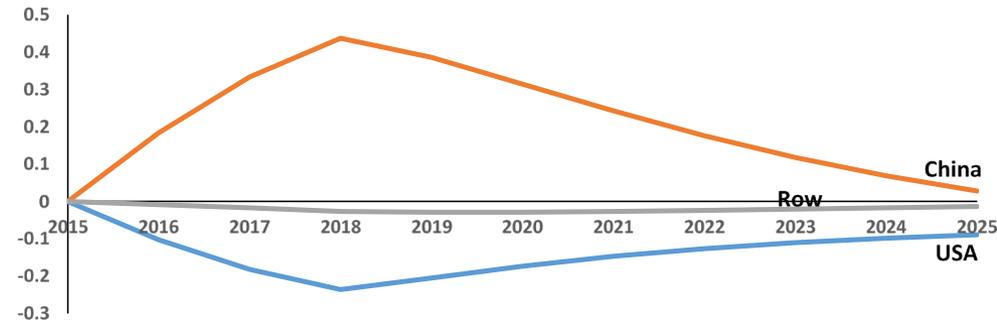
Sim 2. China cuts assets to U.S.: macro effects



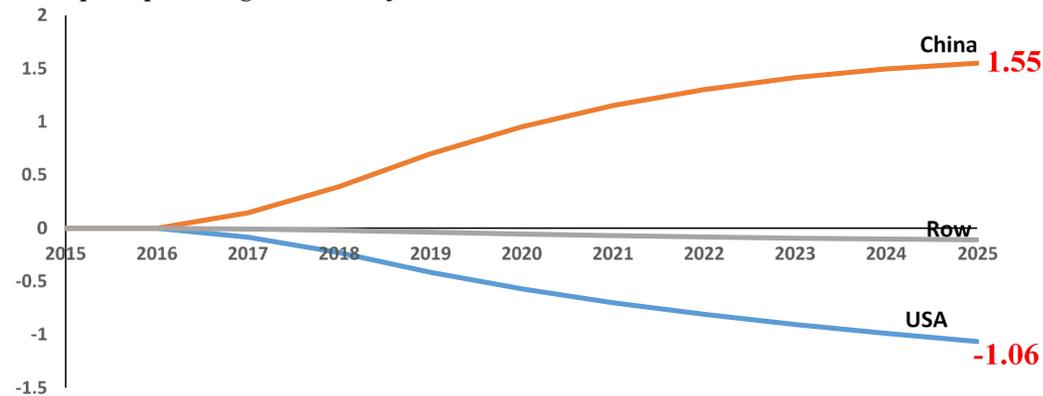
A. GDP: percentage deviations from baseline



B. Employment: percentage deviations from baseline



C. Capital: percentage deviations from baseline



Why is the capital effect in China of withdrawal from U.S. (Sim 2) **6 times greater** than the capital effect in the U.S. of withdrawal from China (Sim 1) : **Capital effect in 2025 of 1.81% compared with 0.30% ?**

Asset Region	2025		
	USA	China	RoW
Sim 1: U.S. cuts in China			
Liability region			
USA	0.30	-2.83	-1.07
China	-50.00	-0.43	0.97
RoW	0.86	-1.77	0.03
<i>Wealth</i>	<i>0.14</i>	<i>-0.17</i>	<i>0.01</i>
Sim 2: China cuts in U.S.			
Liability region			
USA	-1.63	-50.00	3.15
China	-11.56	1.81	-6.17
RoW	-5.87	7.68	-0.10
<i>Wealth</i>	<i>-0.72</i>	<i>0.62</i>	<i>0.01</i>

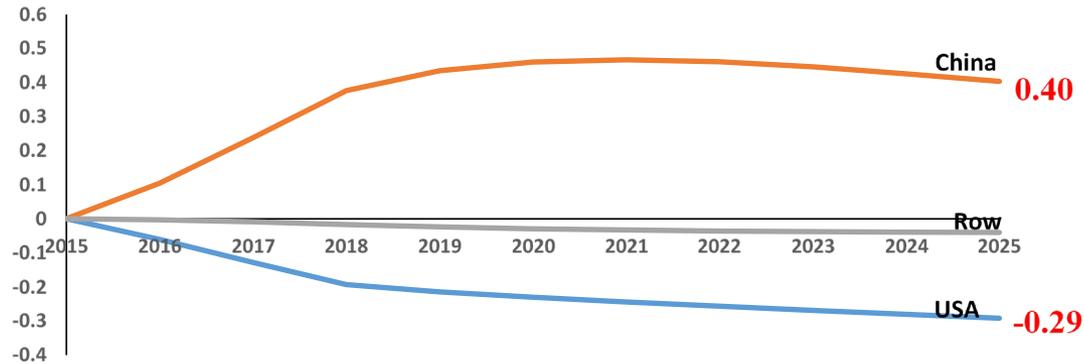
Two reasons:

- (1) Impact effect is 4 times bigger for China in sim 2 than for the U.S. in sim 1**
- (2) U.S. financial markets are more open than those for China**

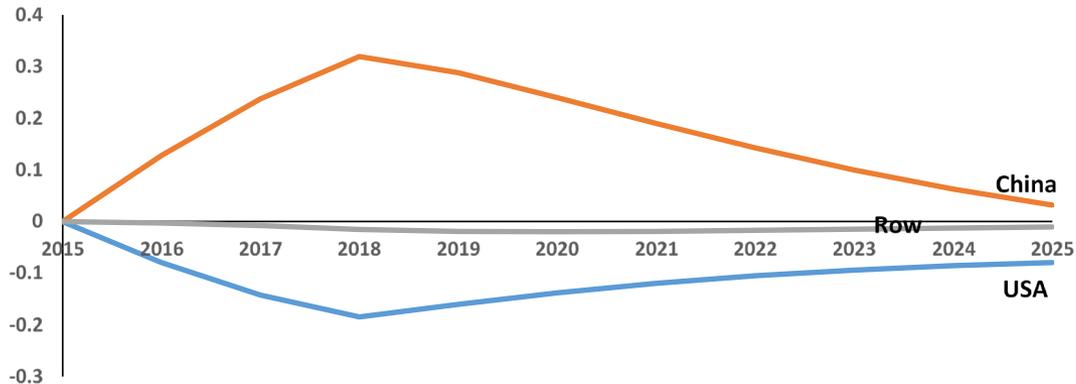
Implication: China would win in a tit-for-tat financial decoupling

Sim 3. 50% financial decoupling by U.S. & China

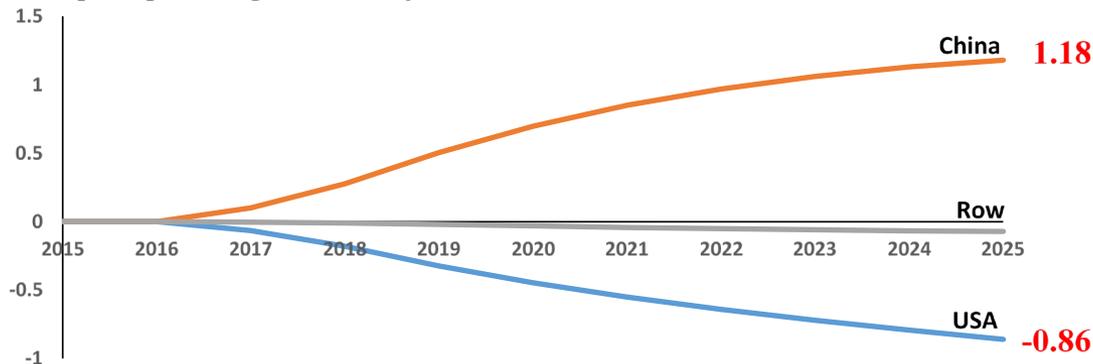
A. GDP: percentage deviations from baseline



B. Employment: percentage deviations from baseline



C. Capital: percentage deviations from baseline

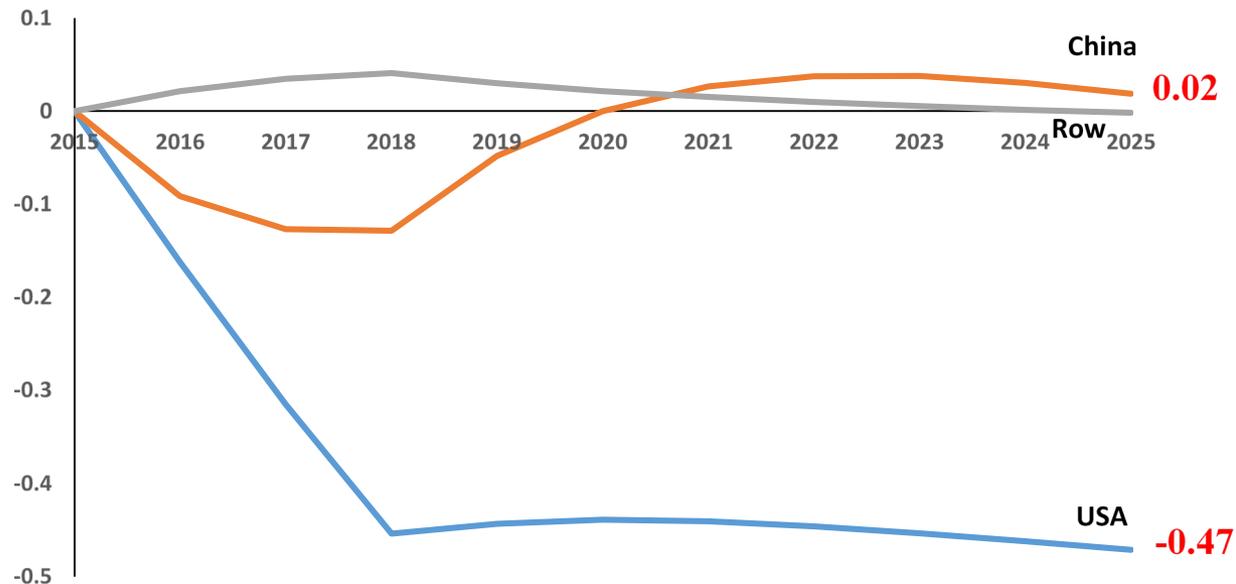


Concluding remarks

In terms of macro effects, a 50% financial decoupling is just as important as a 50 per cent trade decoupling. But both countries lose in tit-for-tat trade decoupling

Adding trade decoupling wipes out Chinese gains from financial decoupling and accentuates U.S. losses

*The U.S. and China decouple by 50 per cent in both finance and trade
(GDP percentage deviations from baseline)*



Area for future development:

- more data work on the ALC tables
- **disgregation of the financial instruments** into loans, bonds, equity, cash, and special drawing rights & gold
- recognition of **multiple financial agents** for each country: households, banks, non-bank financial institution, retirements funds, industries and government

END

Why is the capital effect in China of withdrawal from U.S. (Sim 2) 6 times greater than the capital effect in the U.S. of withdrawal from China (Sim 1): **Further explanation**

(1) Impact effect

Assets & liabilities at the start of 2015 (\$UST)

Asset region	USA	China	RoW	Total
Liability region				
USA	53.85	3.00	24.26	81.11
China	1.14	40.79	7.70	49.64
RoW	19.97	7.62	161.74	189.33
Total	74.96	51.42	193.70	

Impact effect in Sim 1: U.S. supplements its funds for domestic investment by **0.77%** [= $100 \times 0.50 \times 1.14 / (53.85 + 19.97)$]

Impact effect in Sim 2: China supplements its funds for domestic investment by **3.10%** [= $100 \times 0.50 \times 3.00 / (40.79 + 7.62)$]

Impact effects suggest that the Chinese capital effect in Sim 2 should be about **4** times the U.S. capital effect in sim 1 ($4.0 = 3.10/0.77$).

What is the extra effect ? **Greater U.S. openness**

(2) Openness effect

In sim 1, the U.S. agent has *considerable* opportunities to switch funds to ROW and the ROW agent was *considerable* opportunities to switch funds out of the U.S.

In sim 2, the Chinese agent has *limited* opportunities to switch funds to ROW and the ROW agent was *limited* opportunities to switch funds out of China