Global Imbalances
and Structural Change in the United States

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Introduction

United States has borrowed heavily from the rest of the world since early 1990s

At the same time, the share of employment in goods-producing sectors has fallen dramatically

What will happen when United States starts to repay its debt?

• Will employment return to goods producing sectors?

• How disruptive would be a sudden stop to foreign lending?

Global savings glut

Why is the United States, with the world's largest economy, borrowing heavily on international capital markets — rather than lending, as would seem more natural? …[O]ver the past decade a combination of diverse forces has created a significant increase in the global supply of saving — a global saving glut — which helps to explain both the increase in the U.S. current account deficit and the relatively low level of long-term real interest rates in the world today.

Ben S. Bernanke (2005)

- Large literature seeks to explain savings glut

    o Example: Financial integration with asymmetric financial development (Mendoza et al. 2009; Caballero et al. 2008)

- We take savings glut as given and focus on its impact and on impact of two different exit scenarios.

What We Do

Interpret savings glut as period of increased demand for U.S. bonds

Build model consistent with 3 key facts about U.S. economy since 1992

Assess impact of end to savings glut

- Emphasize reallocation effects on goods, services, construction sectors.

- Experiment with 2 exit scenarios: gradual rebalancing and unexpected, disorderly sudden stop in 2015–2016

Summary of results: Goods-sector employment

Savings glut accompanied by decline in goods employment

Will labor compensation/employment return to goods production when United States starts running trade surpluses to repay debt?

Labor compensation in goods fell along with trade deficit
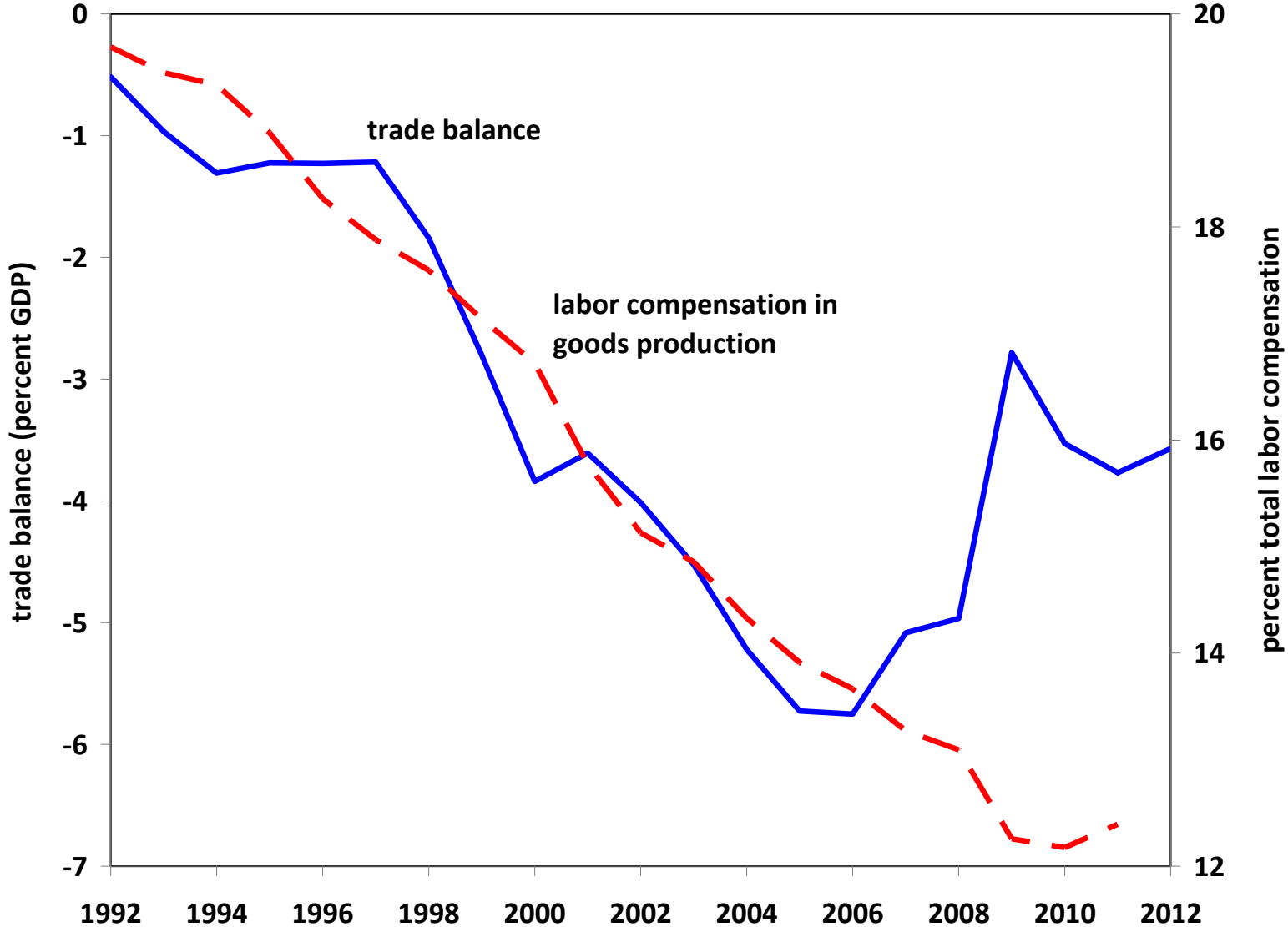
Summary of result: Goods-sector employment

Savings glut accompanied by decline in goods employment

Will labor compensation/employment return to goods production when United States starts running trade surpluses to repay debt?

No!

Most of allocation of labor out of goods production is due to structural change, not to saving glut

Services trade reduces need to export goods to repay debt

Summary of results: Welfare

Have U.S. households benefited from global savings glut?

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Yes!

U.S. households are much better off after 20 years of foreign lending and cheap foreign goods…

Summary of results

Have U.S. households benefited from global savings glut?

Yes!

U.S. households are much better off after 20 years of foreign lending and cheap foreign goods…

…but unexpected, disorderly sudden stop could make them worse off than if savings glut never occurred
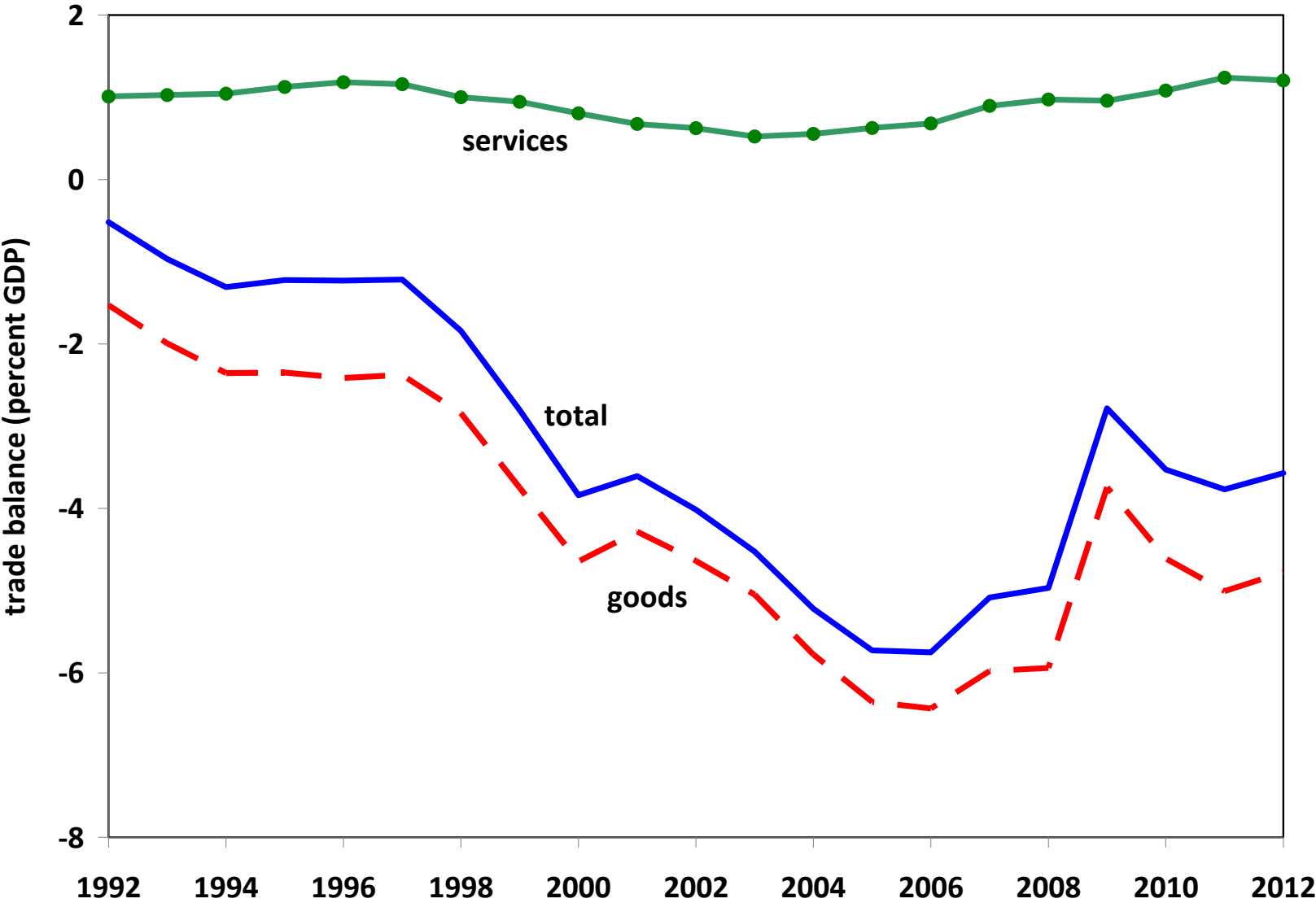
Game Plan

1. Key facts

2. Baseline model

3. Quantitative strategy and calibration

4. Model's performance on key facts and predictions under gradual rebalancing

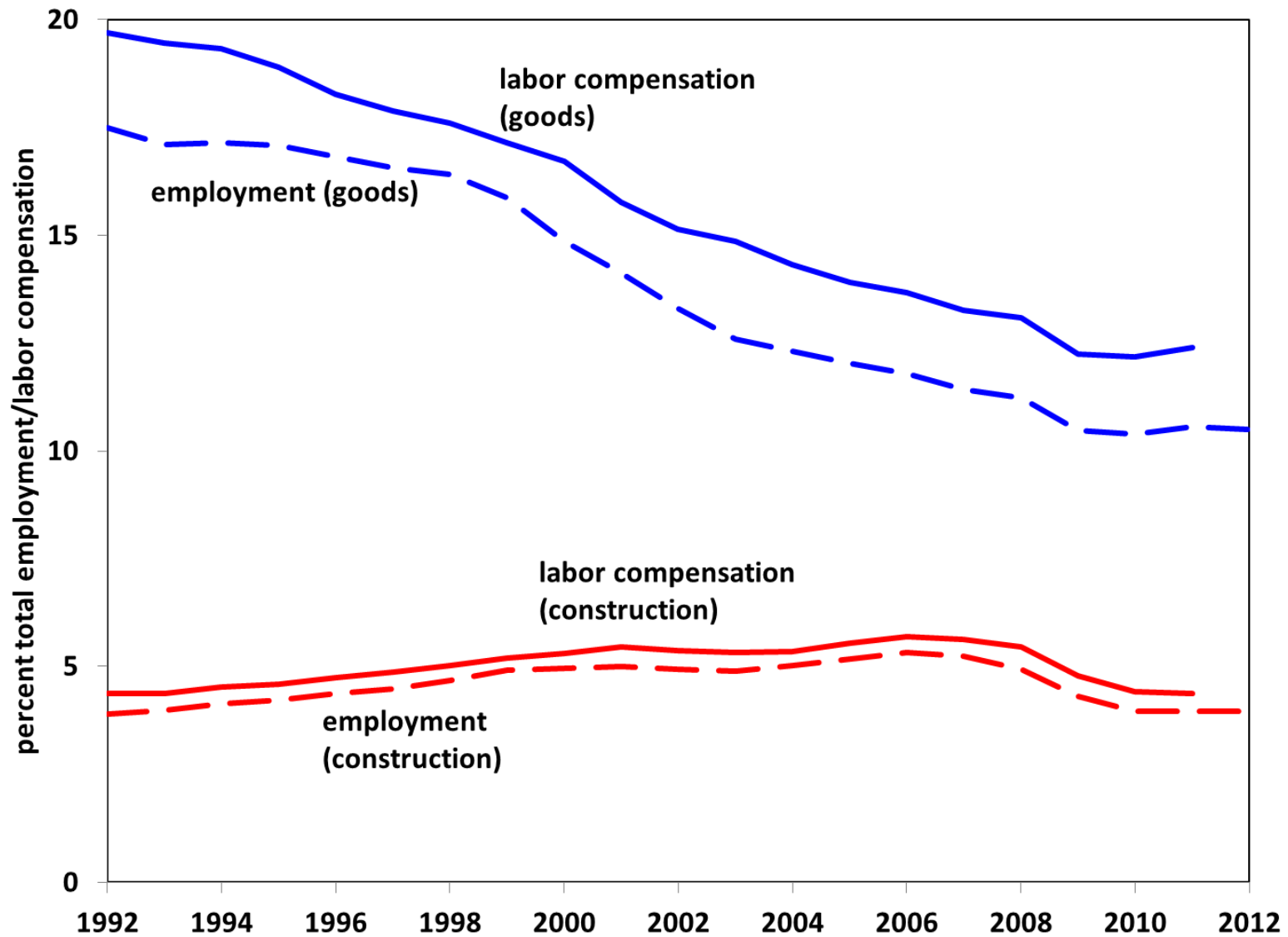5. Sudden stop in 2015–2016

6. Two puzzles

Fact 1: U.S. real exchange rate appreciates, then depreciates
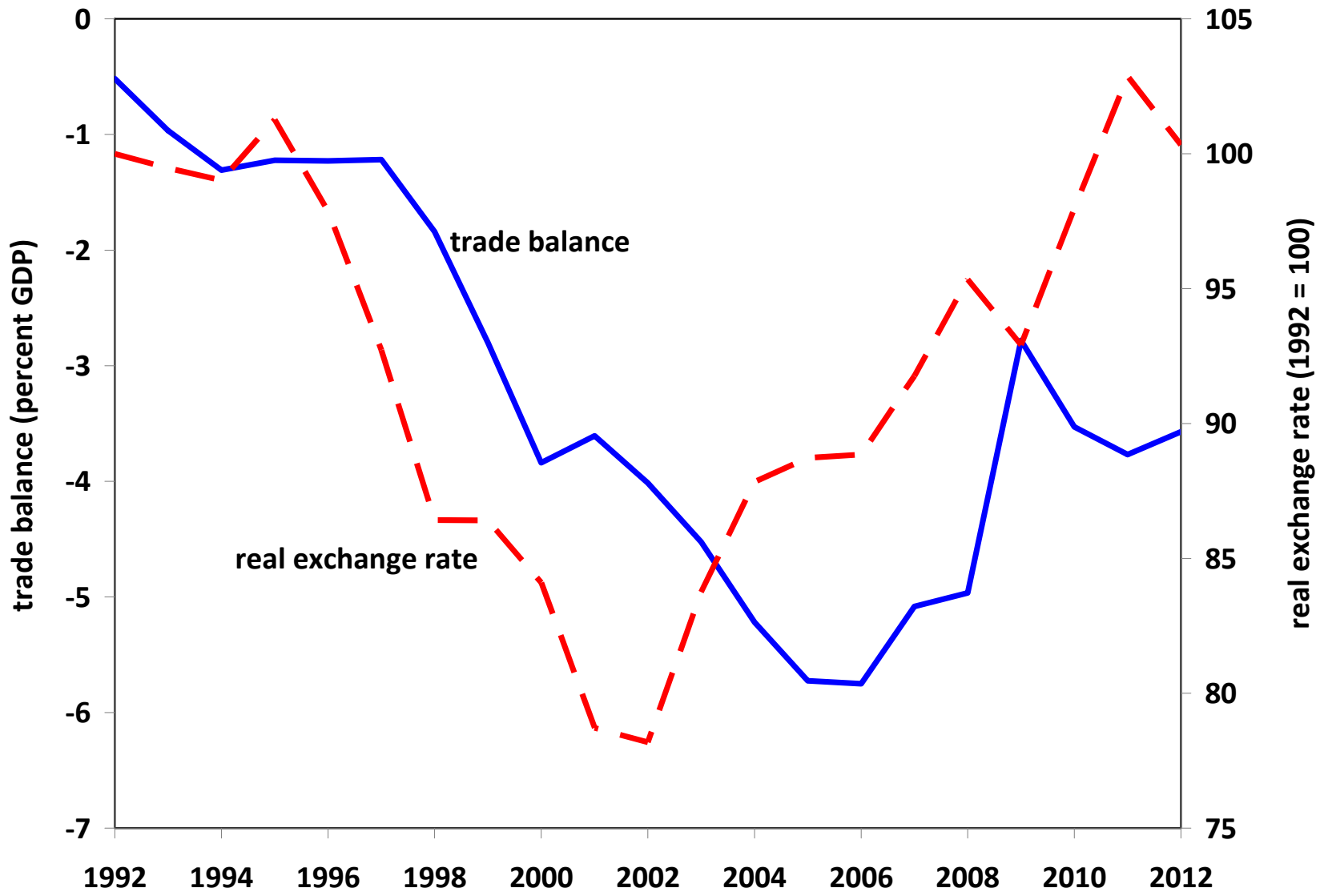
Fact 2: Dynamics of trade deficit are driven by deficits in goods trade

Fact 3: Labor in goods declines, and there is a boom in construction

Aside: Measuring the goods-sector employment share

We measure the goods-sector employment share as the fraction of total labor compensation paid in goods-producing sectors

This measure corresponds directly to our model

Moves in tandem with alternative measures like the fraction of total employment in goods-producing sectors

Model

Dynamic general equilibrium model with two countries:

- United States (U.S.)

- Rest of the world (R.W.)

Key assumption that generates the savings glut

- R.W.'s discount factor is the same as that of the U.S. in the long run

- R.W.'s discount factor varies over time (deterministically), calibrated to match U.S. trade balance during 1992–2012

Timing and expectations

The savings glut

- In 1992, agents expect deterministic economy without savings glut; R.W.'s discount factor constant at long-run level

- In 1993, savings glut starts unexpectedly and lasts through 2012

Exit scenarios

1. Gradual rebalancing: agents expect economy to follow deterministic path in which demand for U.S. bonds (driven by R.W.'s discount factor) falls slowly after 2012

2. Sudden stop: lending stops unexpectedly in 2015–2016, 10% TFP drop

Commodity types

U.S. produces goods y_{gt}^{us}, services y_{st}^{us}, construction y_{ct}^{us}, and investment y_{it}^{us}

R.W. produces goods y_{gt}^{rw} and services y_{st}^{rw}

Goods and services and tradable, construction is not

Perfectly competitive firms

U.S. production: goods, services, and construction

To produce goods and services ($j=g,s$)

$$y_{jt}^{us} = \mathrm{M}_j^{us} \left(\mu_j^{us} \min\left[\frac{z_{gjt}^{us}}{a_{gjt}^{us}}, \frac{z_{sjt}^{us}}{a_{sjt}^{us}}, \frac{z_{cjt}^{us}}{a_{cjt}^{us}}, A_{jt}^{us}(k_{jt}^{us})^{\alpha_j}(\gamma_{jt}^{us}\ell_{jt}^{us})^{1-\alpha_j} \right]^{\zeta_j} + (1-\mu_j^{us})(m_{jt}^{us})^{\zeta_j} \right)^{\frac{1}{\zeta_j}}$$

Domestic intermediate inputs: goods z_{gjt}^{us} , services z_{sjt}^{us}, construction z_{cjt}^{us}

Imported intermediates from R.W.'s sector j: m_{jt}^{us}

A_{jt} constant except for decline during sudden stop

Labor productivity γ_{jt}^{us} grows at different rates across sectors

Construction similar but with no traded component: $\mu_{ct}^{us}=1$, $m_{ct}^{us}=0$

U.S. production: investment

Aggregate of goods, services, and construction

$$y_{it}^{us} = G^{us} (z_{git}^{us})^{\theta_g} (z_{sit}^{us})^{\theta_s} (z_{cit}^{us})^{\theta_c} , \quad \theta_g + \theta_s + \theta_c = 1$$

Construction has largest share, followed by goods

Cobb-Douglas specification consistent with constant investment input expenditure shares in data (Bems, 2008)

Bonds

Bonds are denominated in units of U.S. CPI, which we calculate as

$$p_{cpi}^{us}(p_{gt}^{us}, p_{st}^{us}) = \frac{p_{gt}^{us} c_{g1992}^{ush} + p_{st}^{us} c_{s1992}^{ush}}{p_{g1992}^{us} c_{g1992}^{ush} + p_{s1992}^{us} c_{s1992}^{ush}}$$

q_t is the price in period t of a bond that pays one unit of U.S. CPI in period $t+1$

Real interest rate in units of U.S. CPI is given by

$$1 + r_{t+1} = \frac{p_{cpi}^{us}(p_{gt}^{us}, p_{st}^{us})}{q_t}$$

U.S. households

Choose consumption of goods and services, investment, labor and bonds to maximize

$$\sum_{t=0}^{\infty} \beta^t u\left(\frac{c_{gt}^{ush}}{n_t^{us}}, \frac{c_{st}^{ush}}{n_t^{us}}, \frac{\ell_t^{ush}}{\overline{\ell}_t^{us}} \right)$$

subject to

$$p_{gt}^{us} c_{gt}^{ush} + p_{st}^{us} c_{st}^{ush} + p_{it}^{us} i_t^{us} + q_t b_{t+1}^{ush} = w_t^{us} \ell_t^{us} + p_{cpi}^{us}(p_{gt}^{us}, p_{st}^{us})b_t + (1-\tau_k)r_{kt}^{us} k_t^{us} - T_t^{us}$$

$$k_{t+1}^{us} = (1-\delta)k_t^{us} + i_t$$

Adult-equivalent population n_t^{us} and working-age population $\overline{\ell}_t^{us}$ grow over time at different rates

U.S. government

Government budget constraint:

$$p_{gt}^{us} c_{gt}^{usg} + p_{st}^{us} c_{st}^{usg} + q_t b_{t+1}^{usg} = \tau_k r_{kt}^{us} k_t^{us} + T_t + p_{cpi}^{us}(p_{gt}^{us}, p_{st}^{us}) b_t^{usg}$$

Government debt set as fraction υ_t^{us} of GDP:

$$b_{t+1}^{usg} = \upsilon_t^{us} GDP_t^{us}$$

Goods and services consumption maximize

$$(c_{gt}^{usg})^{\varepsilon^{usg}} (c_{st}^{usg})^{1-\varepsilon^{usg}}$$

subject to requirement that total expenditures equal fraction v_t^{us} of U.S. GDP:

$$p_{gt}^{us} c_{gt}^{usg} p_{st}^{us} c_{st}^{usg} = v_t^{us} GDP_t^{us}$$

Ricardian equivalence except for during sudden stop

R.W. production: goods and services

Abstract from capital and input-output structure for simplicity

Goods and services produced using domestic and imported inputs in standard Armington aggregator:

$$y_{jt}^{rw} = M_j^{rw} \left(\mu_j^{rw} \left(\gamma_{jt}^{rw} \ell_{jt}^{rw} \right)^{\varsigma_j} + (1 - \mu_j^{rw})(m_{jt}^{rw})^{\varsigma_j} \right)^{\frac{1}{\varsigma_j}}, \quad j = g, s$$

CPI in R.W. computed as in United States

Calculate real exchange rate using CPIs:

$$rer_t = \frac{p_{cpi}^{rw}(p_{gt}^{rw}, p_{st}^{rw})}{p_{cpi}^{us}(p_{gt}^{us}, p_{st}^{us})}$$

R.W. Households

Choose consumption, bonds, and labor to maximize

$$\sum_{t=0}^{\infty} \beta^t \omega_t^{rw} u \left(\frac{c_{gt}^{rw}}{n_t^{rw}}, \frac{c_{st}^{rw}}{n_t^{rw}}, \frac{\ell_t^{rw}}{\overline{\ell}_t^{rw}} \right)$$

Subject to

$$p_{gt}^{rw} c_{gt}^{rw} + p_{st}^{rw} c_{st}^{rw} + q_t b_{t+1}^{rw} = w_t^{rw} \ell_t^{rw} + p_{cpi}^{us}(p_{gt}^{us}, p_{st}^{us}) b_t^{rw}$$

ω_t^{rw} are shifters to intertemporal marginal rate of substitution

ω_t^{rw} fall during 1992–2012, creating increased demand for bonds

Output and bond market clearing

U.S. goods and services:

$$z_{jgt}^{us} + z_{jst}^{us} + z_{jct}^{us} + z_{jit}^{us} + c_{jt}^{ush} + c_{jt}^{usg} + m_{jt}^{rw} = y_{jt}^{us}$$

U.S. construction:

$$z_{jgt}^{us} + z_{jst}^{us} + z_{jct}^{us} + z_{cit}^{us} = y_{ct}^{us}$$

U.S. investment:

$$i_{it}^{us} = y_{it}^{us}$$

R.W. goods and services:

$$c_{jt}^{rw} + m_{jt}^{us} = y_{jt}^{rw}$$

Bonds

$$b_t^{ush} + b_t^{usg} + b_t^{rw} = 0$$

Equilibrium

Given $(\bar{k}_{t_0}^{us}, \bar{b}_{t_0}^{ush}, \bar{b}_{t_0}^{usg})$ and $\{\omega_t^{rw}, v_t^{us}, \upsilon_t^{us}\}_{t=0t_0}^{\infty}$ …

… an equilibrium is sequences of prices and quantities that satisfy

- Households' optimality conditions

- Marginal product pricing conditions

- Government's budget constraint and consumption optimality condition

- Market clearing for output, bonds, and factors

Overview of quantitative strategy

Calibrate model to match 1992 data

Choose time series for R.W.'s preference parameter ω_t^{rw} to match trade balance during 1992–2012

Solve for equilibrium assuming BGP in 100 years

Analyze implications of savings glut exit

Study short and long-run dynamics following

1. Gradual rebalancing

2. Sudden stop in 2015–2016

Calibration overview

Rest of the world: top 20 U.S. trading partners by 1992 imports

Choose elasticities of substitution from literature

Choose discount factor β so that 3% long-run real interest rate consistent with balanced growth

Demographic growth rates from historical data for 1992–2012 and UN World Population Project projections

Growth rates for labor productivity γ_{jt}^{us} and γ_{jt}^{rw} based on BEA industry accounts

Government spending, debt paths from historical data for 1992–2012 and CBO projections

Choose production and preference parameters so equilibrium replicates 1992 input-output matrix and national accounts

1992 input-output matrix (bil. 1992 dollars)

Industry	Inputs			Final demand					Total demand
	Goods	Services	Construction	Private consumption	Government consumption	Investment	Exports	-Imports	
Goods	z_{ggt}^{us}	z_{gst}^{us}	z_{gct}^{us}	c_{gt}^{ush}	c_{gt}^{usg}	z_{git}^{us}	m_{gt}^{rw}	$-m_{gt}^{us}$	y_{gt}^{us}
Services									
Construction									
Labor compensation									
Returns to capital									
Total gross output									

1992 input-output matrix (bil. 1992 dollars)

Industry	Inputs			Final demand					Total demand
	Goods	Services	Construction	Private consumption	Government consumption	Investment	Exports	-Imports	
Goods	1,345	424	240	891	196	345	448	-545	**3,346**
Services	638	1,488	179	3,346	854	228	187	-123	**6,798**
Construction	26	139	1	-	-	514	-	-	**679**
Labor compensation	849	3,273	188	-	-	-	-	-	**4,310**
Returns to capital	488	1,474	71	-	-	-	-	-	**2,033**
Total gross output	**3,346**	**6,798**	**679**	**4,237**	**1,050**	**1,088**	**635**	**-668**	

Important parameters

Armington elasticities: 3 for goods, 1 for services

Elasticity between goods and services in consumption: 0.5

$(a_{cg}^{us}, a_{cs}^{us}, a_{cc}^{us}) \approx 0$ means construction used primarily for investment

(μ_g^{us}, μ_s^{us}) imply goods trade deficit, services trade surplus

Labor productivity in goods grows faster (4.3%) than in services (1.3%)

# Quantitative exercise: savings glut and gradual rebalancing

In 1992, model agents expect ω_t^{rw} to fall smoothly to 1

In 1993, ω_t^{rw} unexpectedly starts to fall (but perfect foresight over time path thereafter), generating savings glut

Chosen so that model matches U.S. trade balance exactly during 1992–2012

After 2012, ω_t^{rw} gradually returns to 1 ("gradual rebalancing")
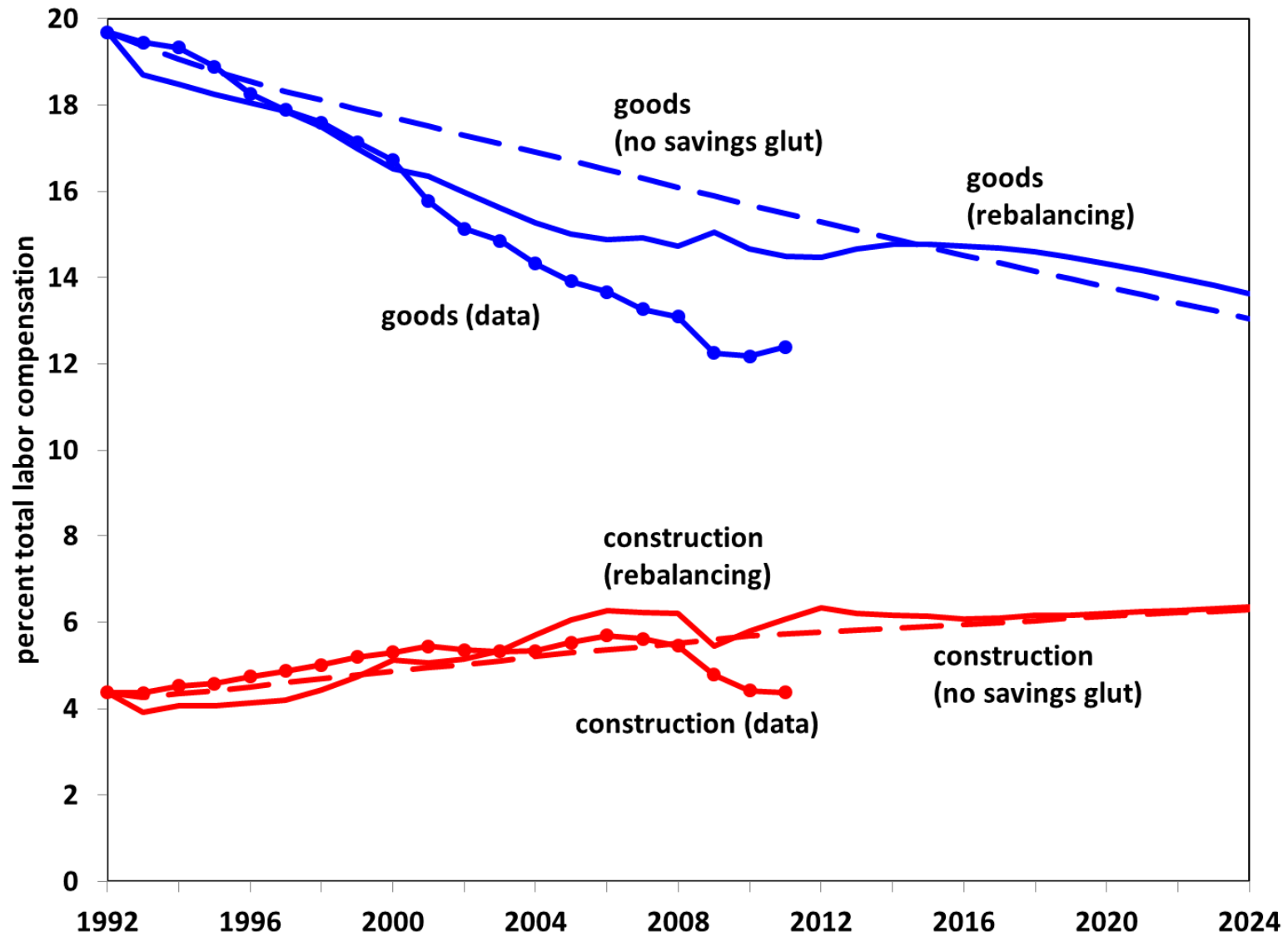
ROW's savings behavior is calibrated to generate savings glut
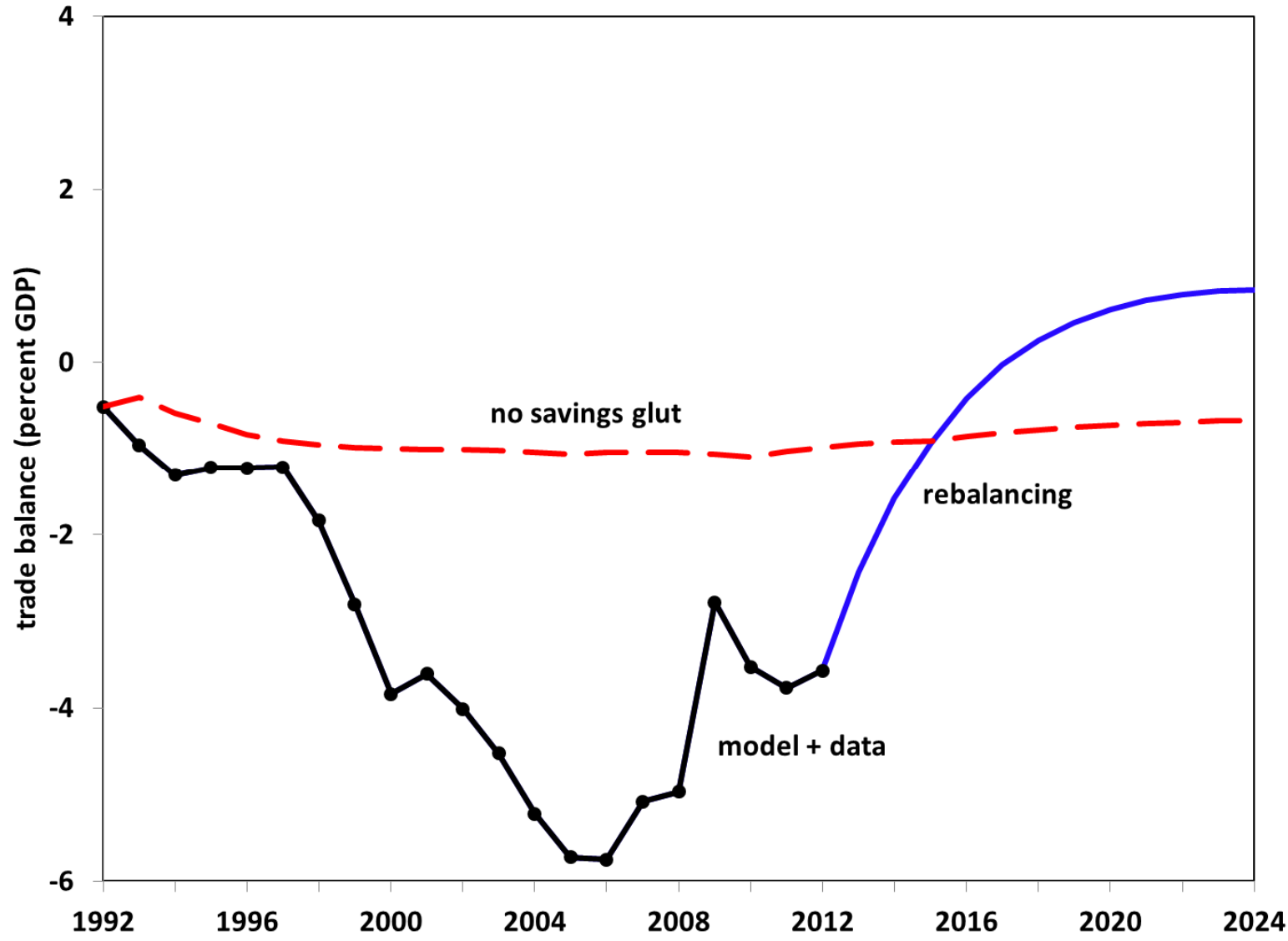
Fact 1: U.S. real exchange rate appreciates, then depreciates
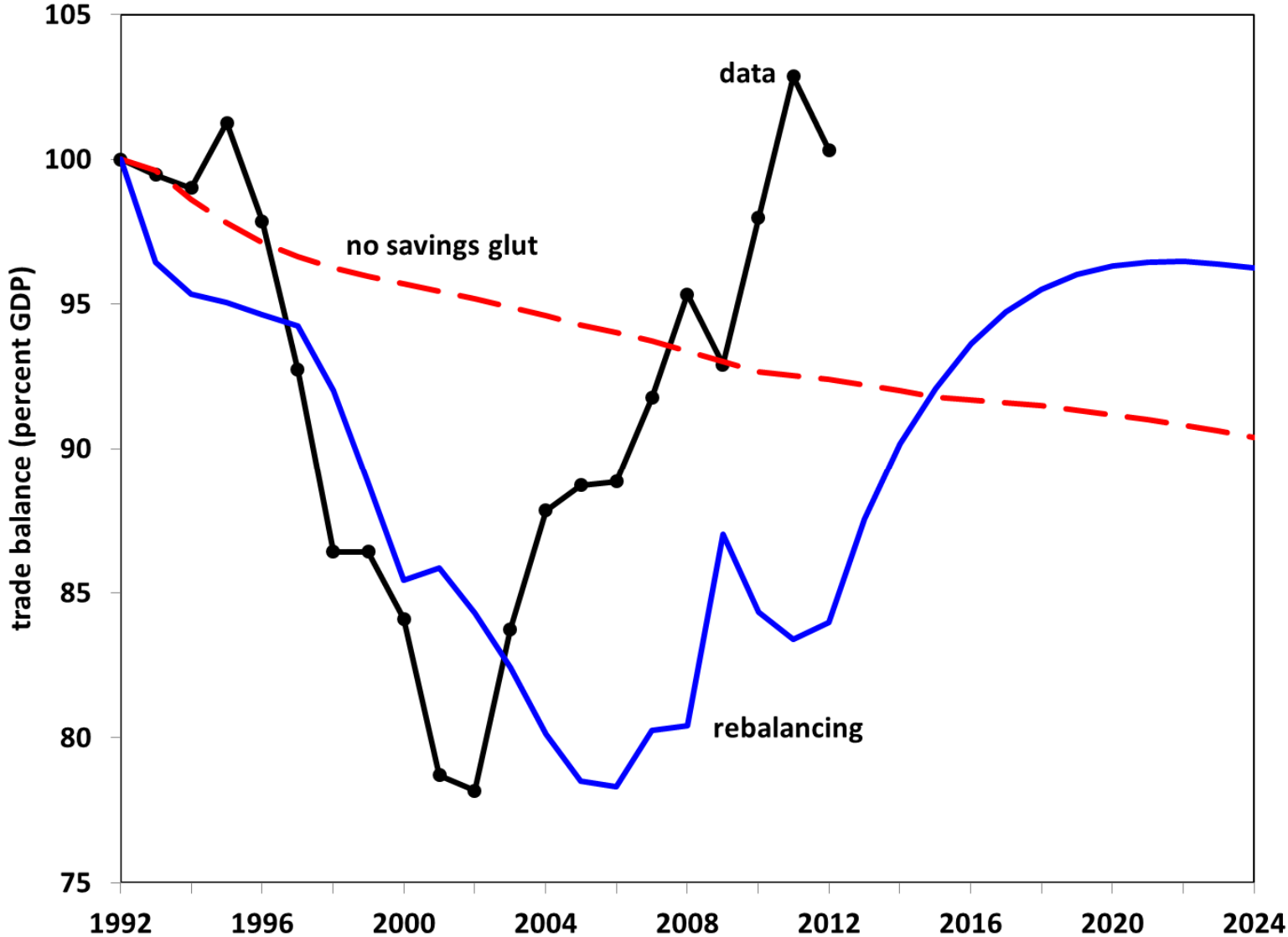
Fact 2: Dynamics of trade deficit are driven by deficits in goods trade
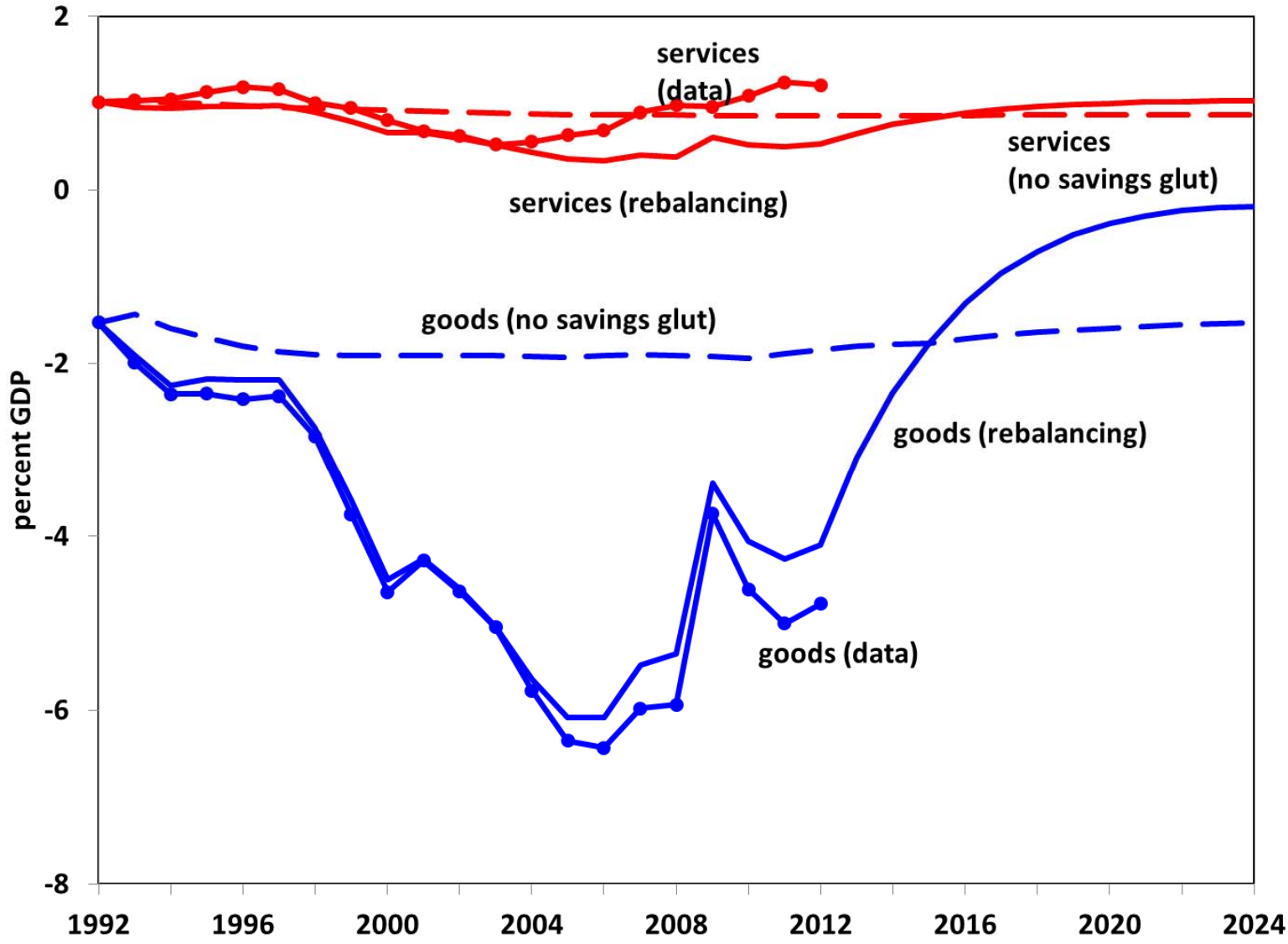
Fact 3: Labor in goods declines, and there is a boom in construction

Summary: in-sample fit and gradual rebalancing

Key facts during 1992–2012:

- Increase in borrowing drives up trade deficit (by construction)

- Drop in exports, rise in imports causes RER appreciation

- Goods imports drives trade balance due to low services import share

- Labor shifts out of goods into construction and services

Post-2012 rebalancing:

- Bond repayment requires trade balance and RER reversal

- Trade balance dynamics again driven by goods

- Goods employment continues to decline!

Sudden stop in 2015–2016

What would happen if, instead of gradual rebalancing, demand for U.S. abruptly and unexpectedly ceases?

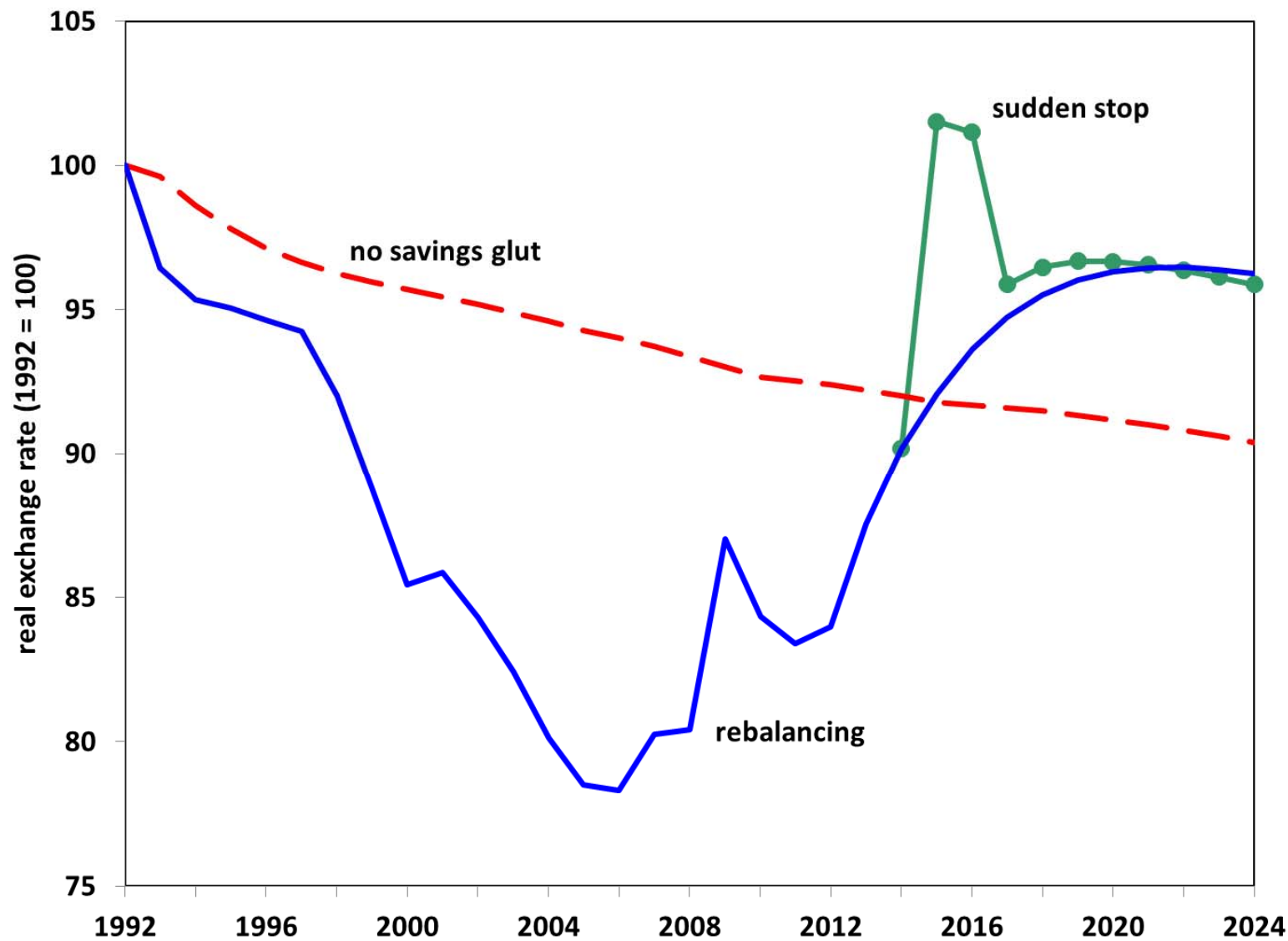Four unexpected events occur in 2015–2016:

- U.S. households restricted from borrowing

- U.S. government debt/GDP begins to fall to lower long-run level

- TFP drops by 10% in 2015, 5% in 2016

- R.W. time preference parameter converges more quickly to 1
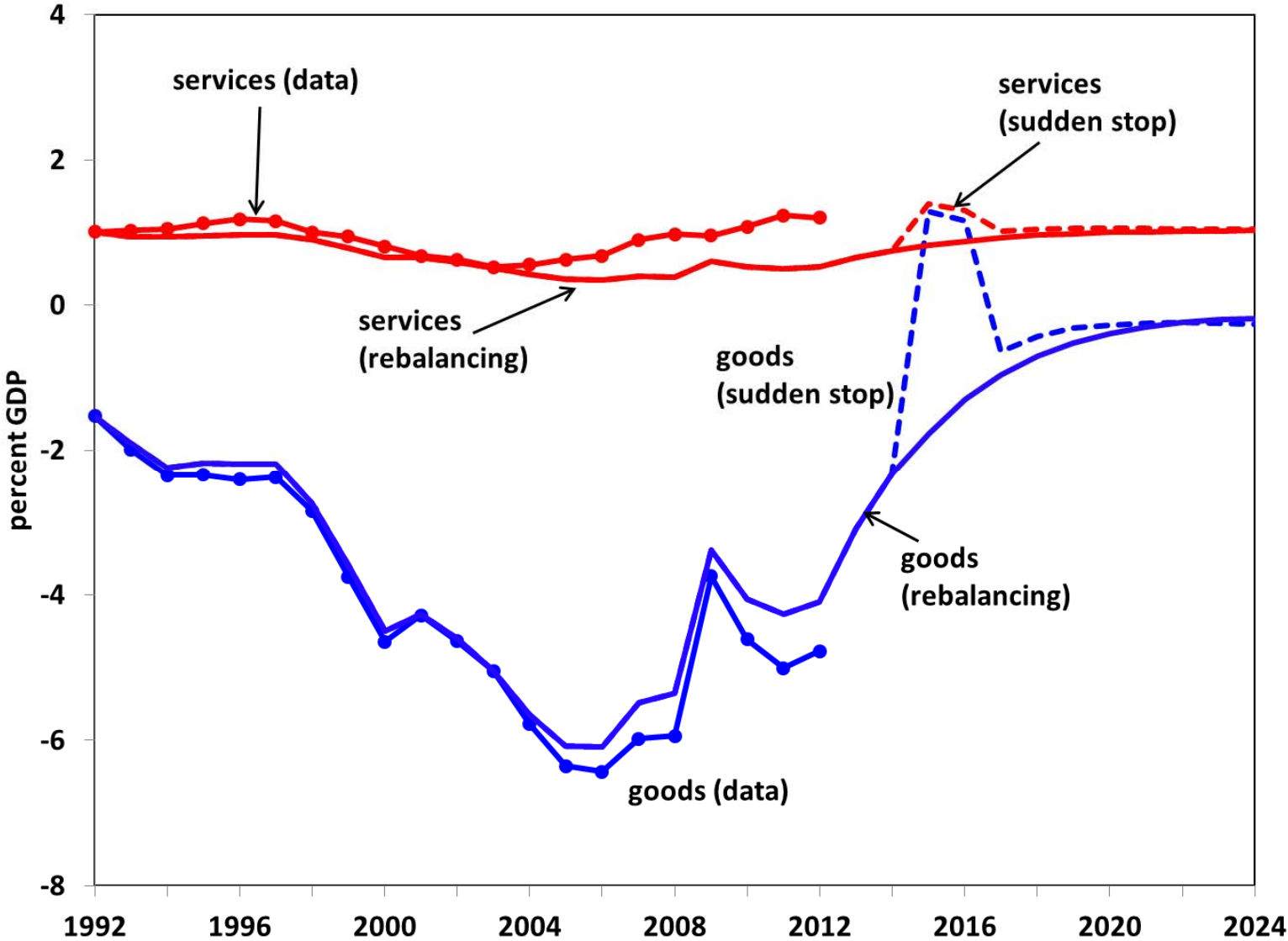
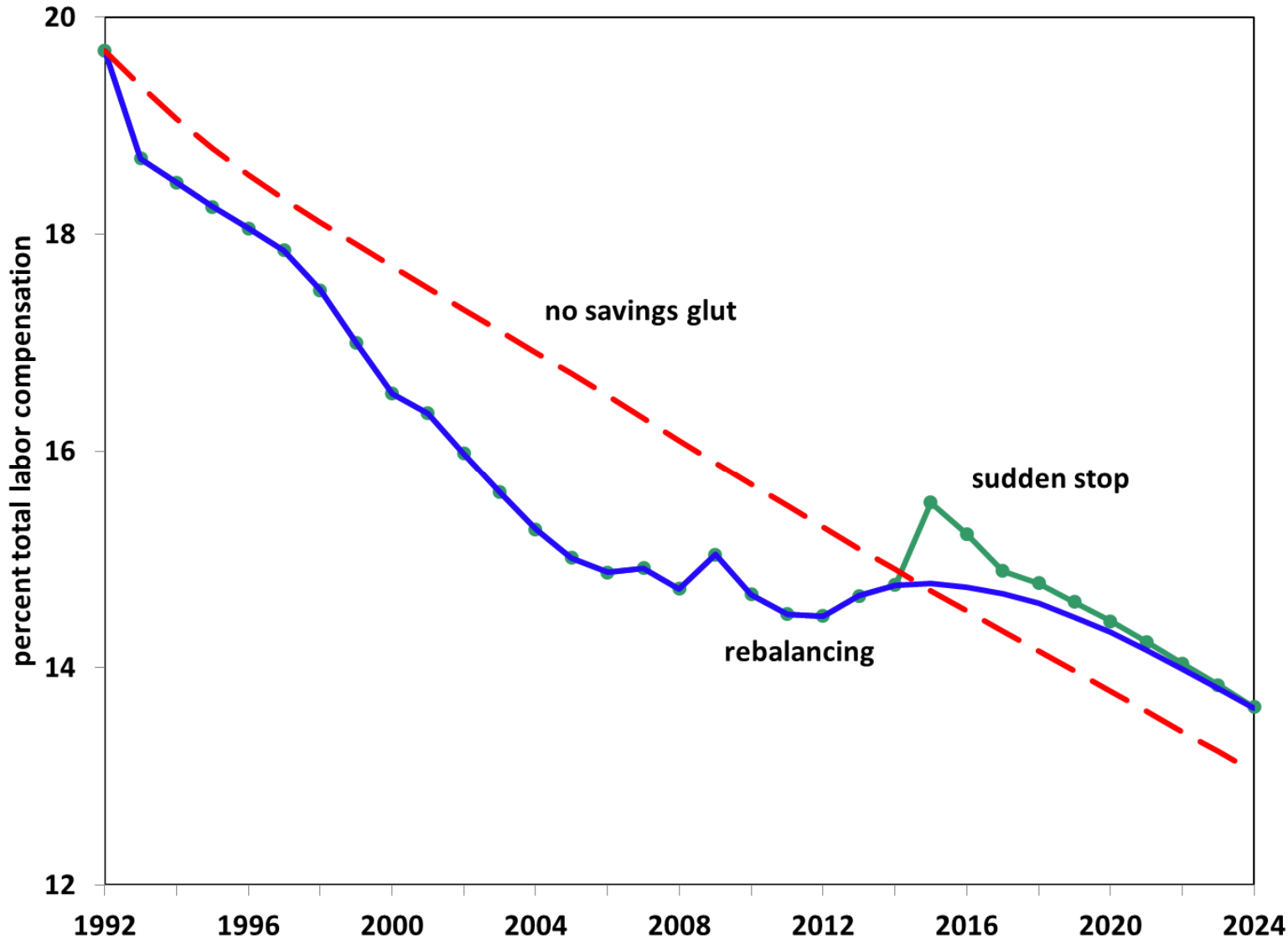After sudden stop, perfect foresight again

Sudden stop: trade balance
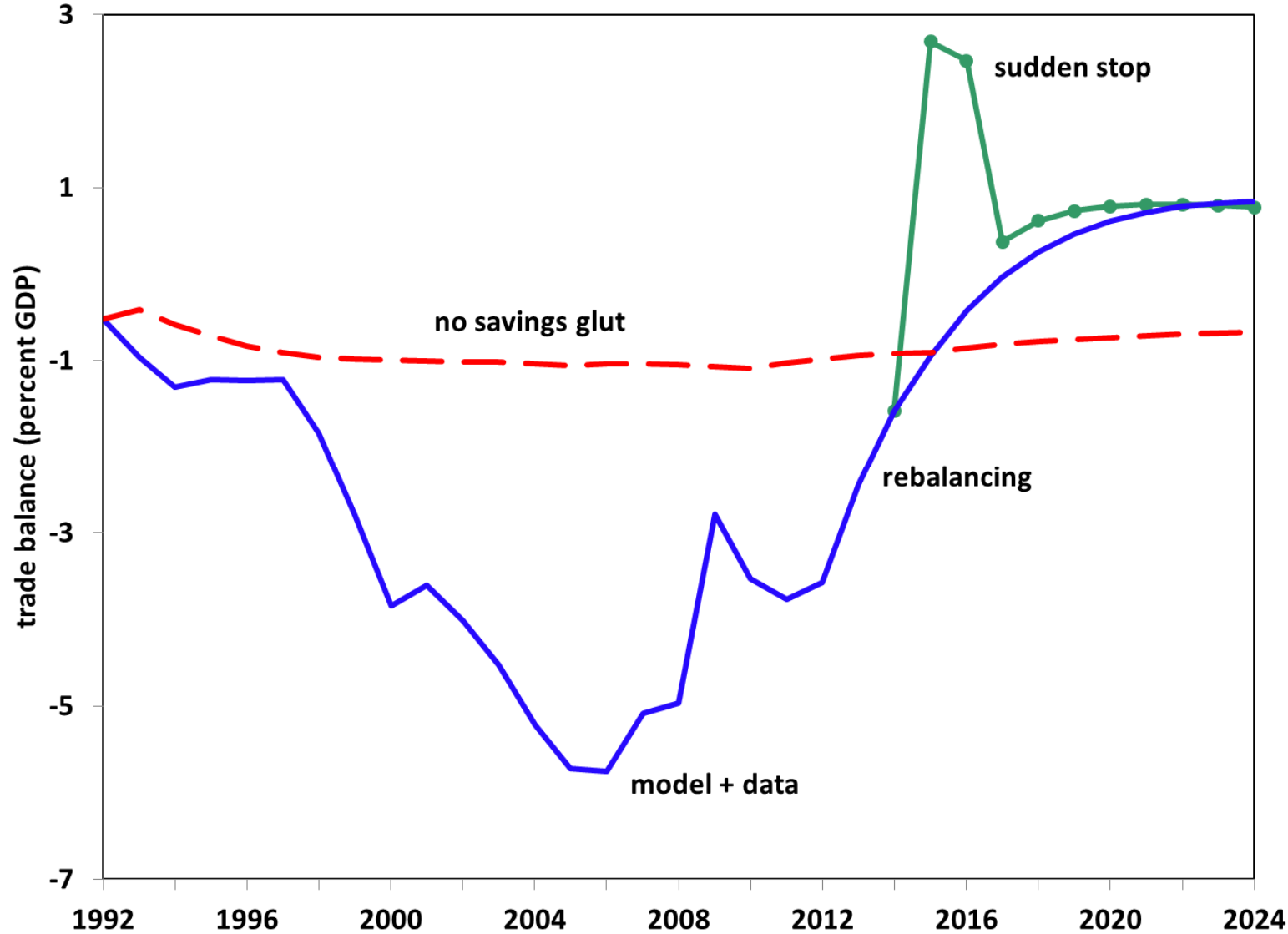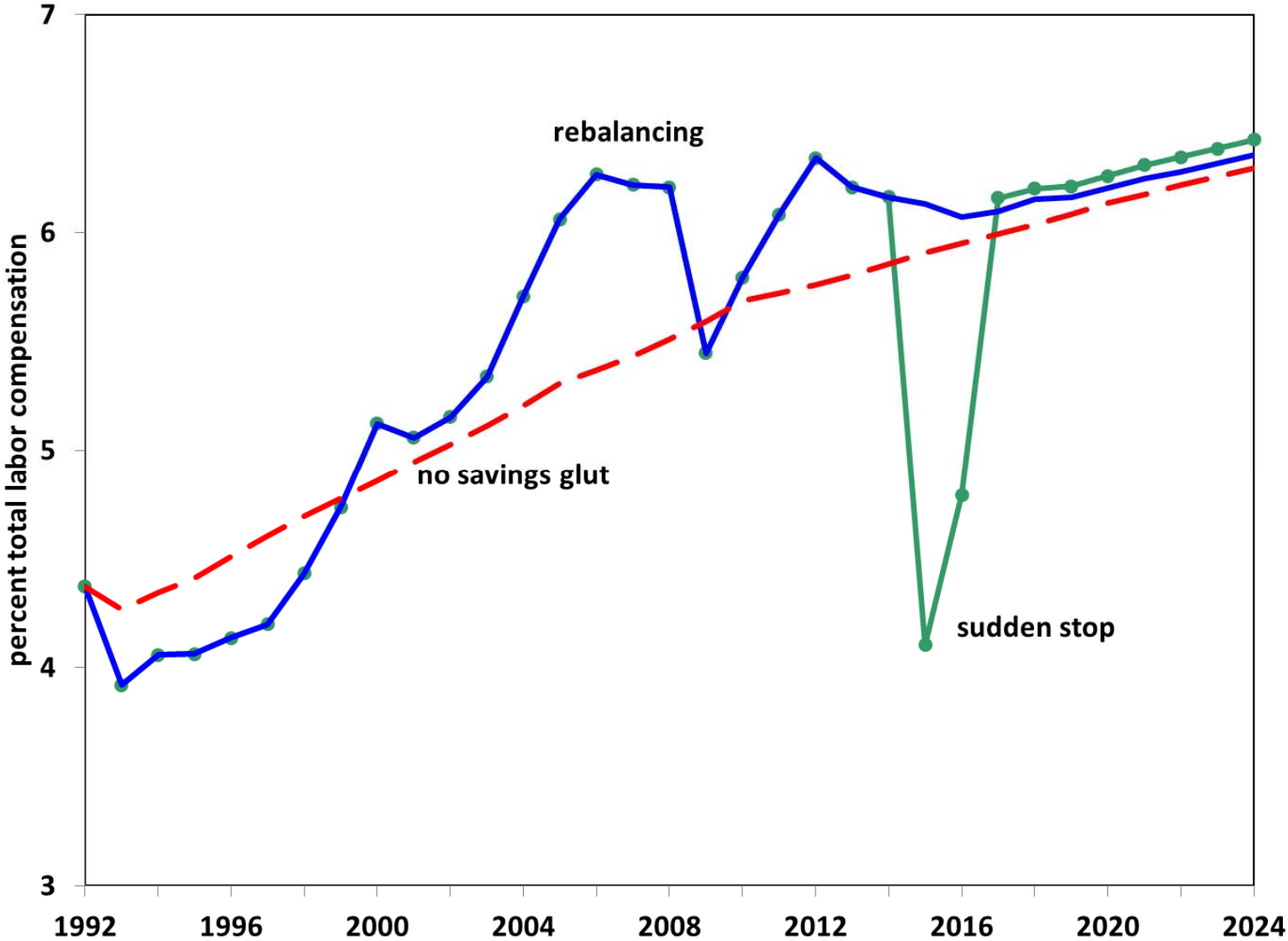
Sudden stop: real exchange rate

Sudden stop: trade in goods and services

Sudden stop: labor compensation in goods

Sudden stop: labor compensation in construction

Summary: impact of sudden stop

Sudden stop hastens rebalancing process: larger and more abrupt trade balance and RER reversals

Temporary rise in goods employment (small), drop in construction employment (large)

Small long-run impact: trade balance, RER, employment share on almost exactly same paths by 2024 as if sudden stop never happened

Goods employment continues to fall in long run

In the long run, it is the savings glut itself that matters for aggregate dynamics of U.S. economy, not manner in which savings glut ends

Welfare impact of savings glut and sudden stop

How does lifetime utility differ across scenarios we have studied?

Have U.S. households been made better or worse off by savings glut?

Does the answer depend on whether sudden stop occurs?

Welfare measure: real income in 1992

Calculate homogeneous-of-degree-1 representation of lifetime utility in baseline model with savings glut

$$U = \left(\sum_{t=0}^{\infty} \beta^t \left(\varepsilon^{ush} \left(\frac{c_{gt}^{ush}}{n_t^{us}} \right)^{\rho} + (1-\varepsilon^{ush}) \left(\frac{c_{st}^{ush}}{n_t^{us}} \right)^{\rho} \right)^{\frac{\eta\psi}{\rho}} \left(\frac{\overline{\ell}_t^{us} - \ell_t^{us}}{\overline{\ell}_t^{us}} \right)^{(1-\eta)\psi} \right)^{\frac{1}{\psi}}$$

Use 1992 consumption prices in model and data to calculate scalar Ω that converts U to 1992 dollars

Use same Ω to calculate 1992-dollar-value of lifetime consumption streams in alternative scenarios

Assume government consumption now constant in quantities in all scenarios

Change in 1992 real income compared to gradual rebalancing

Scenario	No adjustment costs	Labor adjustment costs
No savings glut counterfactual	-679	-821
Sudden stop (no TFP shock)	-390	-444
Sudden stop (TFP shock)	-1,034	-1,118

Summary: welfare

Savings glut benefits U.S. households by providing them with cheap credit and with cheap foreign goods for more than 20 years

Causes real income of 19923 U.S. households to rise by 679 billion 1992 dollars, or equivalently, 10.7 percent of 1992 U.S. GDP

Unexpected sudden stop is costly — real income of U.S. households falls by 1,034 billion 1992 dollars, reversing welfare gains generated by savings glut

Bernanke on the danger of a sudden stop

[T]he underlying sources of the U.S. current account deficit appear to be medium-term or even long-term in nature, suggesting that the situation will eventually begin to improve, although a return to approximate balance may take some time. Fundamentally, I see no reason why the whole process should not proceed smoothly. However, the risk of a disorderly adjustment in financial markets always exists, and the appropriately conservative approach for policymakers is to be on guard for any such developments.

Ben S. Bernanke (2005)

Puzzle: U.S. real interest rates

Conventional wisdom: foreign lending keeps U.S. real interest rates low

*Why is the United States, with the world's largest economy, borrowing heavily on international capital markets — rather than lending, as would seem more natural? ...[O]ver the past decade a combination of diverse forces has created a significant increase in the global supply of saving — a global saving glut — which helps to explain both the increase in the U.S. current account deficit **and the relatively low level of long-term real interest rates** in the world today.*

Ben S. Bernanke (2005)

Model: savings glut has little impact on interest rates

Results consistent with some empirical estimates of foreign lending's impact on U.S. interest rates, e.g. Warnock and Warnock (2008)

U.S. real interest rates in the model vs. data
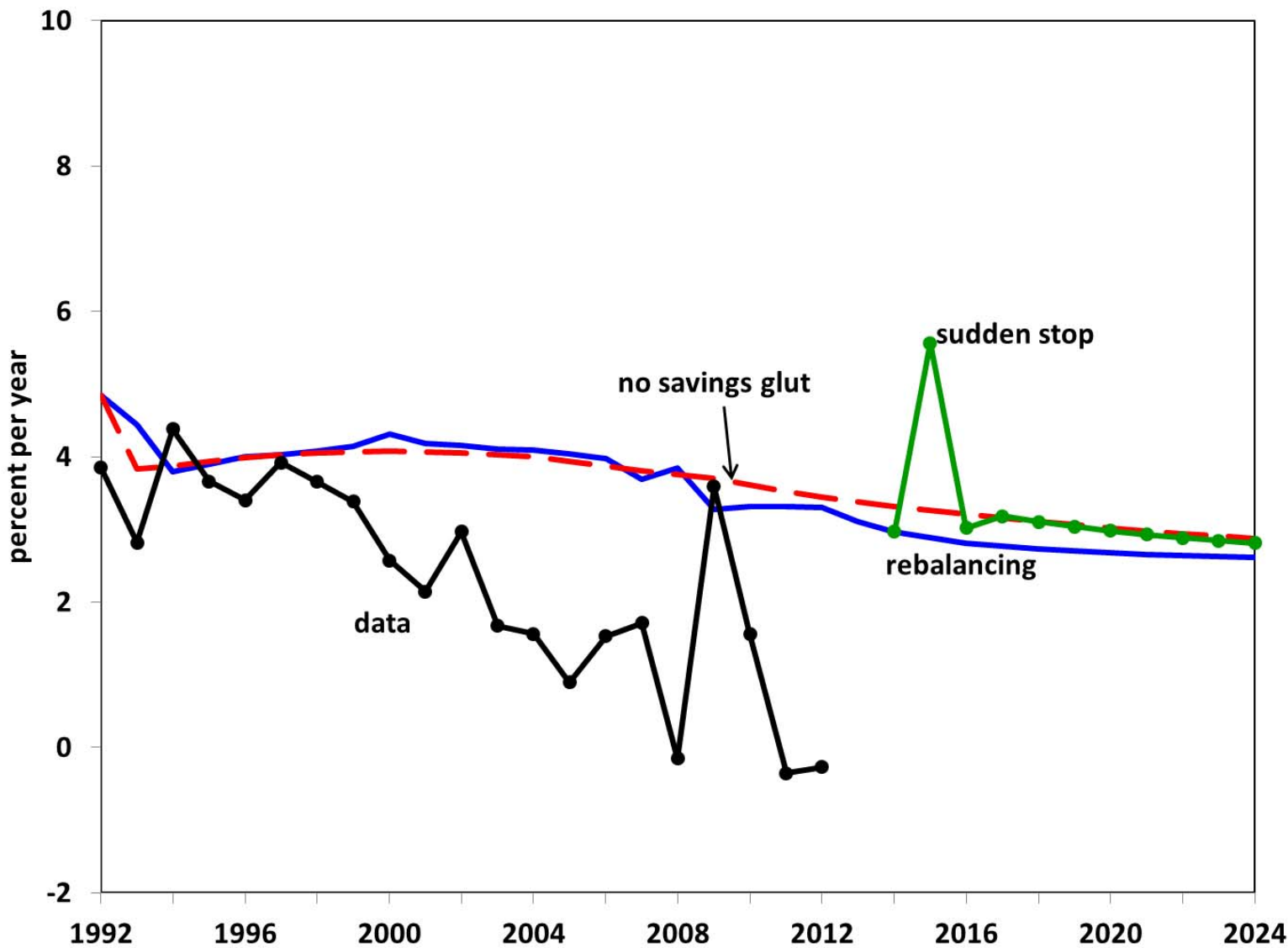
# Puzzle: timing of real exchange rate vs. trade balance

Real exchange rate and trade balance out of sync in data

Peak real exchange rate appreciation occurs in 2002, but peak trade deficit does not occur until 2006

Why do U.S. imports continue to rise after 2002, even though imports are becoming more expensive?

Is this just a long J-curve (Backus, Kehoe, and Kydland, 1994), or is something else at play?

U.S. real exchange rates with China and other trade partners
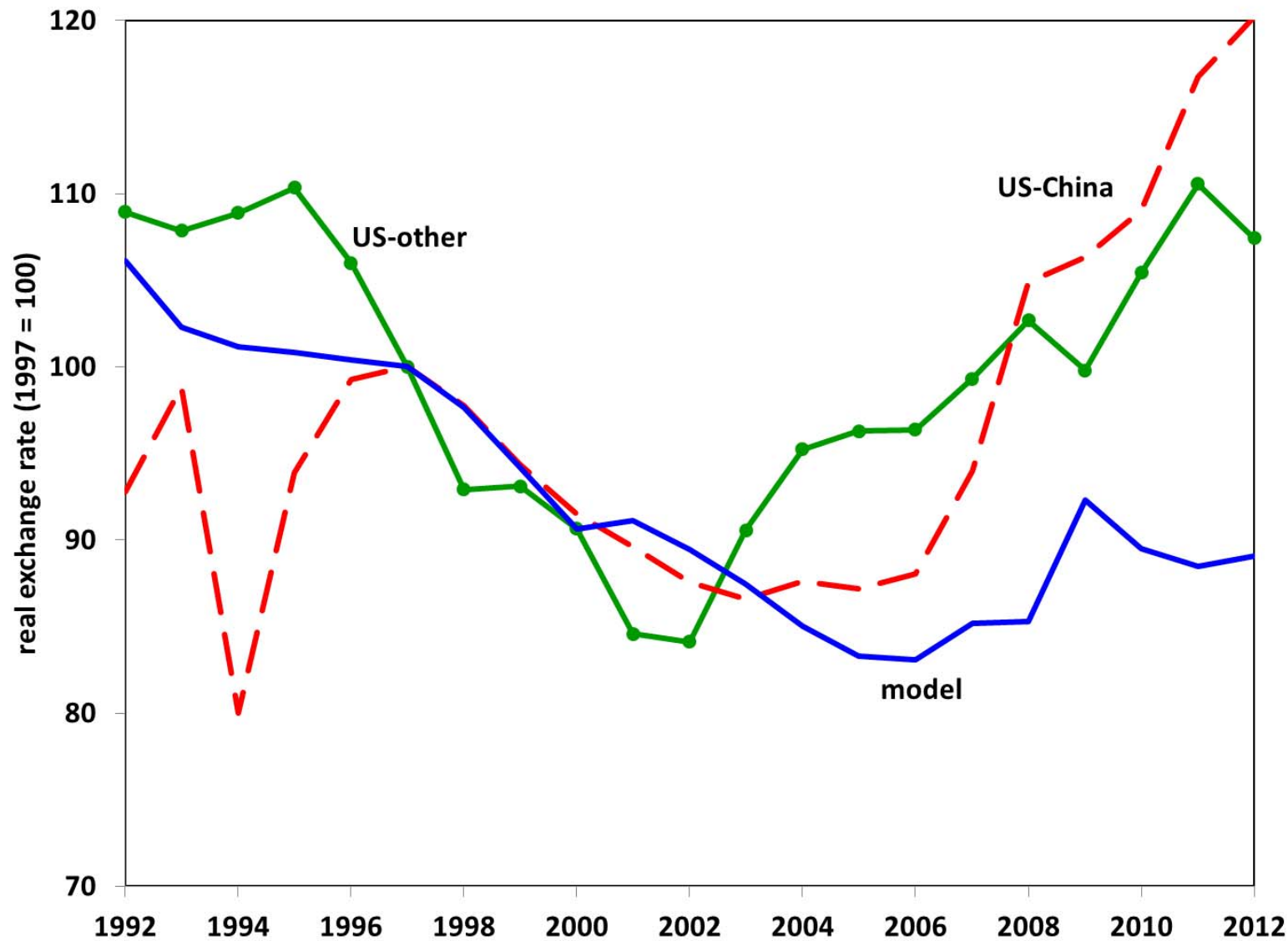
Conclusion

Increased demand for U.S. assets important driver of U.S. trade balance and real exchange rate…

…But NOT of decline in goods-sector employment

Goods-sector employment decline due primarily to fast productivity growth compared to other sectors

Decline will continue regardless of how savings glut ends

Sudden stop in 2015–2016 will temporarily halt decline, but will be very costly, completely wiping out welfare gains caused by the savings glut in the first place