



Workshop on Monetary Policy in Developing Economies
Istanbul School of Central Banking

Monetary Policy, Capital Flows, and Exchange Rates

Part 2: Capital Flows and Crises

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Self-fulfilling debt crises and the Mexican crisis of 1994–95

H. L. Cole and T. J. Kehoe, “Self-Fulfilling Debt Crises,” *Review of Economic Studies*, 67 (2000), 91–116.

T. J. Kehoe and K. J. Ruhl, “Sudden Stops, Sectoral Reallocations, and the Real Exchange Rate,” *Journal of Development Economics*, 89 (2009), 235–249.

T. J. Kehoe, K. J. Ruhl, and J. B. Steinberg, “Global Imbalances and Structural Change in the United States,” Federal Reserve Bank of Minneapolis, 2013.

Events in Mexico in 1994

1994 was an election year. The government wanted honest elections, but it also wanted the ruling *Partido Revolucionario Institucional* to win.

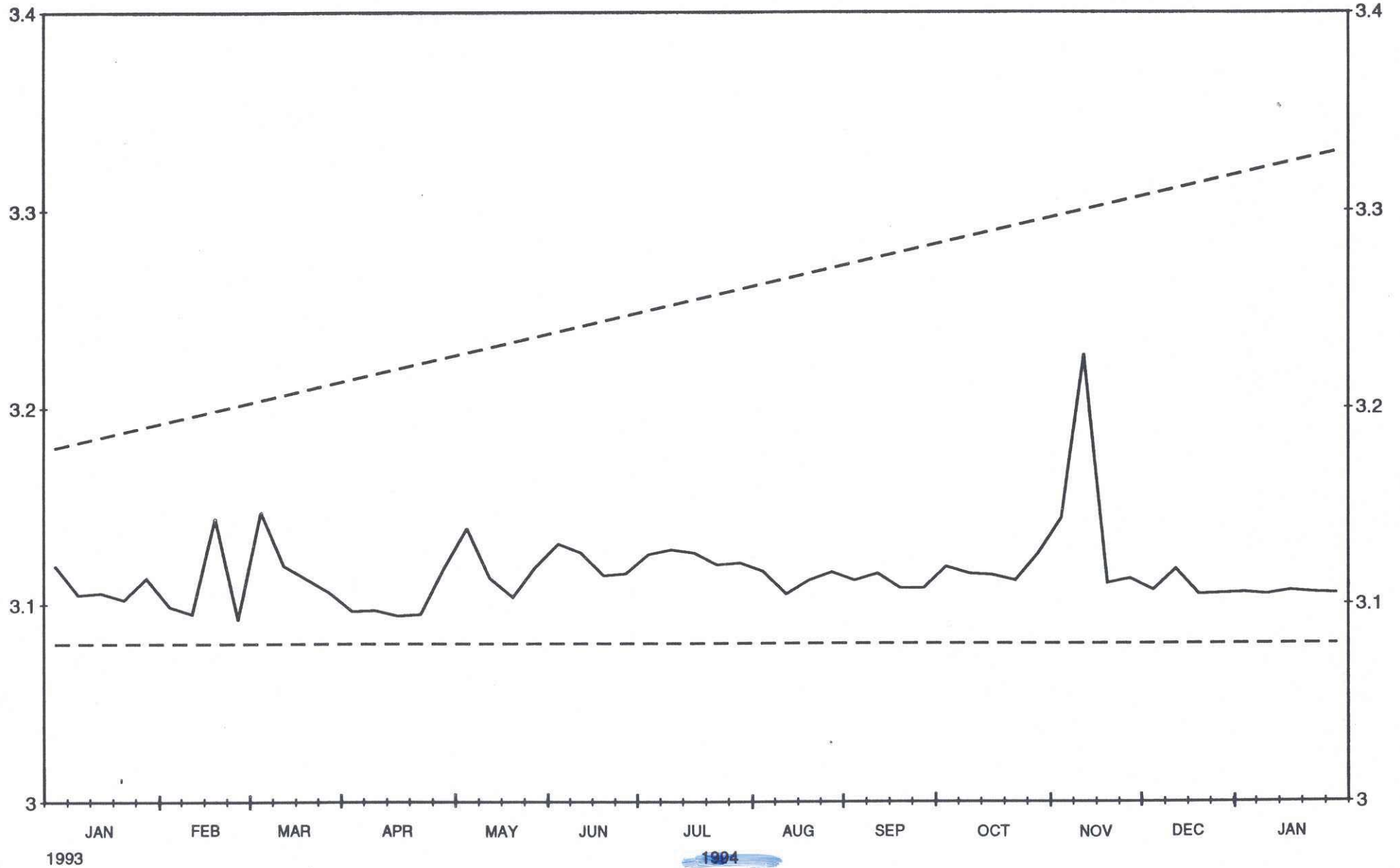
There was enormous political uncertainty following the assassination of the PRI candidate in March.

Every time there was bad political news, more investors moved their investments out of Mexico.

The government gambled with its monetary policy and debt policy that the political situation would stabilize and that capital inflows would resume. A similar gamble had been successful in 1993.

This time the government lost the gamble.

PESOS per DOLLAR EXCHANGE RATE*
JANUARY 1993 - JANUARY 1994

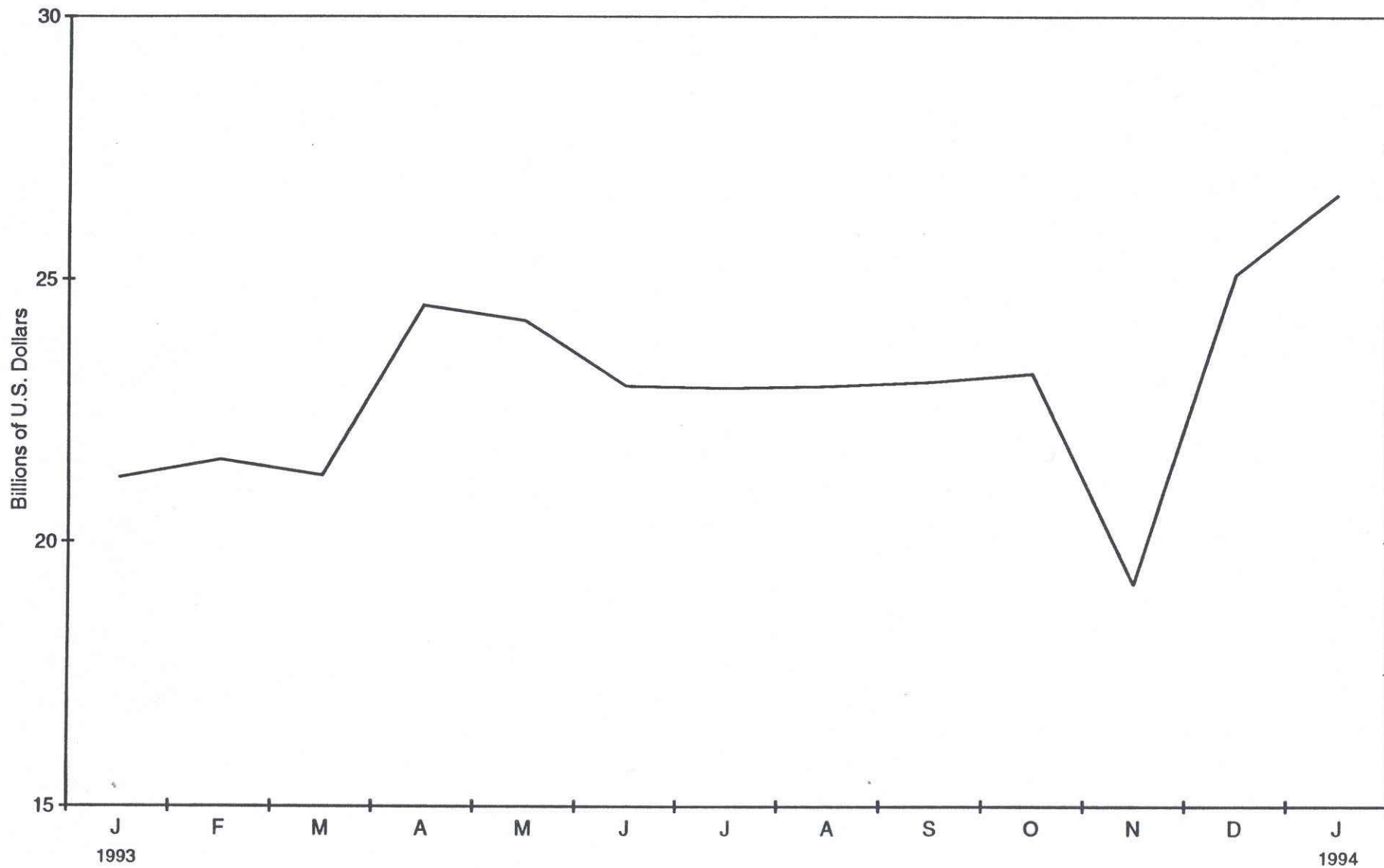


* New York market. Average rate on last day of the week.

Source: Tradeline International

MEXICAN INTERNATIONAL RESERVES*

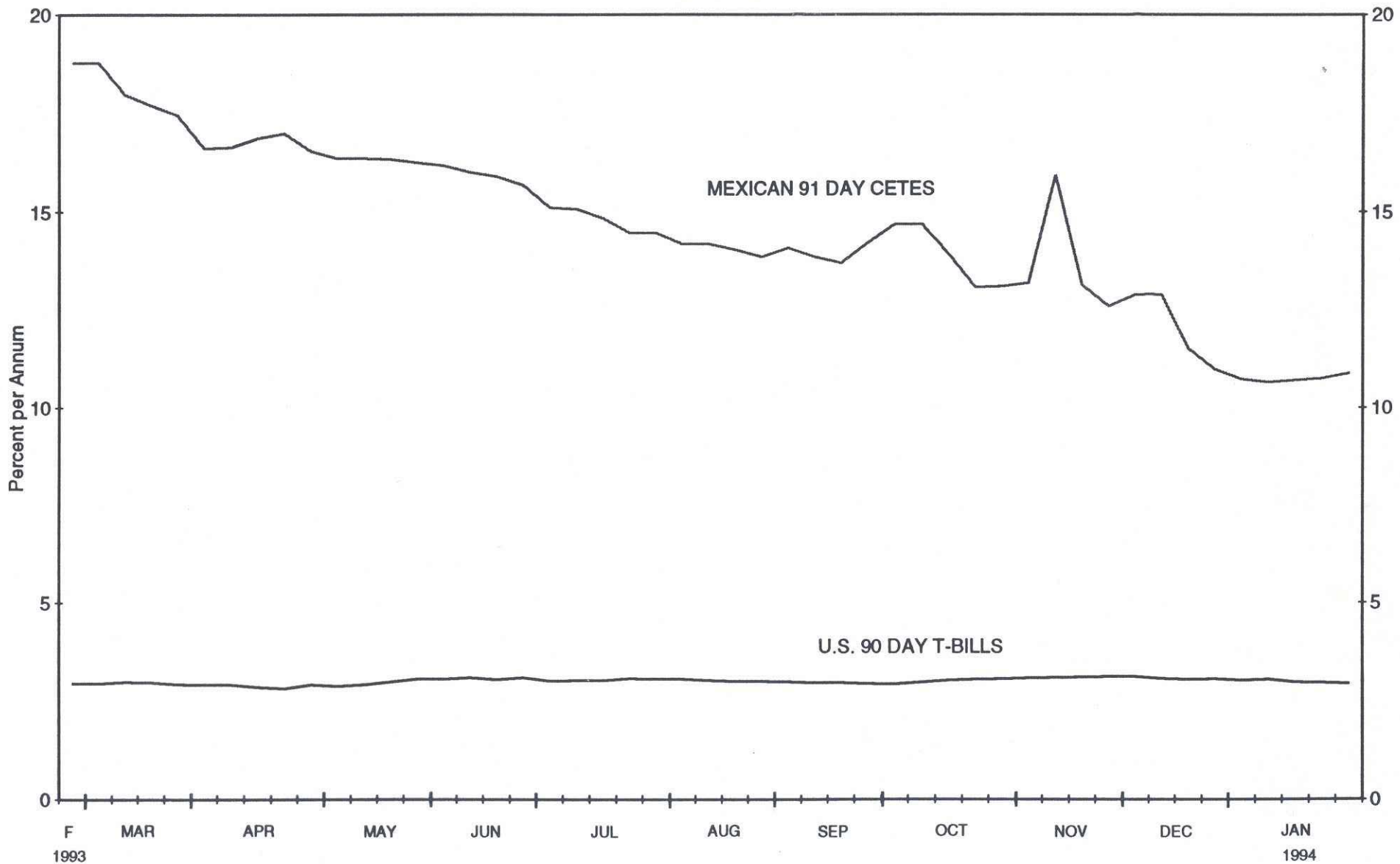
JANUARY 1993 - JANUARY 1994



* Monthly data.

Source: IMF; International Financial Statistics

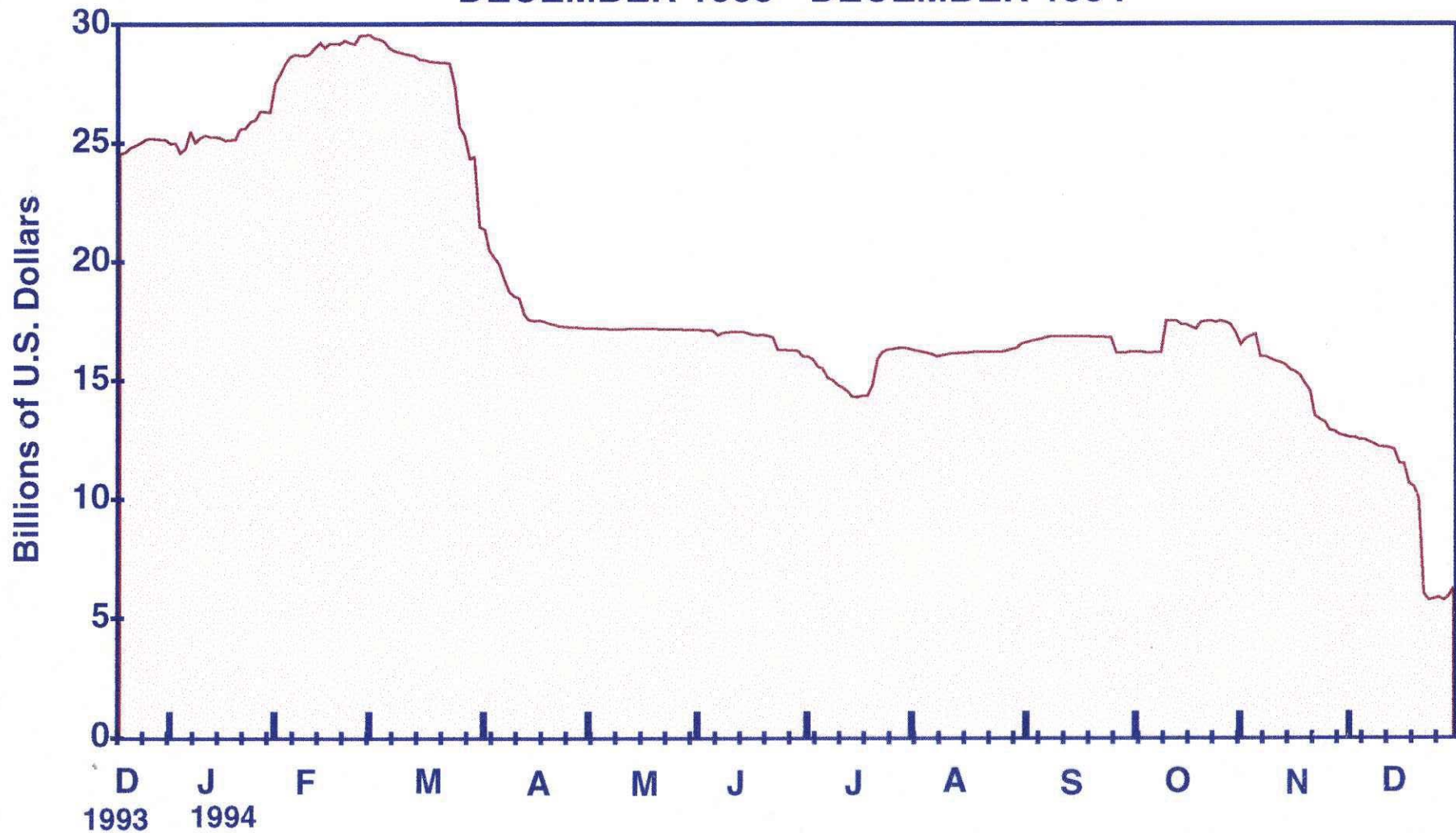
INTEREST RATES*
MEXICAN - U.S. GOVERNMENT BONDS
1993:2/26 - 1994:1/28



* Weekly data

Source: Bloomberg Financial Market

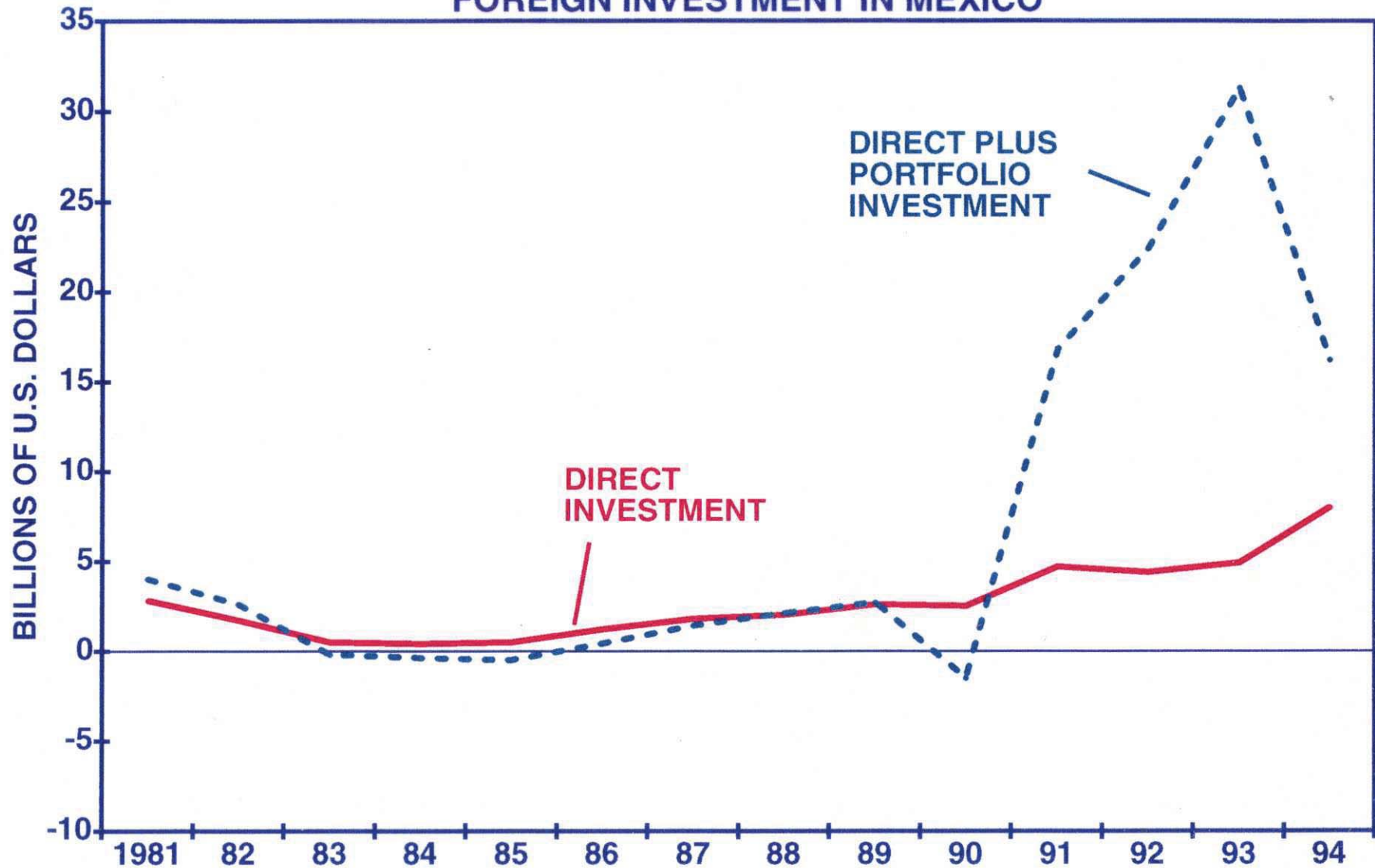
MEXICAN INTERNATIONAL RESERVES* DECEMBER 1993 - DECEMBER 1994



* Daily data.

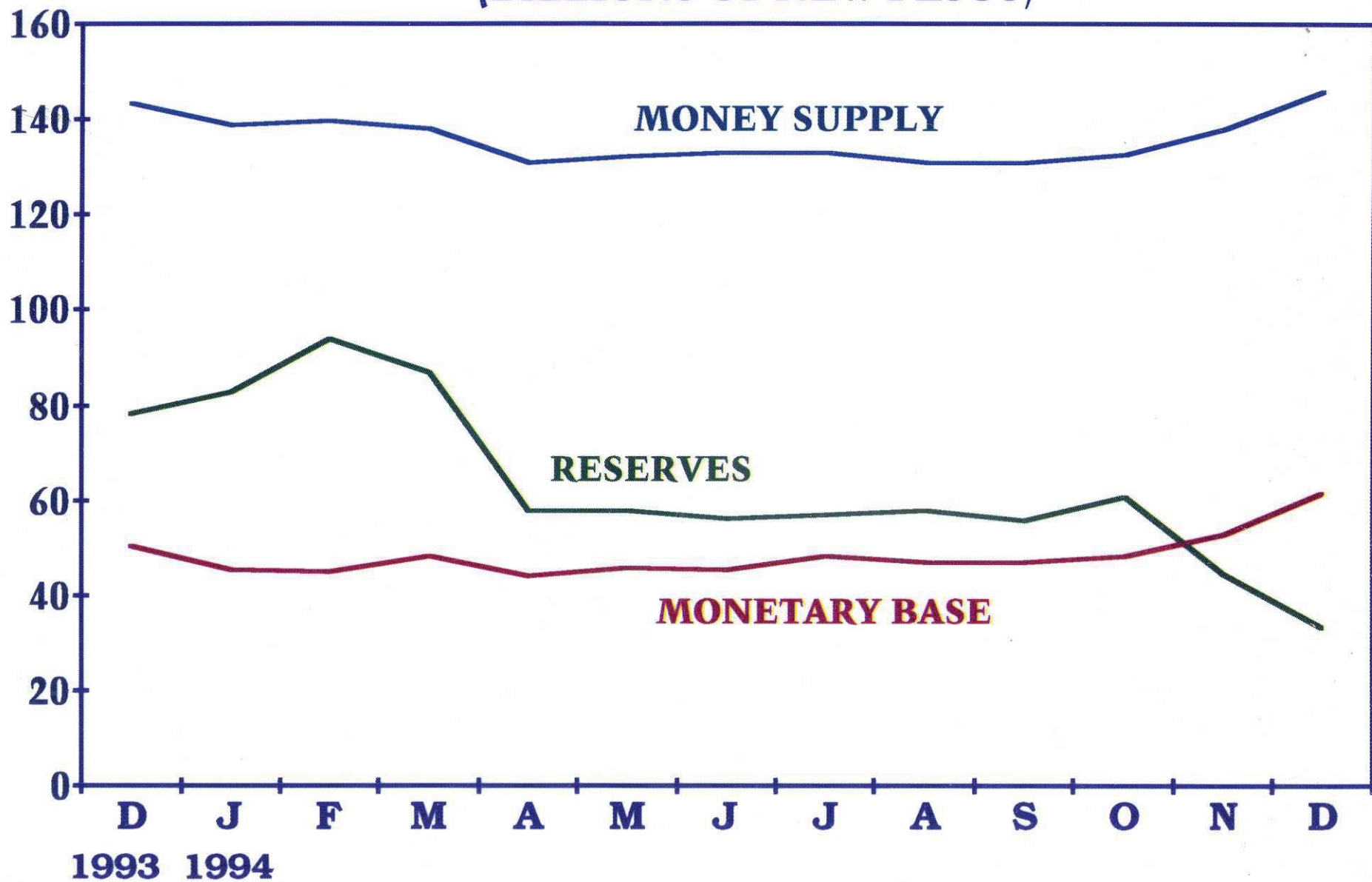
Source: Mancera, Wall Street Journal, 31 January 1995.

FOREIGN INVESTMENT IN MEXICO

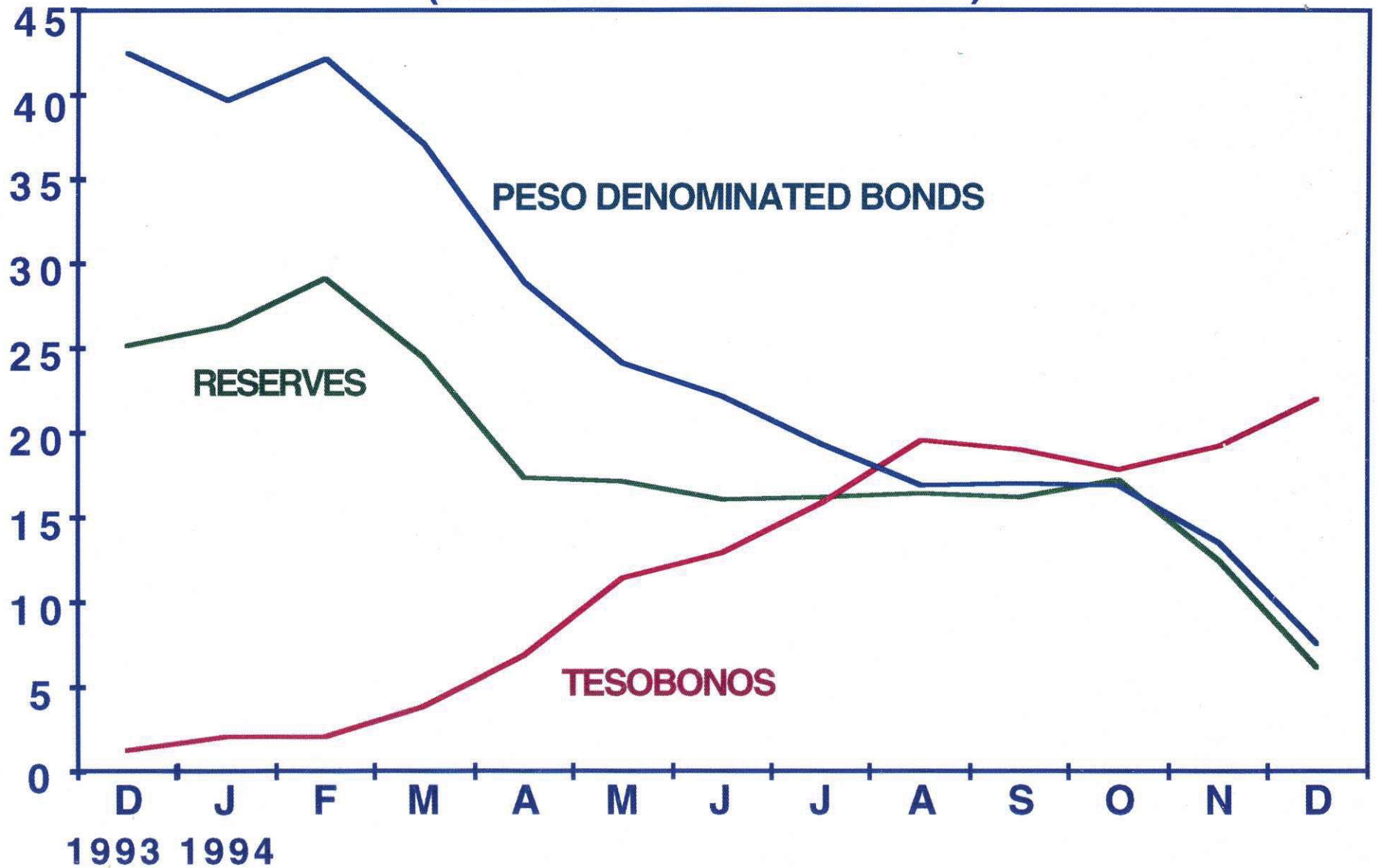


Source: IMF, Balance of Payments, Statistical Yearbook, various issues.

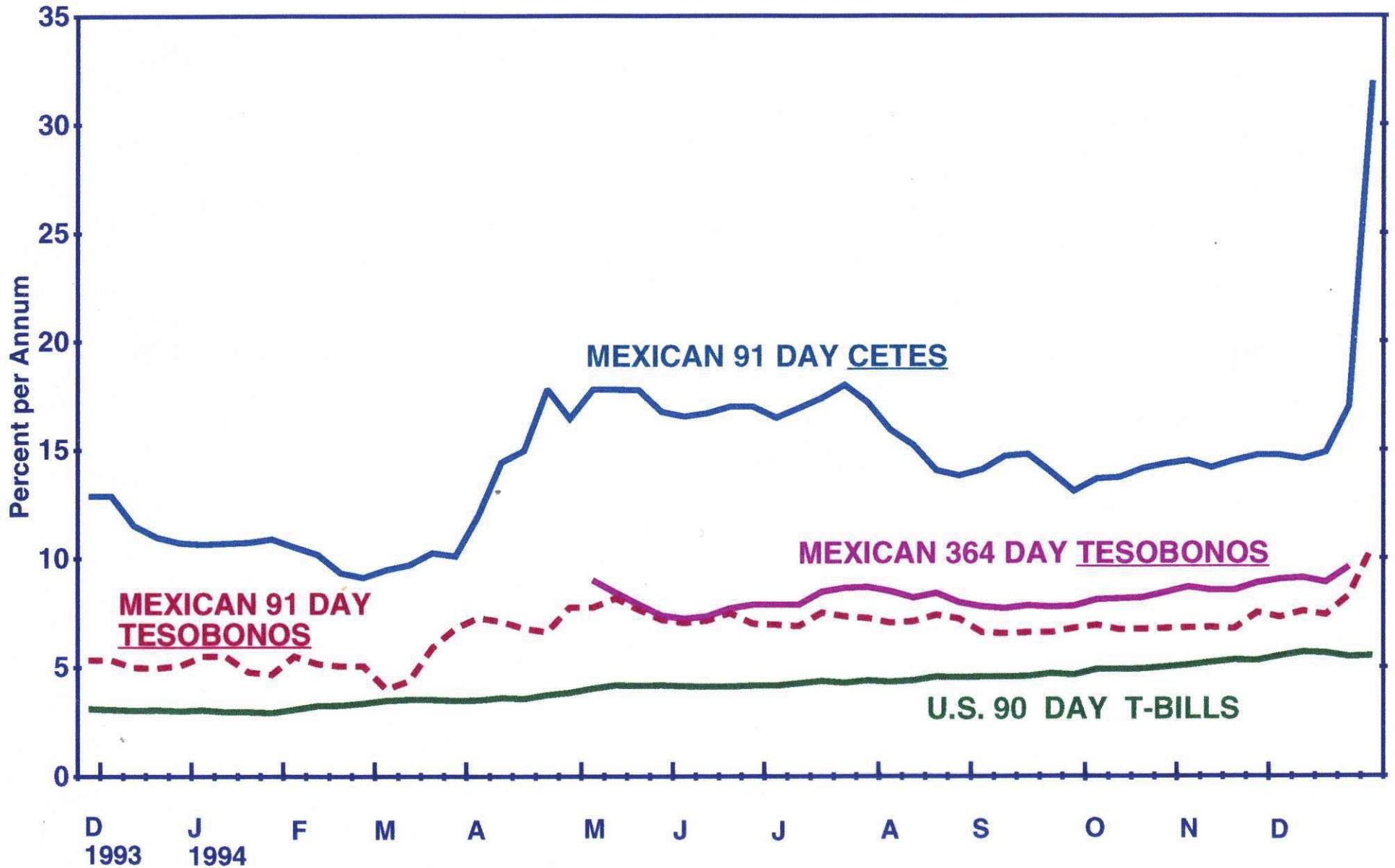
INTERNATIONAL RESERVES VS. MONEY SUPPLY (BILLIONS OF NEW PESOS)



INTERNATIONAL RESERVES VS. GOVERNMENT BONDS (BILLIONS OF U.S. DOLLARS)



**INTEREST RATES
MEXICAN - U.S. GOVERNMENT BONDS
DECEMBER 1993 - DECEMBER 1994**



Source: Bloomberg Financial Market

Global Imbalances and Structural Change in the United States

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 saving 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 saving glut
 - Example: Financial integration with asymmetric financial development (Mendoza et al. 2009; Caballero et al. 2008)
- We take saving glut as given and focus on its impact and on impact of two different exit scenarios.

What We Do

Interpret saving 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 saving glut

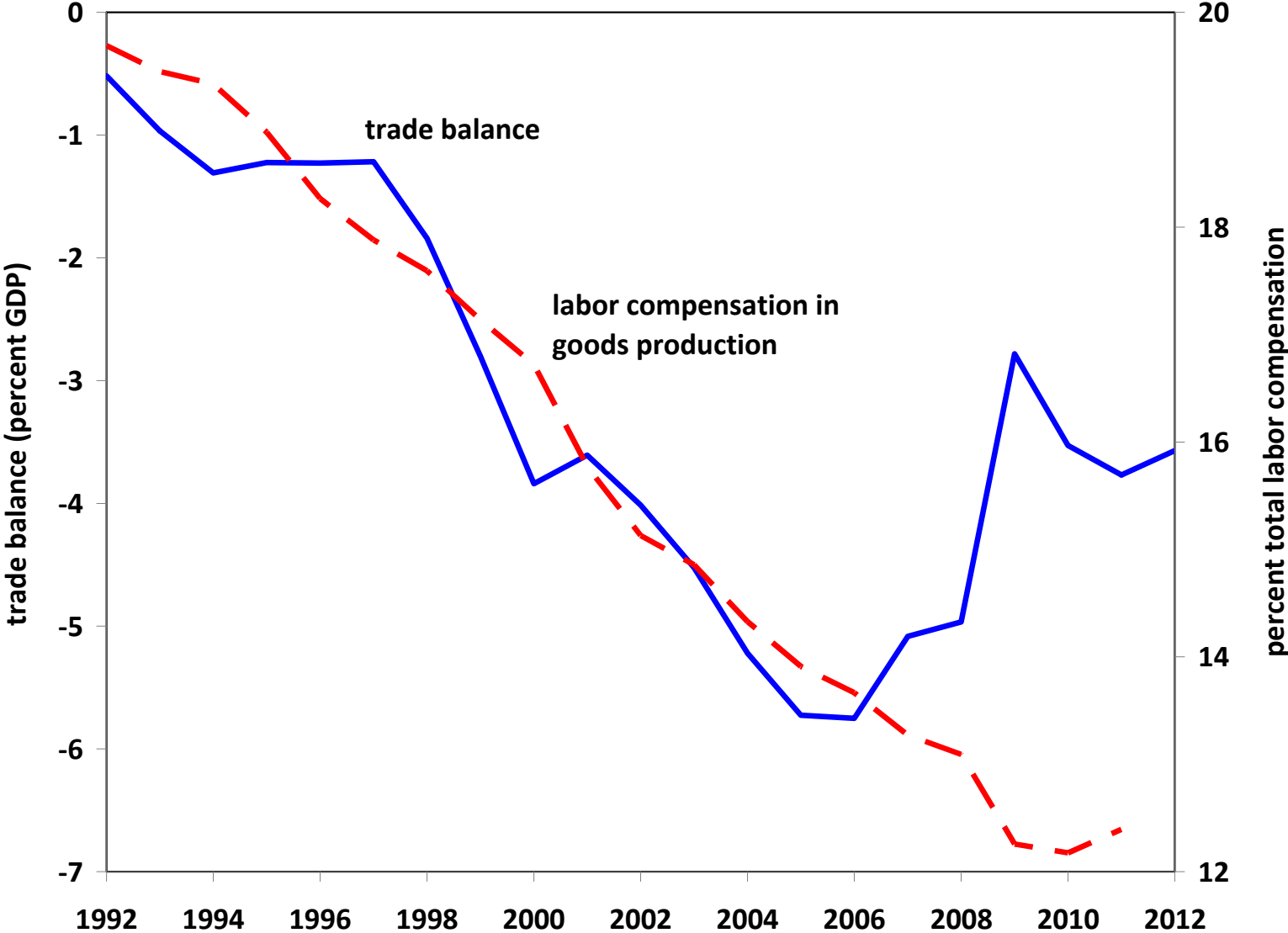
- Emphasize reallocation effects on goods, services, construction sectors.
- Experiment with 2 exit scenarios: gradual rebalancing and unexpected, disorderly sudden stop in 2015–2016

Summary of results: Goods-sector employment

Saving 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

Saving 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 saving 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

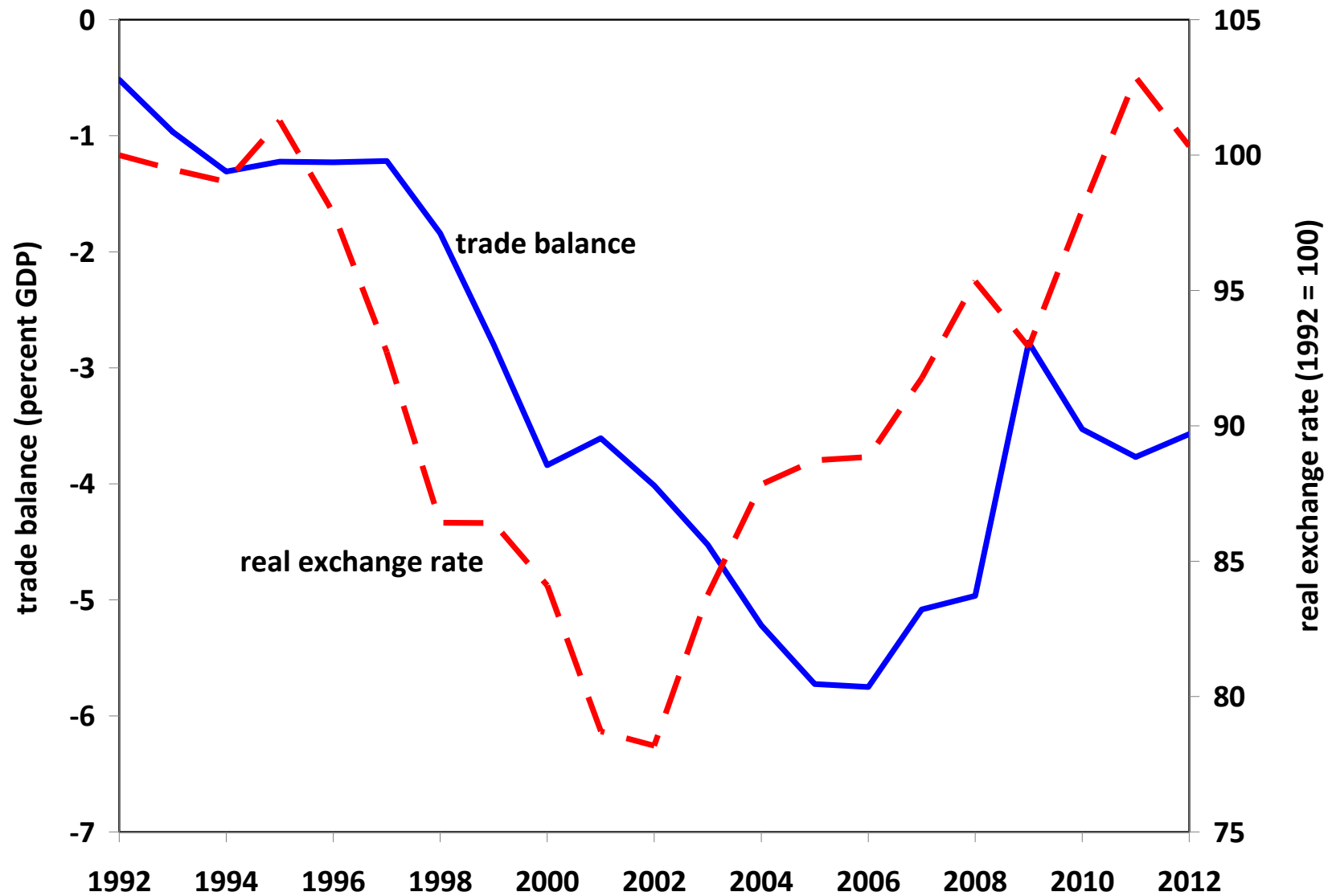
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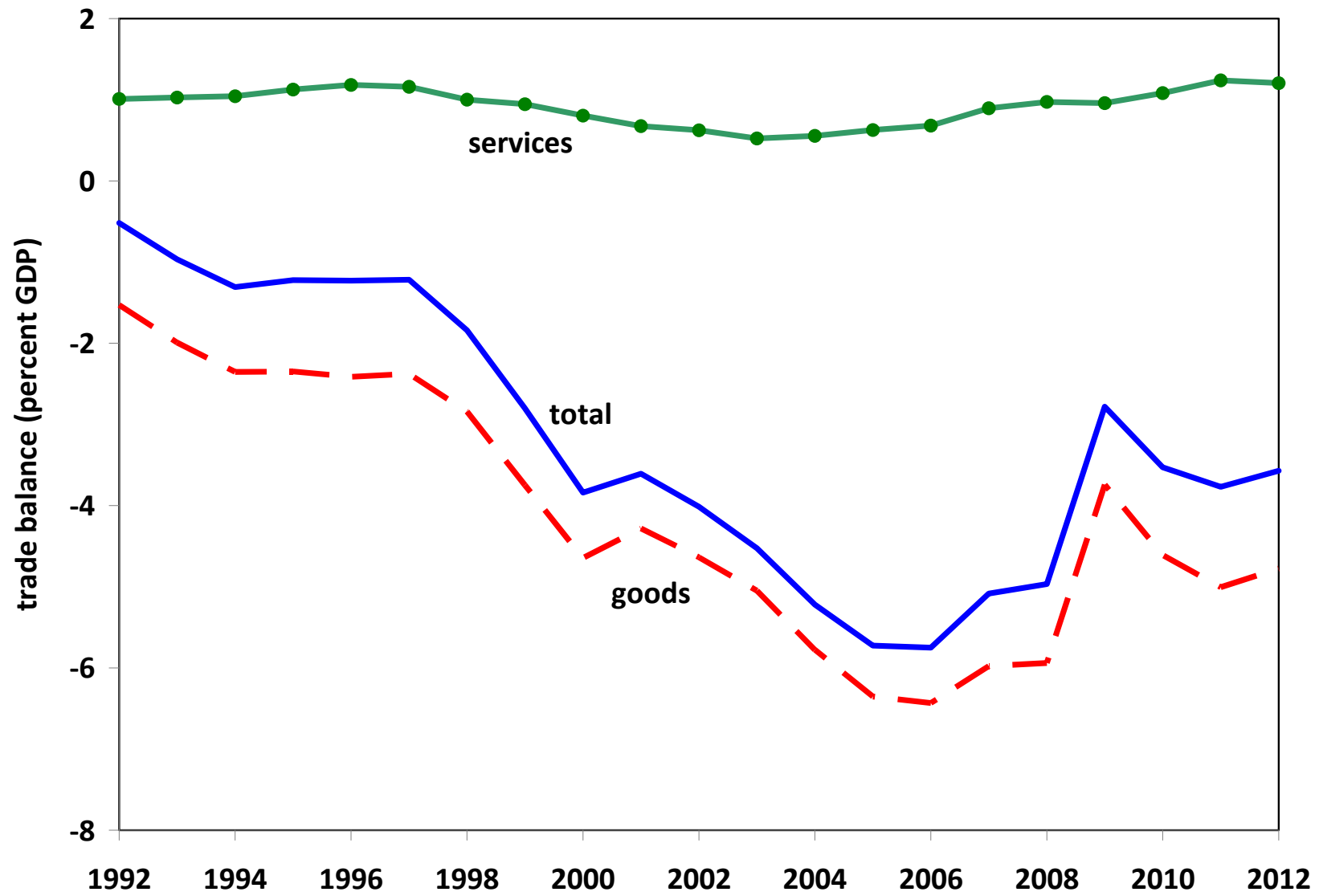
U.S. households are much better off after 20 years of foreign lending and cheap foreign goods...

...but unexpected, disorderly sudden stop could make them worse off than if saving glut never occurred

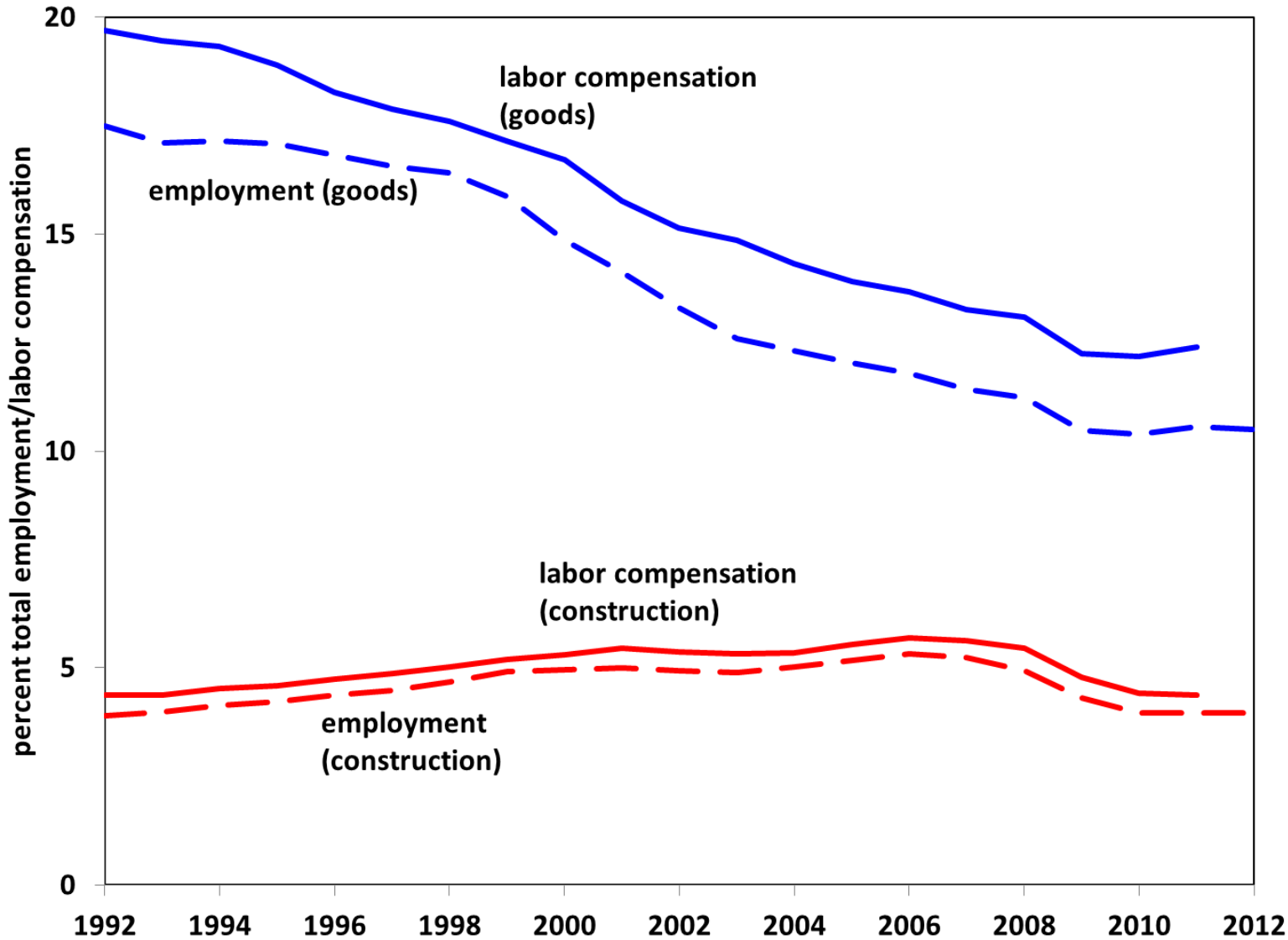
Fact 1: U.S. real exchange rate appreciates, then depreciates



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



Open question:

Why are average wages and salaries higher in goods and construction than in services?

Model

Dynamic general equilibrium model with two countries:

- United States (U.S.)
- Rest of the world (R.W.)

Key assumption that generates the saving 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 saving glut

- In 1992, agents expect deterministic economy without saving glut; R.W.'s discount factor constant at long-run level
- In 1993, saving glut starts unexpectedly

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 are tradable, construction is not

Perfectly competitive firms

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

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

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

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

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

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 $\bar{\ell}_t^{us}$ 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 v_t^{us} of GDP:

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

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:

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

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

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

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 $\{\omega_t^{rw}, \nu_t^{us}, \nu_t^{us}\}_{t=0}^{\infty} \dots$

... 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 saving 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)

	Inputs			Final demand					
Industry	Goods	Services	Construction	Private consumption	Government consumption	Investment	Exports	-Imports	Total demand
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%)

Open question:

Was some of the growth in productivity in goods due to the trade deficit?

Quantitative exercise: saving glut and gradual rebalancing

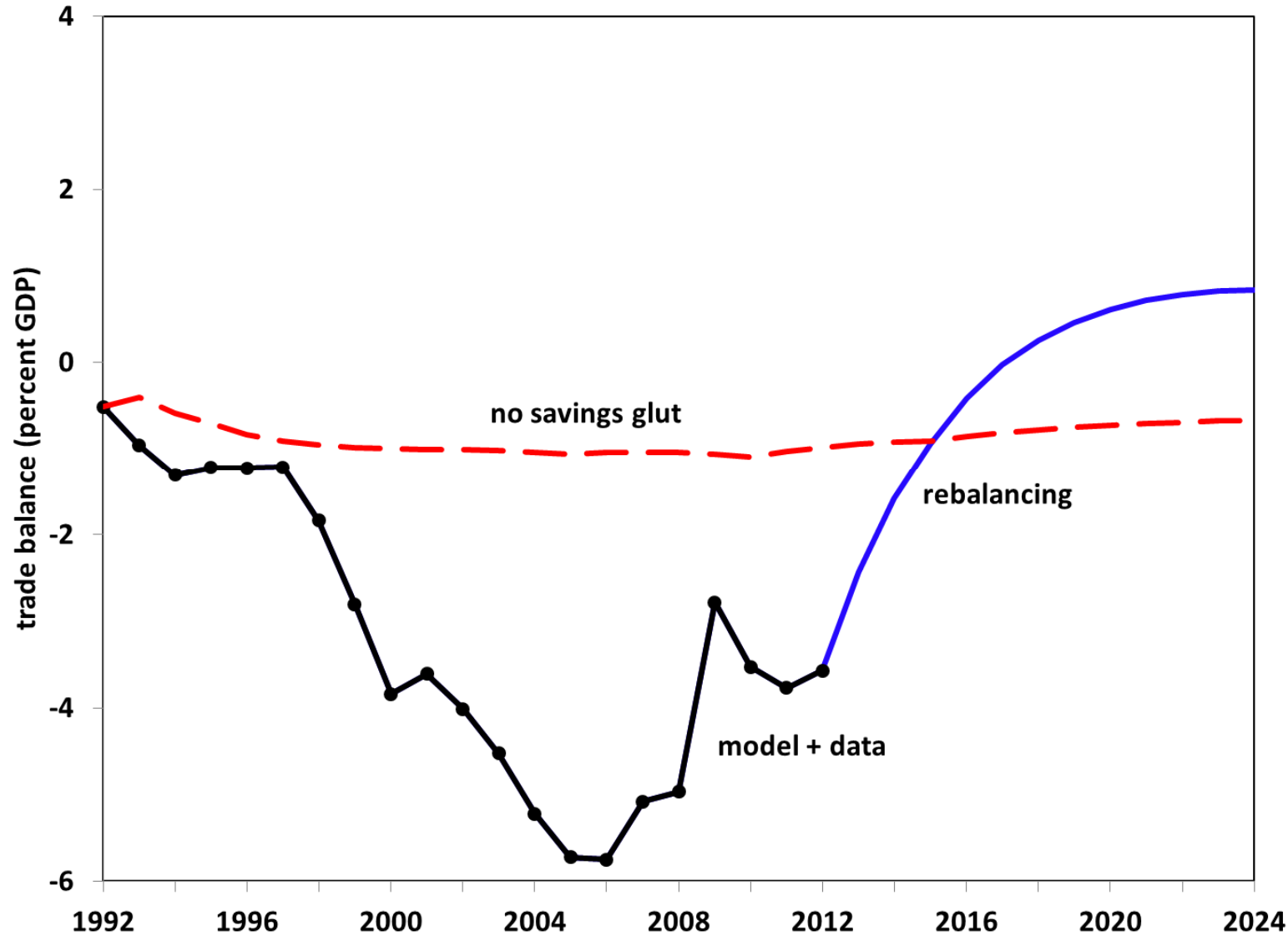
In 1992, model agents expect ω_t^{rw} to fall smoothly to 1

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

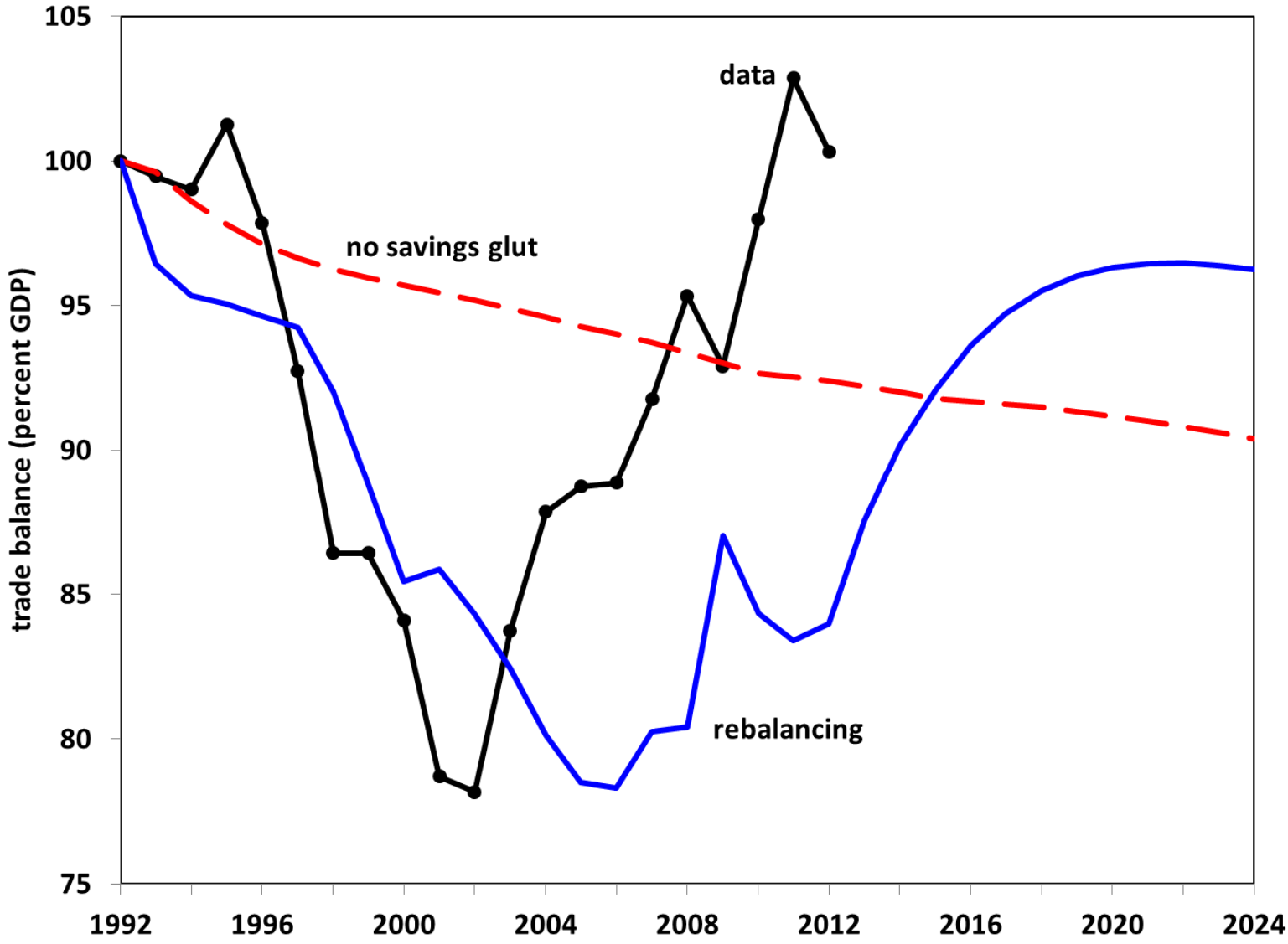
Chosen so that model matches U.S. trade balance exactly during 1992–2012

After 2012, ω_t^{rw} gradually returns to 1 (“gradual rebalancing”)

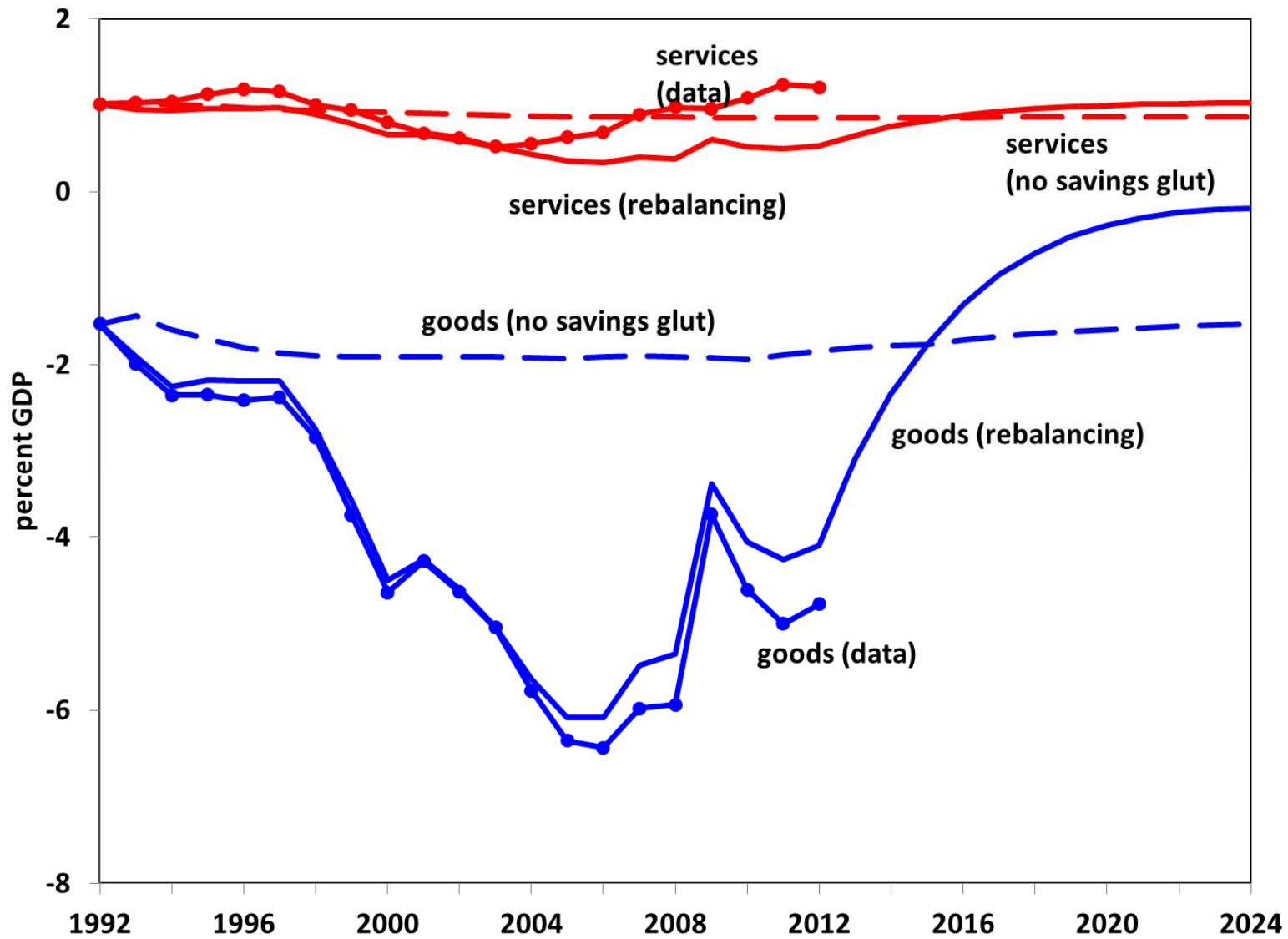
ROW's savings behavior is calibrated to generate saving glut



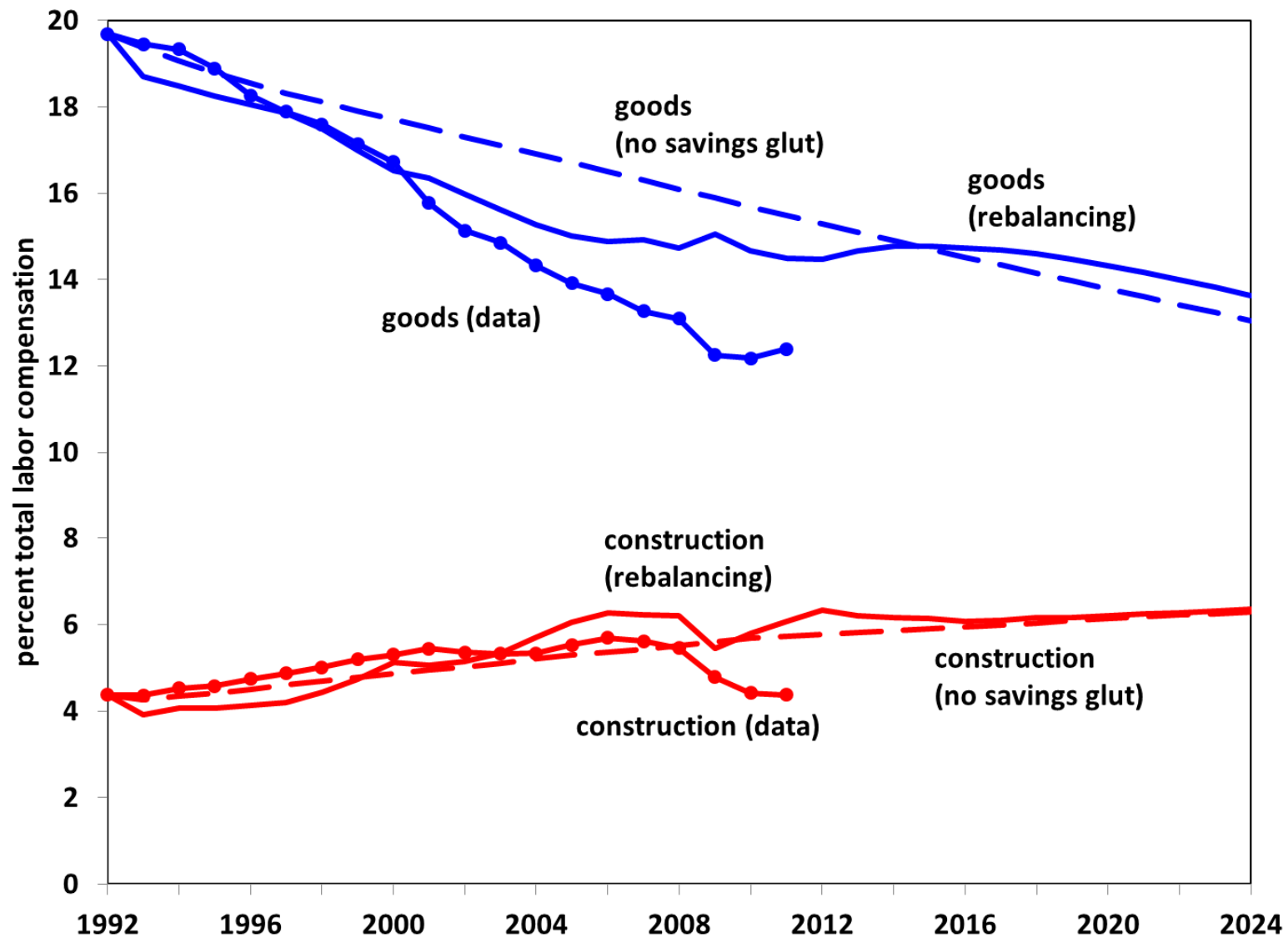
Fact 1: U.S. real exchange rate appreciates, then depreciates



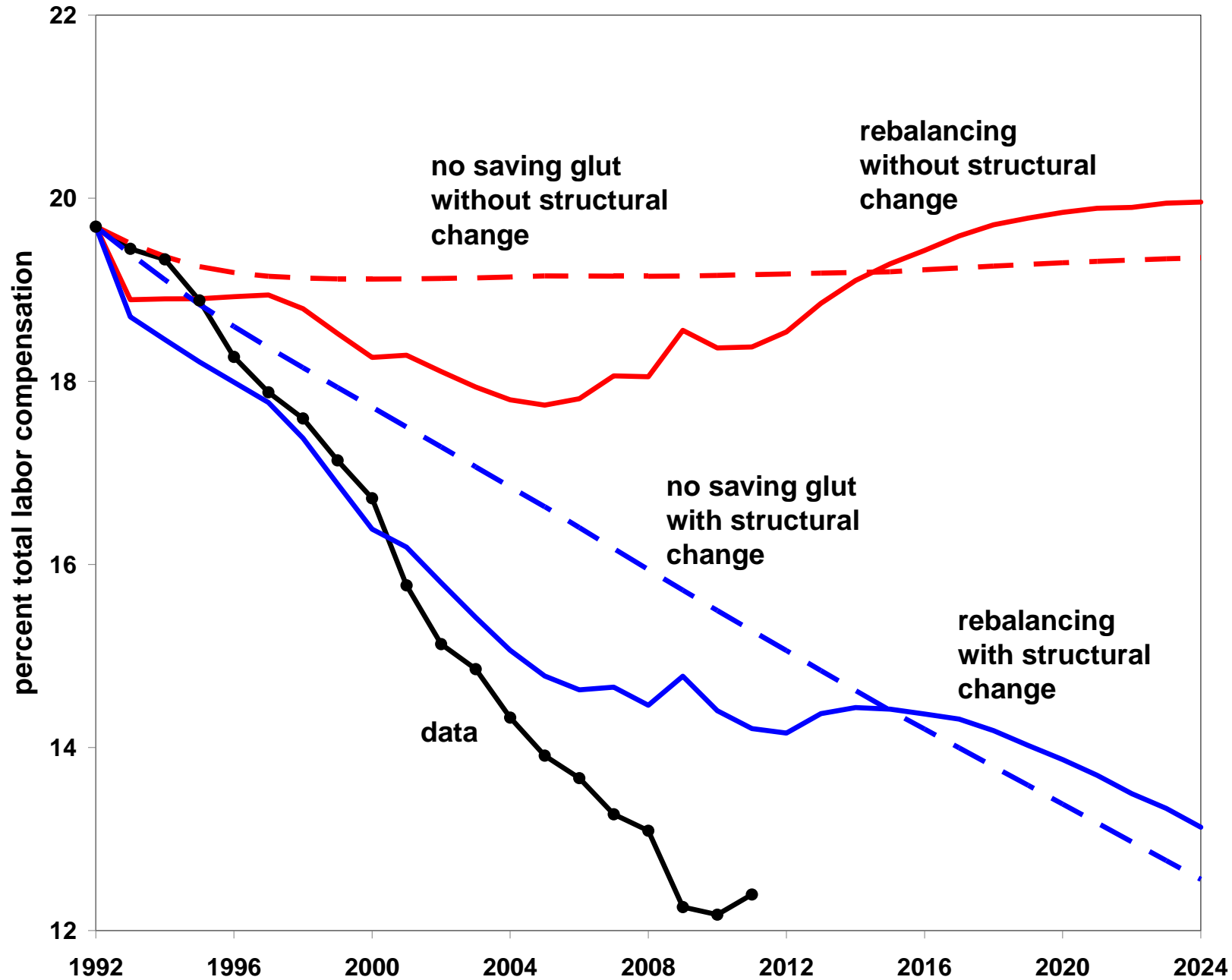
Fact 2: Dynamics of trade deficit are driven by deficits in goods trade



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



Structural change drives the decline of labor in goods production



Open question:

Can nonhomothetic preferences help explain the increased demand for services and reduced demand for goods 2000–2011?

Sudden stop in 2015–2016

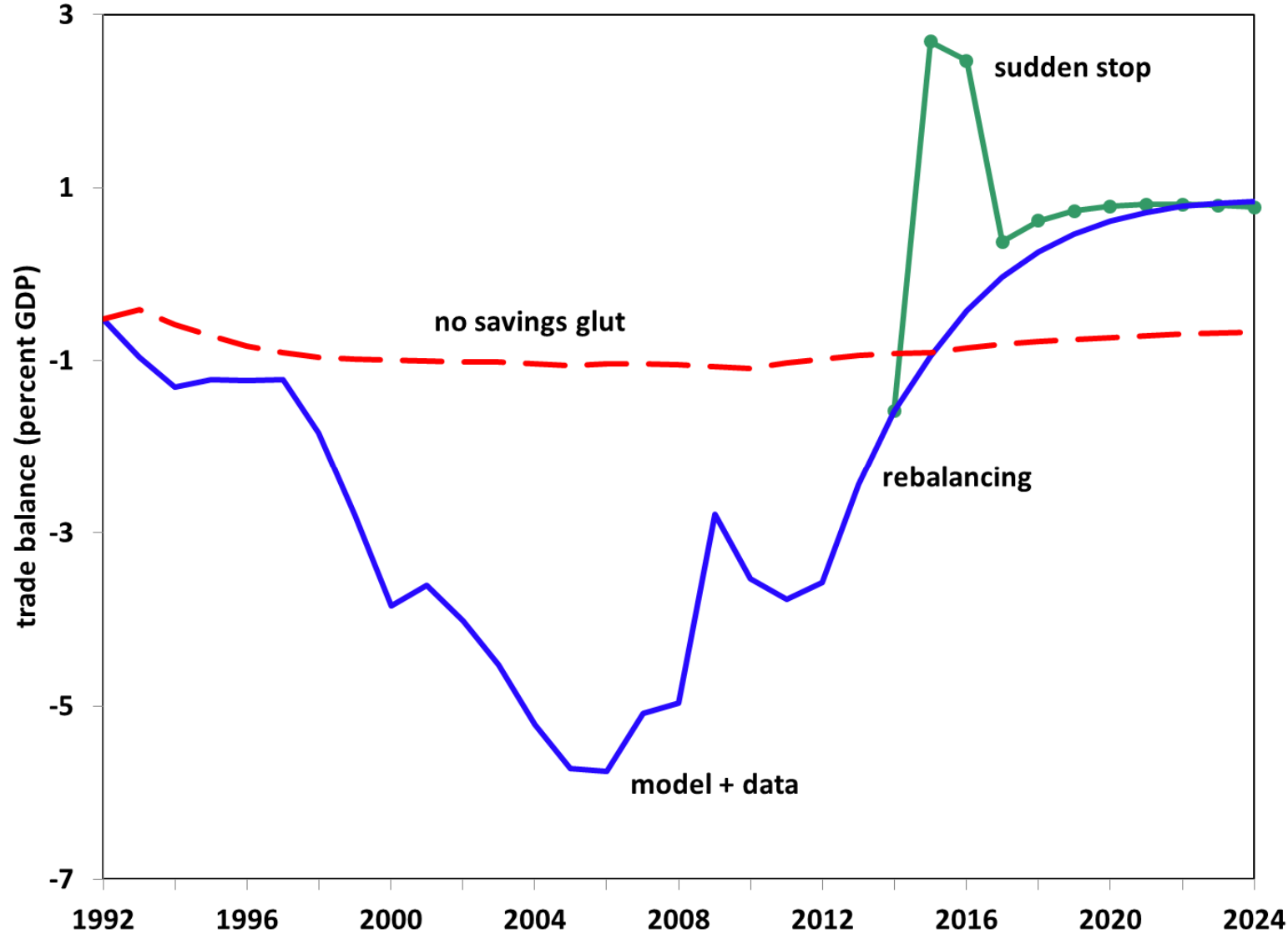
What would happen if, instead of gradual rebalancing, demand for U.S. abruptly and unexpectedly ceases?

Four unexpected events occur in 2015–2016:

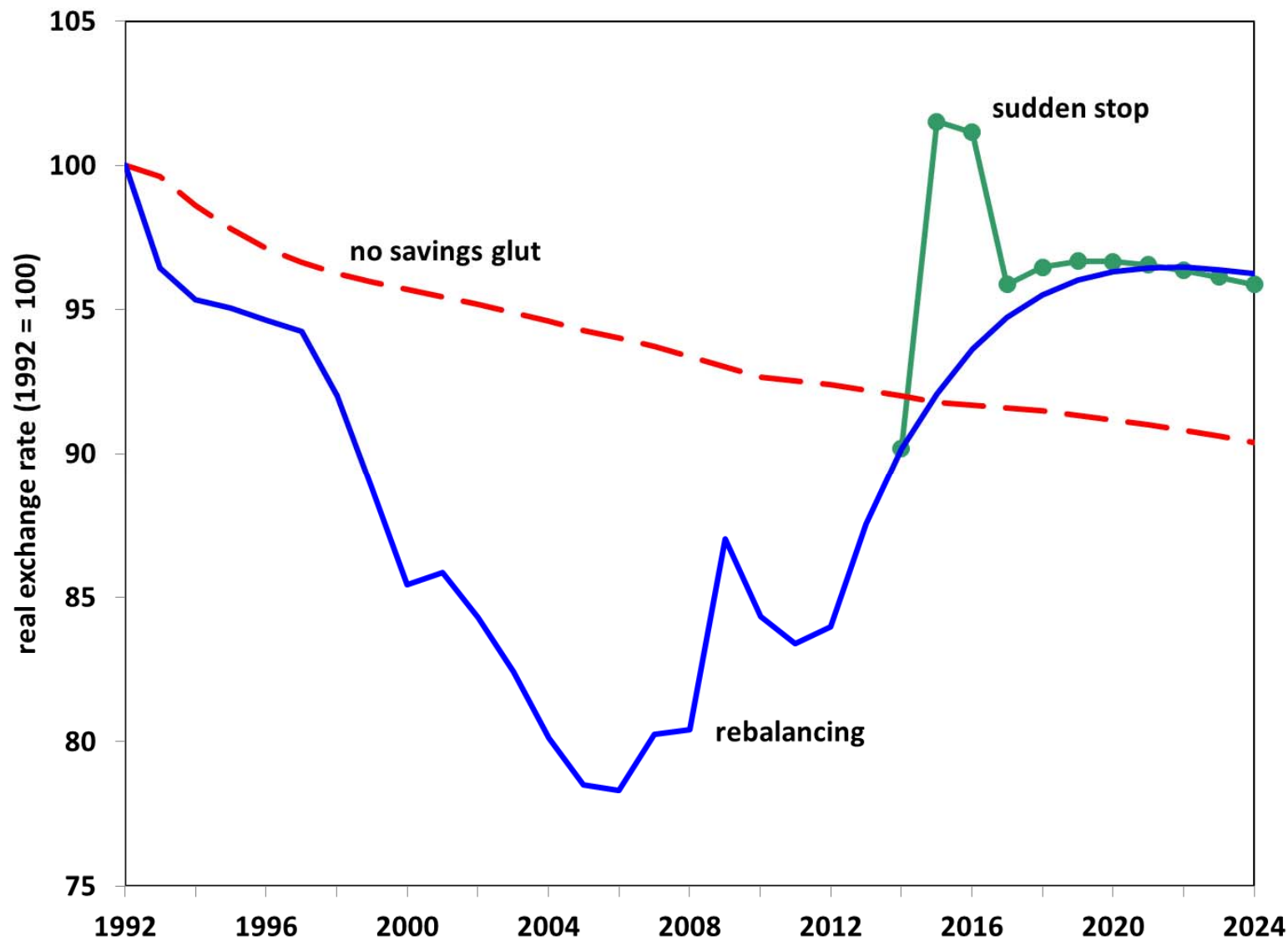
- U.S. households restricted from borrowing
- U.S. government debt/GDP begins to fall to lower long-run level
- TFP drops by 10% in 2015, 5% in 2016
- R.W. time preference parameter converges more quickly to 1

After sudden stop, perfect foresight again

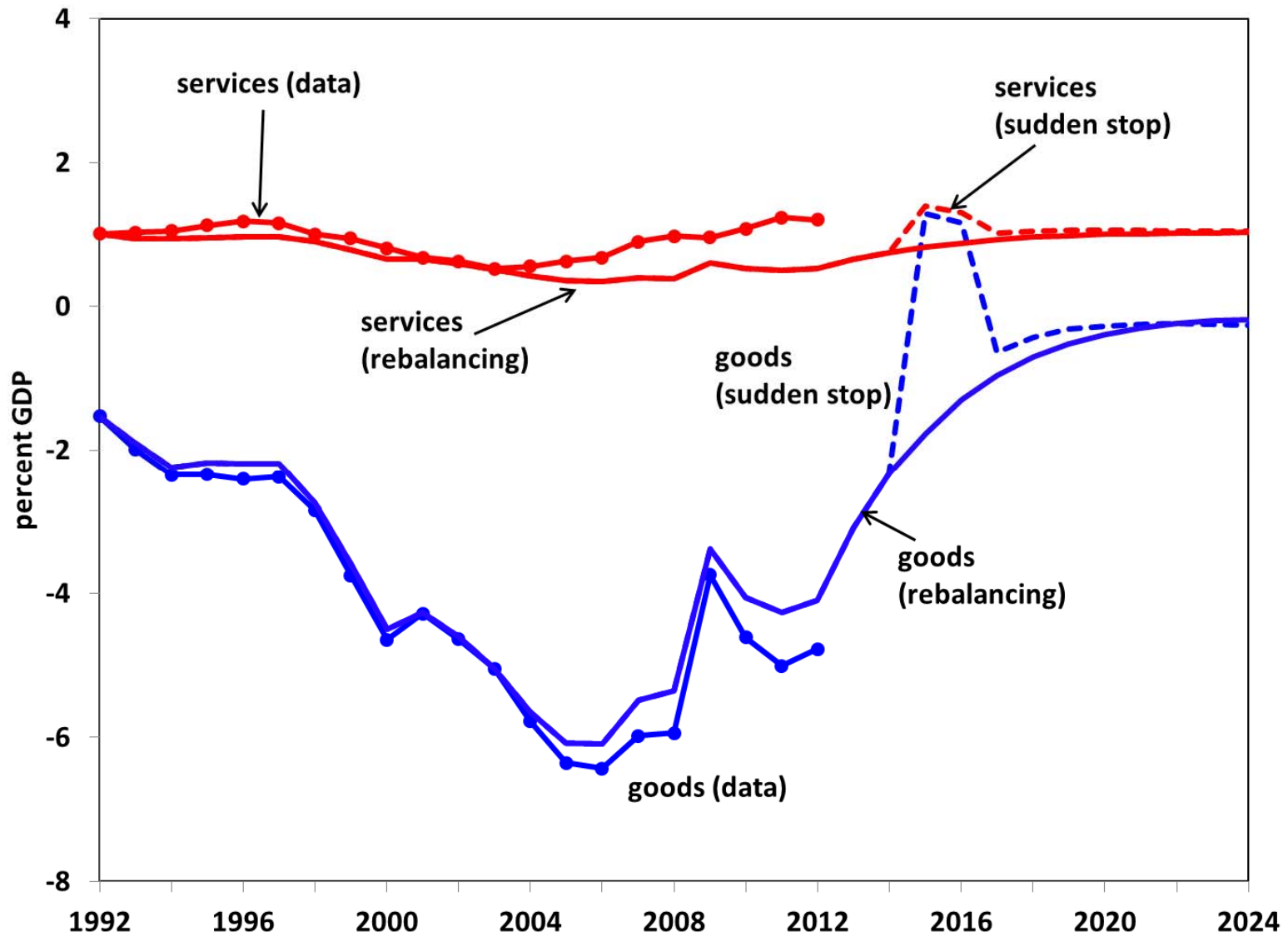
Sudden stop: trade balance



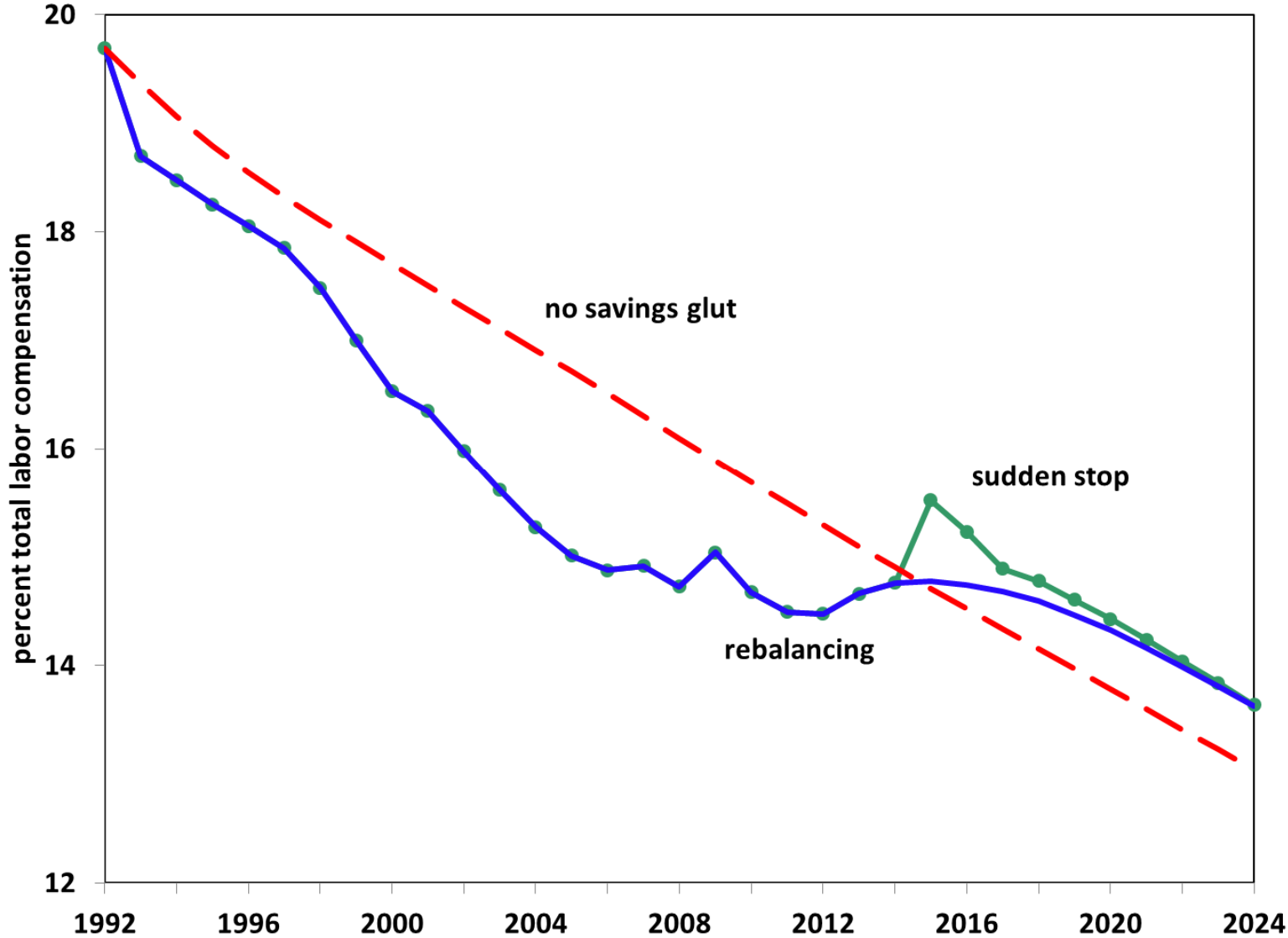
Sudden stop: real exchange rate



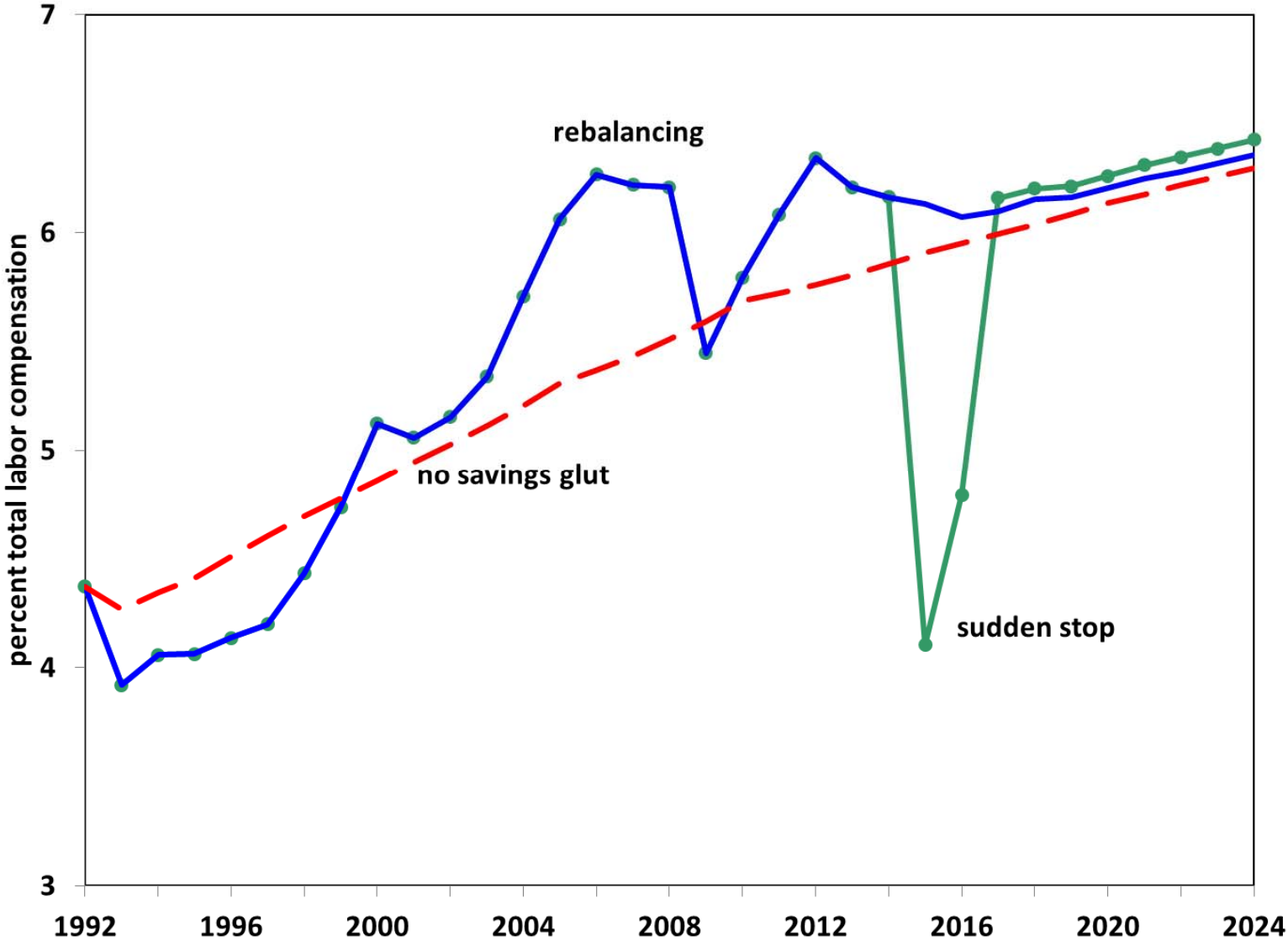
Sudden stop: trade in goods and services



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 saving glut itself that matters for aggregate dynamics of U.S. economy, not manner in which saving glut ends

Welfare impact of saving 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 saving glut?

Does the answer depend on whether sudden stop occurs?

Welfare impact of saving 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 saving glut?

Does the answer depend on whether sudden stop occurs?

Saving 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 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 saving glut

Bernanke versus Obstfeld-Rogoff (2009)

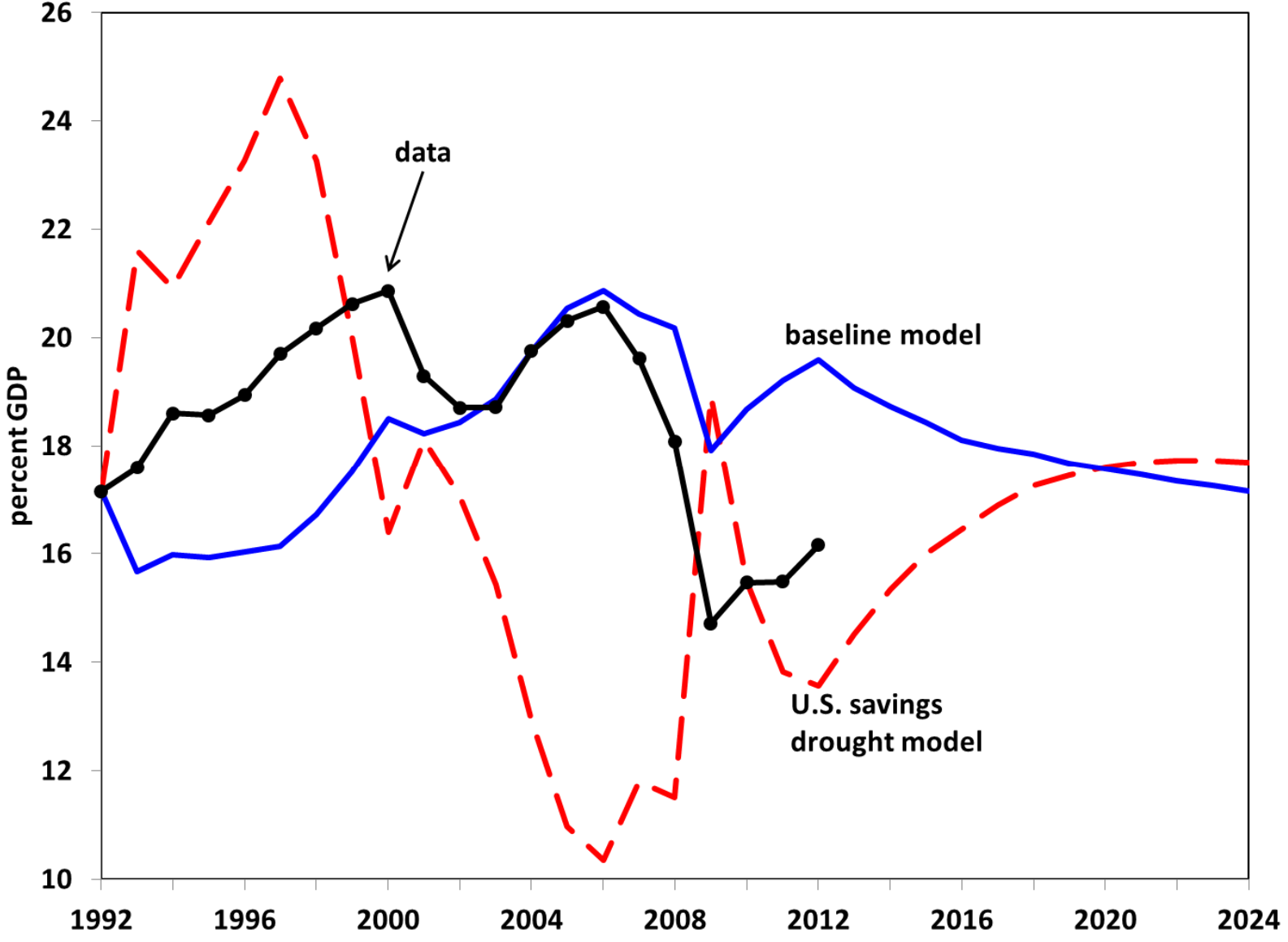
Did the Chinese make us do it?

We model the source of global imbalances as being outside the United States

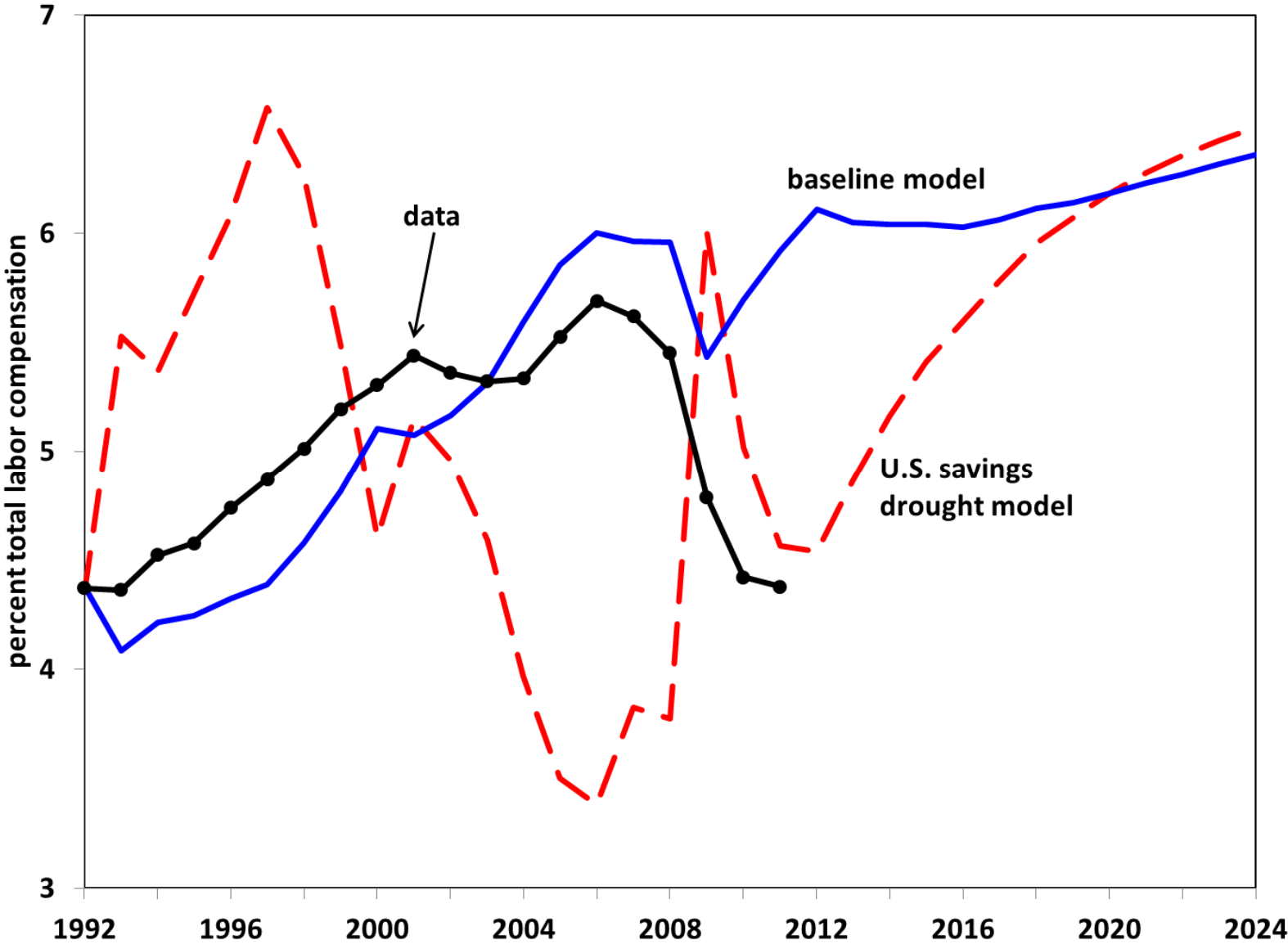
What if we alter preferences of U.S. households to generate the observed borrowing?

Savings drought in the United States rather the saving glut in the rest of the world

Savings drought model: investment



Savings drought model: construction



Puzzle: timing of real exchange rate vs. trade balance

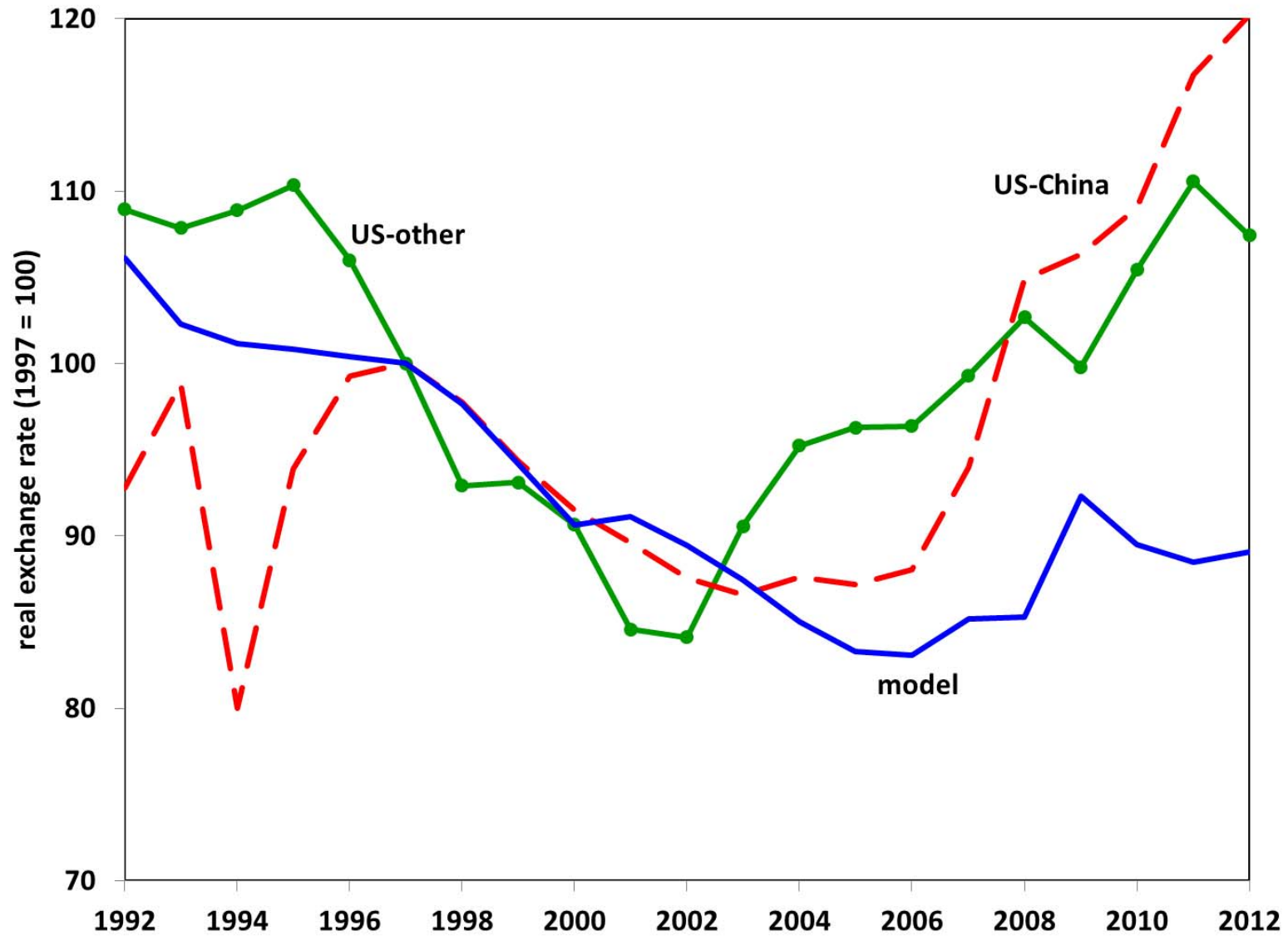
Real exchange rate and trade balance out of sync in data

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



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)