Taxation, Expenditures and the Irish Miracle

Paul Klein
Stockholm University

Gustavo Ventura
Arizona State University

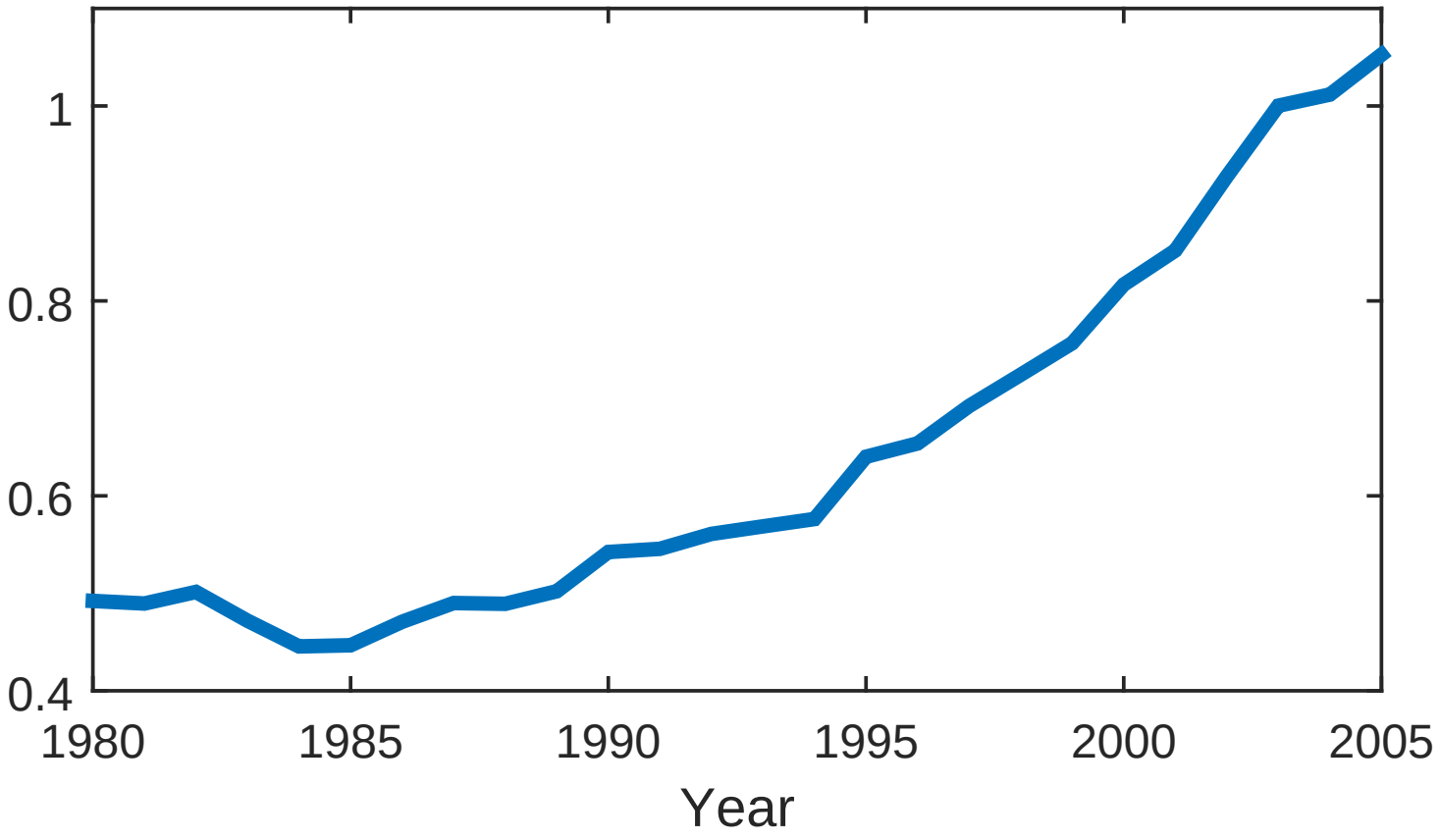
ESRI, Dublin, May 2019

This paper

The Irish Miracle: GDP per working-age adult in Ireland more than **doubled** relative to US in 25 years.

This paper

The Irish Miracle: GDP per working-age adult in Ireland more than **doubled** relative to US in 25 years.



Source: Penn World Tables 8.1

What we do

- Assess the quantitative role of fiscal policy of the Irish growth miracle.

What we do

- Assess the quantitative role of fiscal policy of the Irish growth miracle.
  - Corporate (business) tax reform

What we do

- Assess the quantitative role of fiscal policy of the Irish growth miracle.
  - Corporate (business) tax reform
  - Reductions in government consumption and transfers as shares of GDP, or *austerity*.

What we do

- Assess the quantitative role of fiscal policy of the Irish growth miracle.
  - Corporate (business) tax reform
  - Reductions in government consumption and transfers as shares of GDP, or *austerity*.
- Infer residual changes in Total Factor Productivity

What we do

- Assess the quantitative role of fiscal policy of the Irish growth miracle.
  - Corporate (business) tax reform
  - Reductions in government consumption and transfers as shares of GDP, or *austerity*.
- Infer residual changes in Total Factor Productivity
- Assess the importance of openness to capital inflows and labour supply changes in Ireland's rise.

What we do

- Assess the quantitative role of fiscal policy of the Irish growth miracle.
  - Corporate (business) tax reform
  - Reductions in government consumption and transfers as shares of GDP, or *austerity*.
- Infer residual changes in Total Factor Productivity
- Assess the importance of openness to capital inflows and labour supply changes in Ireland's rise.
- Complementarities.

Facts—The Output Miracle

- Focus on output per adult, ages 16-65.

Facts—The Output Miracle

- Focus on output per adult, ages 16-65.
- GDP per adult grew on average 5.1 percent per year 1980-2005 $\rightarrow$ a factor of 3.5.

Facts—The Output Miracle

- Focus on output per adult, ages 16-65.
- GDP per adult grew on average 5.1 percent per year 1980-2005 $\rightarrow$ a factor of 3.5.
- Ireland's GDP per **adult** went up by 112 percent relative to a 2 percent annual growth trend.

  This is (obviously) **enormous**.

Facts—The Output Miracle

- Focus on output per adult, ages 16-65.
- GDP per adult grew on average 5.1 percent per year 1980-2005 $\rightarrow$ a factor of 3.5.
- Ireland's GDP per **adult** went up by 112 percent relative to a 2 percent annual growth trend.

  This is (obviously) **enormous**.
- No similar case in Western Europe, certainly not recently

Facts—The Output Miracle

- Focus on output per adult, ages 16-65.
- GDP per adult grew on average 5.1 percent per year 1980-2005 $\rightarrow$ a factor of 3.5.
- Ireland's GDP per **adult** went up by 112 percent relative to a 2 percent annual growth trend.

  This is (obviously) **enormous**.
- No similar case in Western Europe, certainly not recently

  By 1980, Spain was actually richer than Ireland. By 2005, output per adult was 75% **higher** in Ireland.

Facts—Taxation and Expenditures

- Corporate (business) tax rates were gradually cut from about **50 percent** to **12.5 percent** in 2003 and onwards.

Facts—Taxation and Expenditures

- Corporate (business) tax rates were gradually cut from about **50 percent** to **12.5 percent** in 2003 and onwards.
- Corporate (business) tax rates were differentiated across sectors until 2003, with manufacturing taxed the least.

Facts—Taxation and Expenditures

- Corporate (business) tax rates were gradually cut from about **50 percent** to **12.5 percent** in 2003 and onwards.
- Corporate (business) tax rates were differentiated across sectors until 2003, with manufacturing taxed the least.

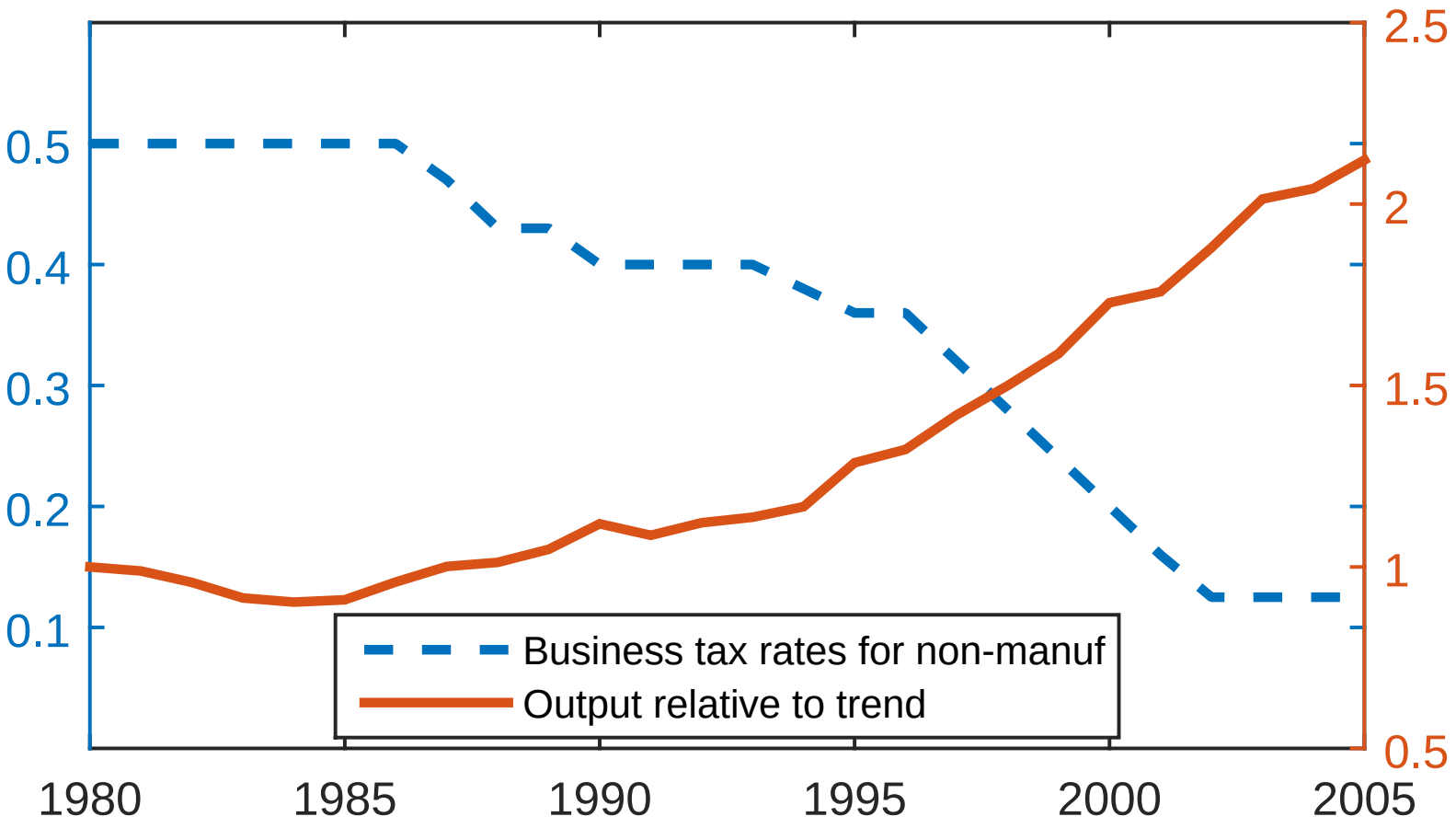
Facts—Taxation and Expenditures

- Corporate (business) tax rates were gradually cut from about **50 percent** to **12.5 percent** in 2003 and onwards.
- Corporate (business) tax rates were differentiated across sectors until 2003, with manufacturing taxed the least.
- Government consumption from about 20% of GDP to 14% of GDP (1980-2005).

Facts—Taxation and Expenditures

- Corporate (business) tax rates were gradually cut from about **50 percent** to **12.5 percent** in 2003 and onwards.
- Corporate (business) tax rates were differentiated across sectors until 2003, with manufacturing taxed the least.
- Government consumption from about 20% of GDP to 14% of GDP (1980-2005).
- Transfers roughly constant at 9% of GDP (1980-2005).

Tax Rates



Note: statutory rates

Facts—GDP vs GNP

- Irish economy attracted large inflows of investment from abroad.

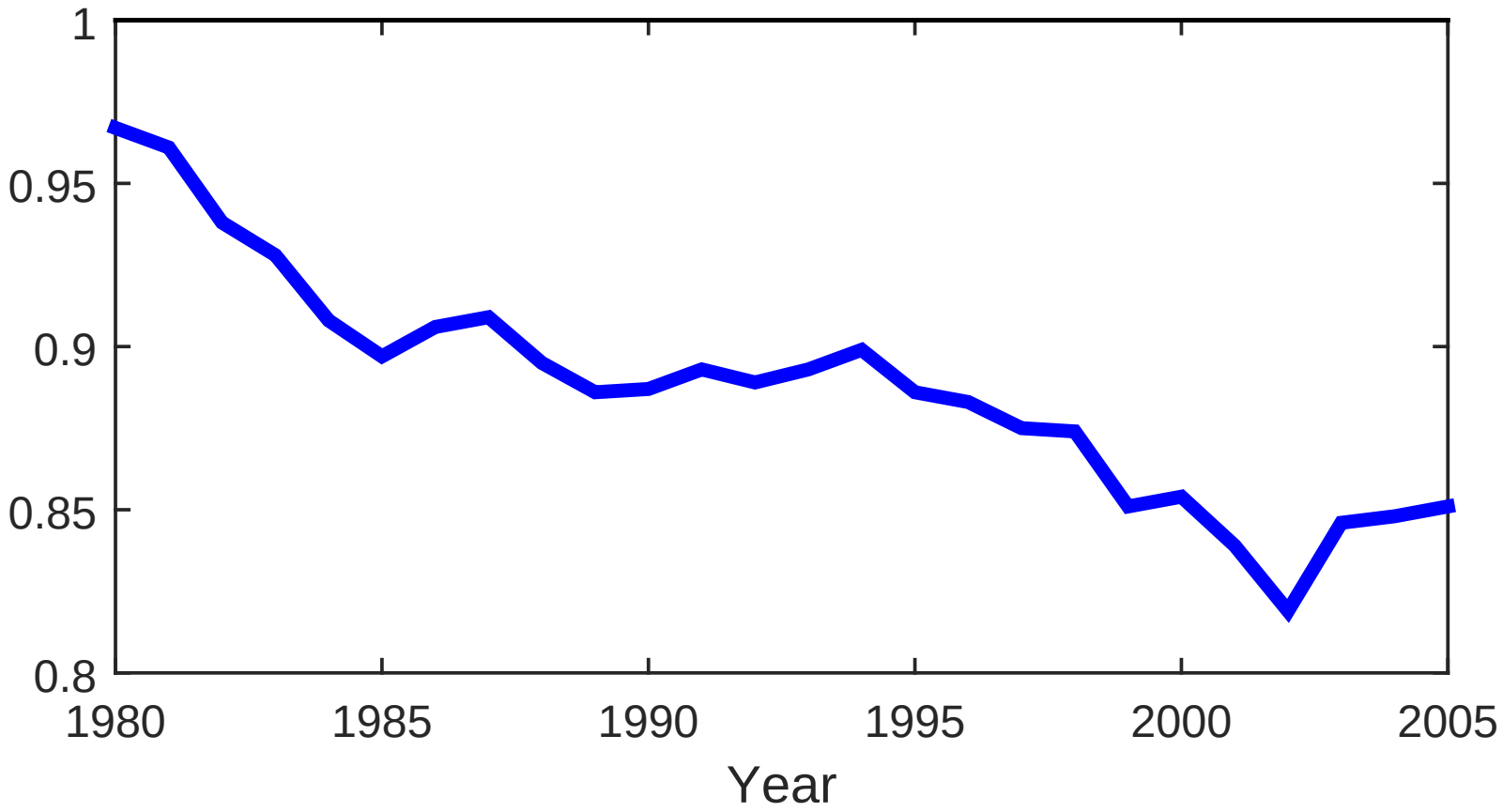
Facts—GDP vs GNP

- Irish economy attracted large inflows of investment from abroad.
- Gap opened between GDP and GNP.

Facts—GDP vs GNP

- Irish economy attracted large inflows of investment from abroad.
- Gap opened between GDP and GNP.
- Ratio of GNP to GDP declined by about 12 points in 1980-2005.

GNP to GDP Ratio



Key model features

- Two sectors to allow for differentiated business taxes

Key model features

- Two sectors to allow for differentiated business taxes
- Small-open economy with (imperfect) capital inflows.

Key model features

- Two sectors to allow for differentiated business taxes
- Small-open economy with (imperfect) capital inflows.
- A government sector to allow for changes in fiscal policy—distortionary taxes, government consumption and transfers.

Key model features

- Two sectors to allow for differentiated business taxes
- Small-open economy with (imperfect) capital inflows.
- A government sector to allow for changes in fiscal policy—distortionary taxes, government consumption and transfers.
- Tangible and Intangible capital.

Key model features

- Two sectors to allow for differentiated business taxes
- Small-open economy with (imperfect) capital inflows.
- A government sector to allow for changes in fiscal policy—distortionary taxes, government consumption and transfers.
- Tangible and Intangible capital.
  - In the spirit of Hall (2001), McGrattan & Prescott (2009,2010, 2016) and others.

Key model features

- Two sectors to allow for differentiated business taxes
- Small-open economy with (imperfect) capital inflows.
- A government sector to allow for changes in fiscal policy—distortionary taxes, government consumption and transfers.
- Tangible and Intangible capital.
  - In the spirit of Hall (2001), McGrattan & Prescott (2009,2010, 2016) and others.
  - Arguably important in Irish case, given large foreign investment inflows.

Key model features

- Two sectors to allow for differentiated business taxes
- Small-open economy with (imperfect) capital inflows.
- A government sector to allow for changes in fiscal policy—distortionary taxes, government consumption and transfers.
- Tangible and Intangible capital.
  - In the spirit of Hall (2001), McGrattan & Prescott (2009,2010, 2016) and others.
  - Arguably important in Irish case, given large foreign investment inflows.
  - Provide a simple amplification mechanism.

Model—household

A representative household maximizes

$$\sum_{t=0}^{\infty} \beta^t (\ln c_t - \frac{\psi}{1+1/\varepsilon} h_t^{1+1/\varepsilon})$$

Model—household

A representative household maximizes

$$\sum_{t=0}^{\infty} \beta^t (\ln c_t - \frac{\psi}{1+1/\varepsilon} h_t^{1+1/\varepsilon})$$

subject to

$$c_t + a_{t+1} + q_t b_{t+1} + k_{t+1} + z_{t+1} =$$
$$= \widehat{w}_t h_t + \widehat{R}_t^k k_t + \widehat{R}_t^z z_t + R^a a_t + b_t + \mathcal{T}_t$$

Model—household

A representative household maximizes

$$\sum_{t=0}^{\infty} \beta^t (\ln c_t - \frac{\psi}{1+1/\varepsilon} h_t^{1+1/\varepsilon})$$

subject to

$$c_t + a_{t+1} + q_t b_{t+1} + k_{t+1} + z_{t+1} =$$
$$= \widehat{w}_t h_t + \widehat{R}_t^k k_t + \widehat{R}_t^z z_t + R^a a_t + b_t + \mathcal{T}_t$$

and

$$\underbrace{a_{t+1} + \varphi k_{t+1} \geq 0}_{\text{collateral constraint}}.$$

Model—technology

The final good is produced according to

$$Y_t = \bar{A}_t F(Y_{s,t}, Y_{m,t}) = \bar{A}_t [\alpha_s Y_{s,t}^{\xi} + (1 - \alpha_s) Y_{m,t}^{\xi}]^{1/\xi}.$$

where $\{\bar{A}_t\}_{t=0}^{\infty}$ is an exogenous sequence of TFPs.

Model—technology

The final good is produced according to

$$Y_t = \bar{A}_t F(Y_{s,t}, Y_{m,t}) = \bar{A}_t [\alpha_s Y_{s,t}^{\xi} + (1-\alpha_s) Y_{m,t}^{\xi}]^{1/\xi}.$$

where $\{\bar{A}_t\}_{t=0}^{\infty}$ is an exogenous sequence of TFPs.

Output in the m sector is produced according to

$$Y_{m,t} = G(Z_{m,t}, K_{m,t}, H_{m,t}) = Z_{m,t}^{\theta_z} K_{m,t}^{\theta_k} H_{m,t}^{1-\theta_z-\theta_k}.$$

Model—technology

The final good is produced according to

$$Y_t = \bar{A}_t F(Y_{s,t}, Y_{m,t}) = \bar{A}_t [\alpha_s Y_{s,t}^{\xi} + (1-\alpha_s) Y_{m,t}^{\xi}]^{1/\xi}.$$

where $\{\bar{A}_t\}_{t=0}^{\infty}$ is an exogenous sequence of TFPs.

Output in the m sector is produced according to

$$Y_{m,t} = G(Z_{m,t}, K_{m,t}, H_{m,t}) = Z_{m,t}^{\theta_z} K_{m,t}^{\theta_k} H_{m,t}^{1-\theta_z-\theta_k}.$$

Output in the s sector is produced according to

$$Y_{s,t} = G(Z_{s,t}, K_{s,t}, H_{s,t}) = Z_{s,t}^{\theta_z} K_{s,t}^{\theta_k} H_{s,t}^{1-\theta_k-\theta_z}.$$

Model—taxation

Labour income is taxed in a proportional fashion so that:

$$\widehat{w}_t = (1 - \tau_t) w_t.$$

Model—taxation

Labour income is taxed in a proportional fashion so that:

$$\widehat{w}_t = (1 - \tau_t) w_t.$$

Capital income is **taxed differentially** across sectors:

$$\widehat{R}_t^{k,s} = 1 + r_t^{k,s} - \delta_k - \tau_t^s (r_t^{k,s} - \delta_k),$$

$$\widehat{R}_t^{k,m} = 1 + r_t^{k,m} - \delta_k - \tau_t^m (r_t^{k,m} - \delta_k),$$

$$\widehat{R}_t^{z,s} = 1 + r_t^{z,s} - \delta_z - \tau_t^s (r_t^{z,s} - \delta_z),$$

and

$$\widehat{R}_t^{z,m} = 1 + r_t^{z,m} - \delta_z - \tau_t^m (r_t^{z,m} - \delta_z)$$

Model—taxation

where, for instance,

$$r_t^{k,m} = \frac{\partial F}{\partial Y_{m,t}} \cdot \frac{\partial G}{\partial K_{m,t}}$$

Model—government budget

$$\underbrace{\sum_{i\in\{m,s\}} \tau_t^i (r_t^{k,i} - \delta_k) K_{i,t} \; + \sum_{i\in\{m,s\}} \tau_t^i (r_t^{z,i} - \delta_z) Z_{i,t}}_{\text{capital income revenue}} \; +$$

$$\underbrace{\tau_t w_t H_t}_{\text{labour income revenue}} \quad + \quad \underbrace{q_t B_{t+1}}_{\text{new debt issue}} \quad =$$

$$G_t + T_t + B_t$$

Model—government budget

$$\underbrace{\sum_{i\in\{m,s\}} \tau_t^i (r_t^{k,i} - \delta_k) K_{i,t} \; + \sum_{i\in\{m,s\}} \tau_t^i (r_t^{z,i} - \delta_z) Z_{i,t}}_{\text{capital income revenue}} \; +$$

$$\underbrace{\tau_t w_t H_t}_{\text{labour income revenue}} \quad + \quad \underbrace{q_t B_{t+1}}_{\text{new debt issue}} \quad =$$

$$G_t + T_t + B_t$$

Note: labour income tax $\tau_t = \tilde{\tau}_t + \tau$ where $\tilde{\tau}_t$ is taken from the data and the surtax τ is endogenous.

Equilibrium—comments

- $GNP_t := Y_t + (R^a - 1)A_t.$

Equilibrium—comments

- $GNP_t := Y_t + (R^a - 1)A_t$.
- The tightness parameter (φ) of the collateral constraint can be used to calibrate the GNP/GDP ratio.

Equilibrium—comments

- $GNP_t := Y_t + (R^a - 1)A_t$.
- The tightness parameter (φ) of the collateral constraint can be used to calibrate the GNP/GDP ratio.
- Small open economies do not behave like closed ones.

  Permanent changes in technology have long-run effects on labour supply, even with balanced-growth preferences. Additional effects on output as a result.

The Quantitative Exercise

- Aim: Provide an assessment of the contribution of fiscal policy changes in Irish miracle.

The Quantitative Exercise

- Aim: Provide an assessment of the contribution of fiscal policy changes in Irish miracle.
- Specifically:
  - Given changes in fiscal policy, we infer TFP sequence to match the rise in GDP. Fully anticipated changes.

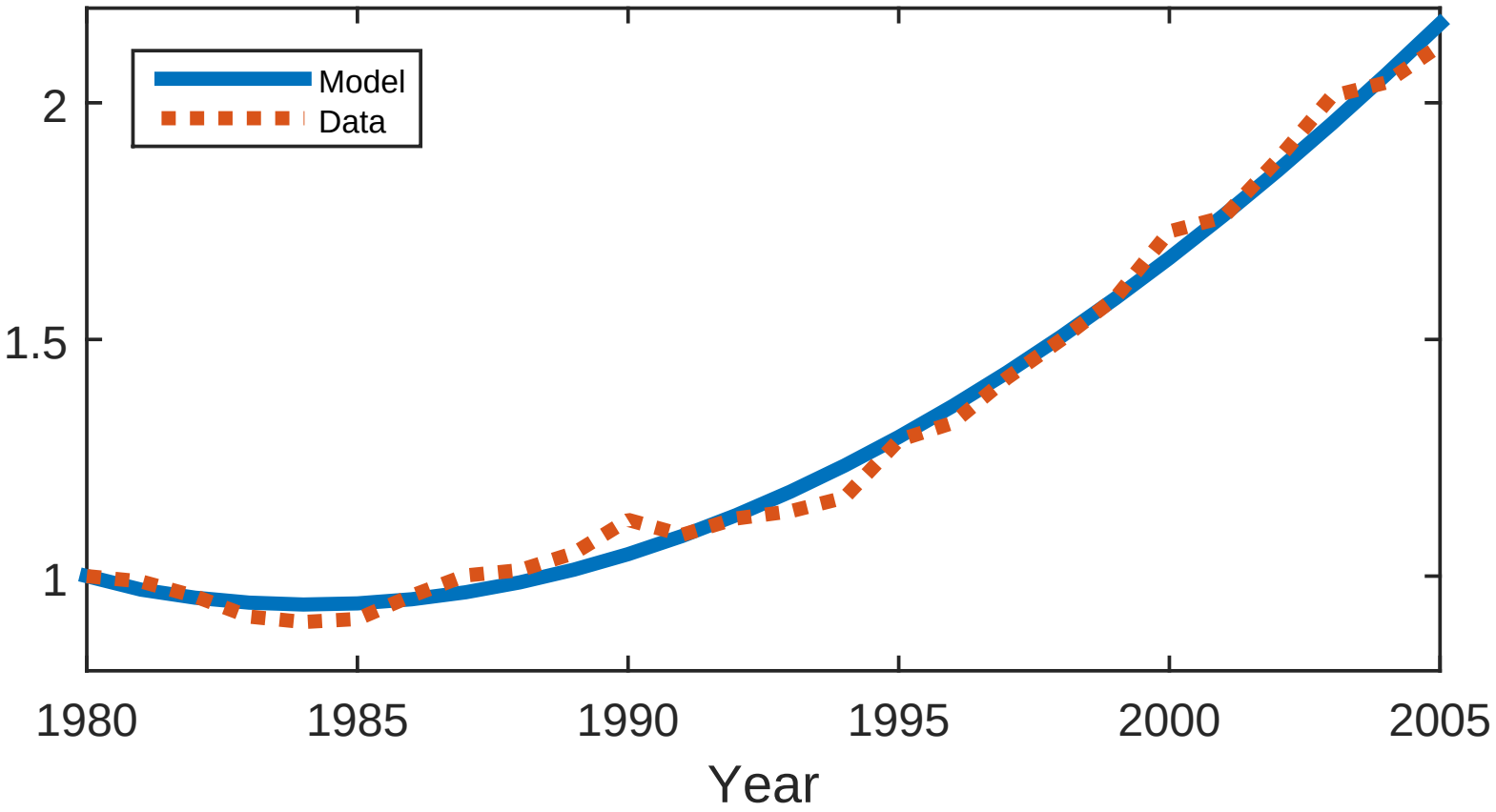
The Quantitative Exercise

- Aim: Provide an assessment of the contribution of fiscal policy changes in Irish miracle.
- Specifically:
  - Given changes in fiscal policy, we infer TFP sequence to match the rise in GDP. Fully anticipated changes.
  - Evaluate specific contribution of driving forces—tax reform, changes in spending, TFP.

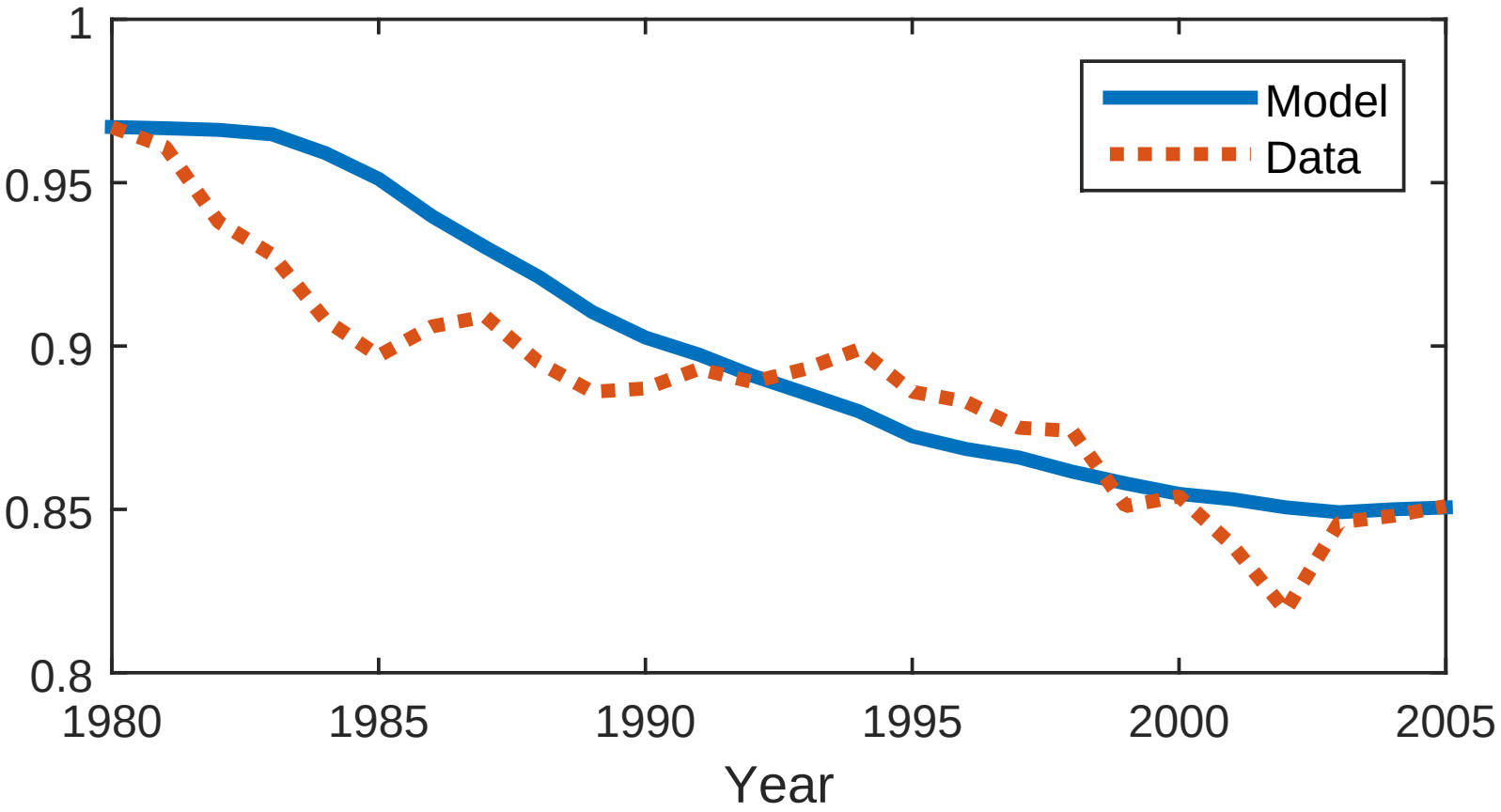
The Quantitative Exercise

- Aim: Provide an assessment of the contribution of fiscal policy changes in Irish miracle.
- Specifically:
  - Given changes in fiscal policy, we infer TFP sequence to match the rise in GDP. Fully anticipated changes.
  - Evaluate specific contribution of driving forces—tax reform, changes in spending, TFP.
  - Evaluate importance of openness to capital inflows and other model features.

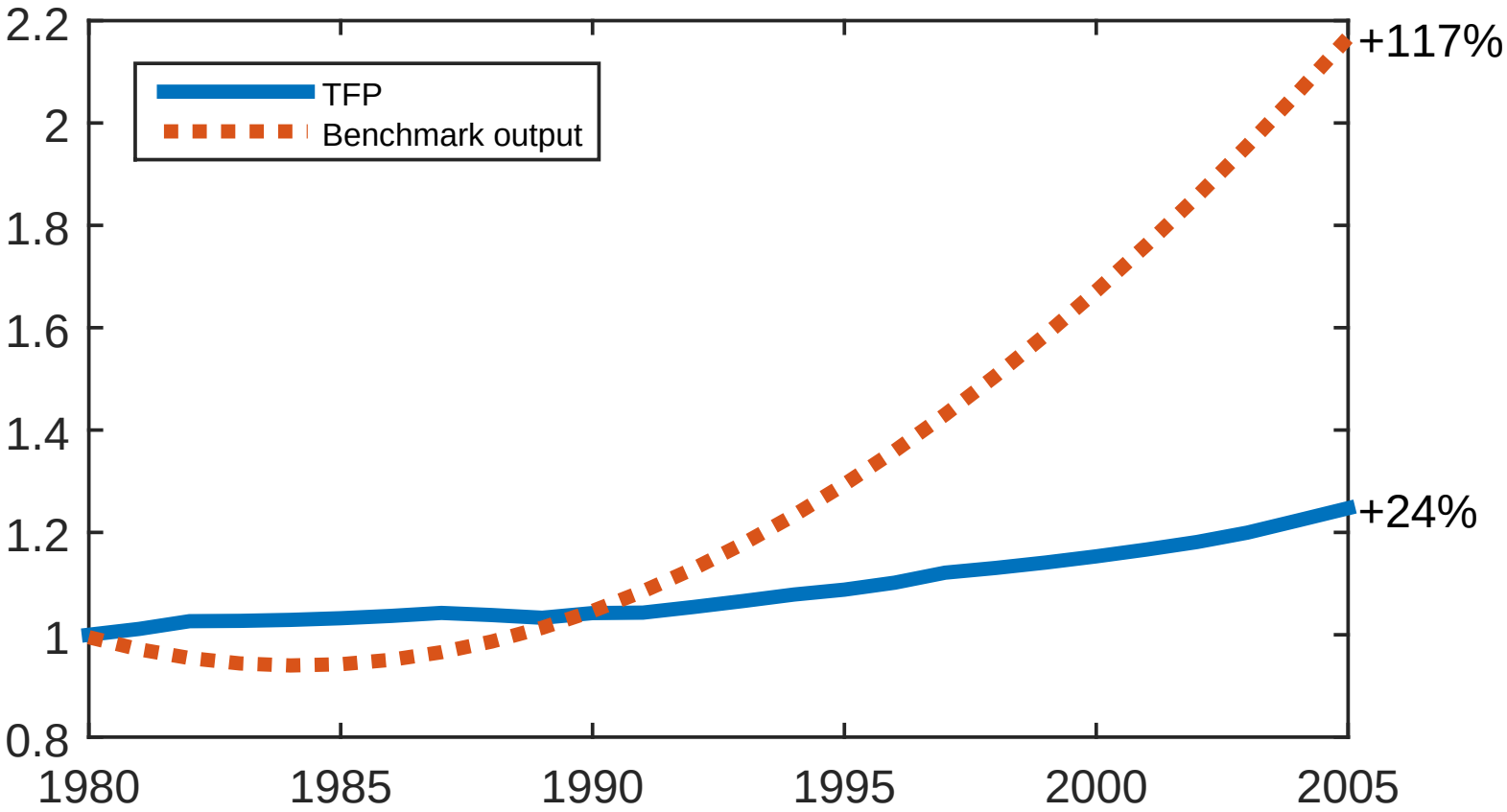
Results



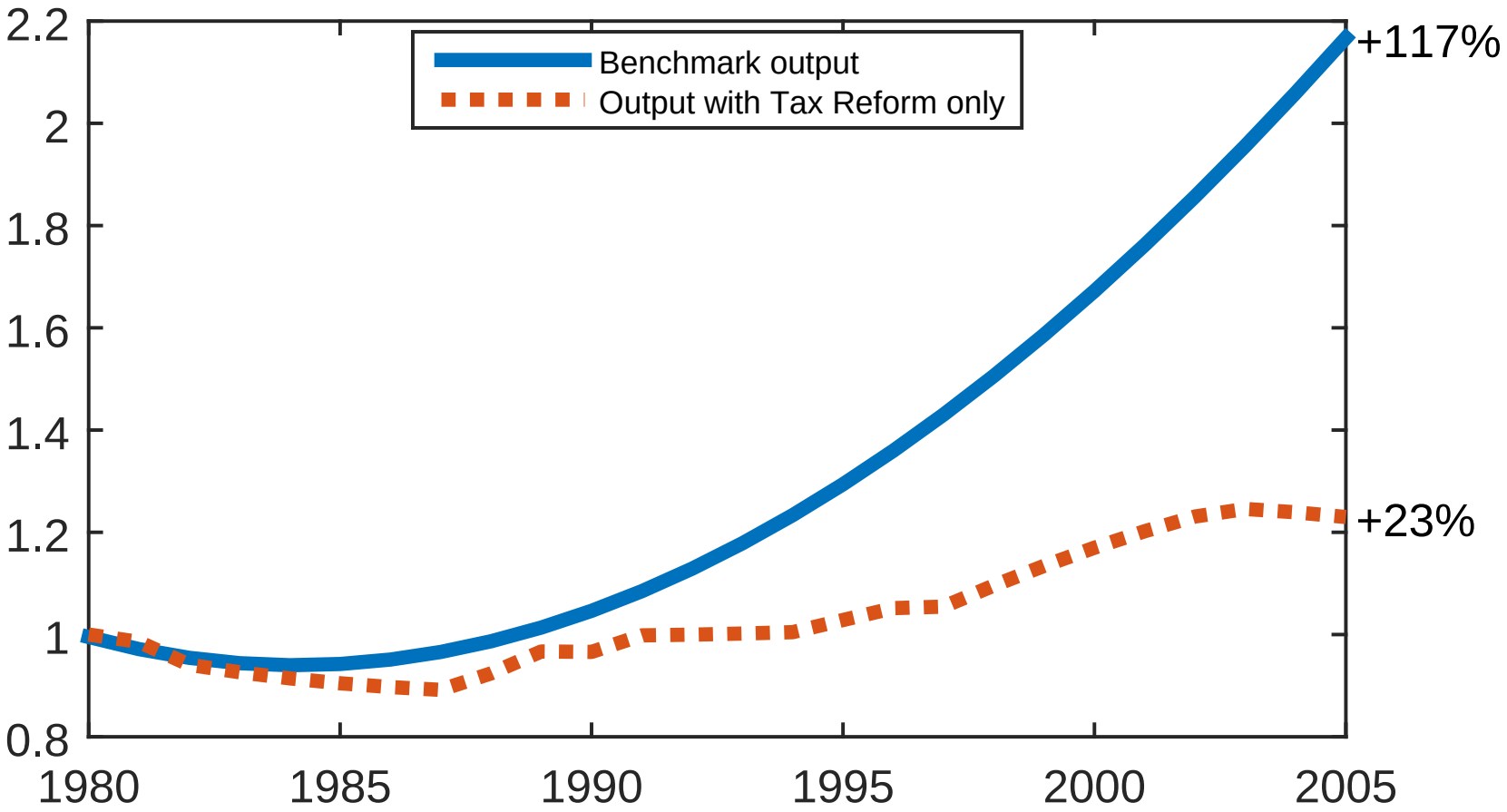
Results—GNP/GDP



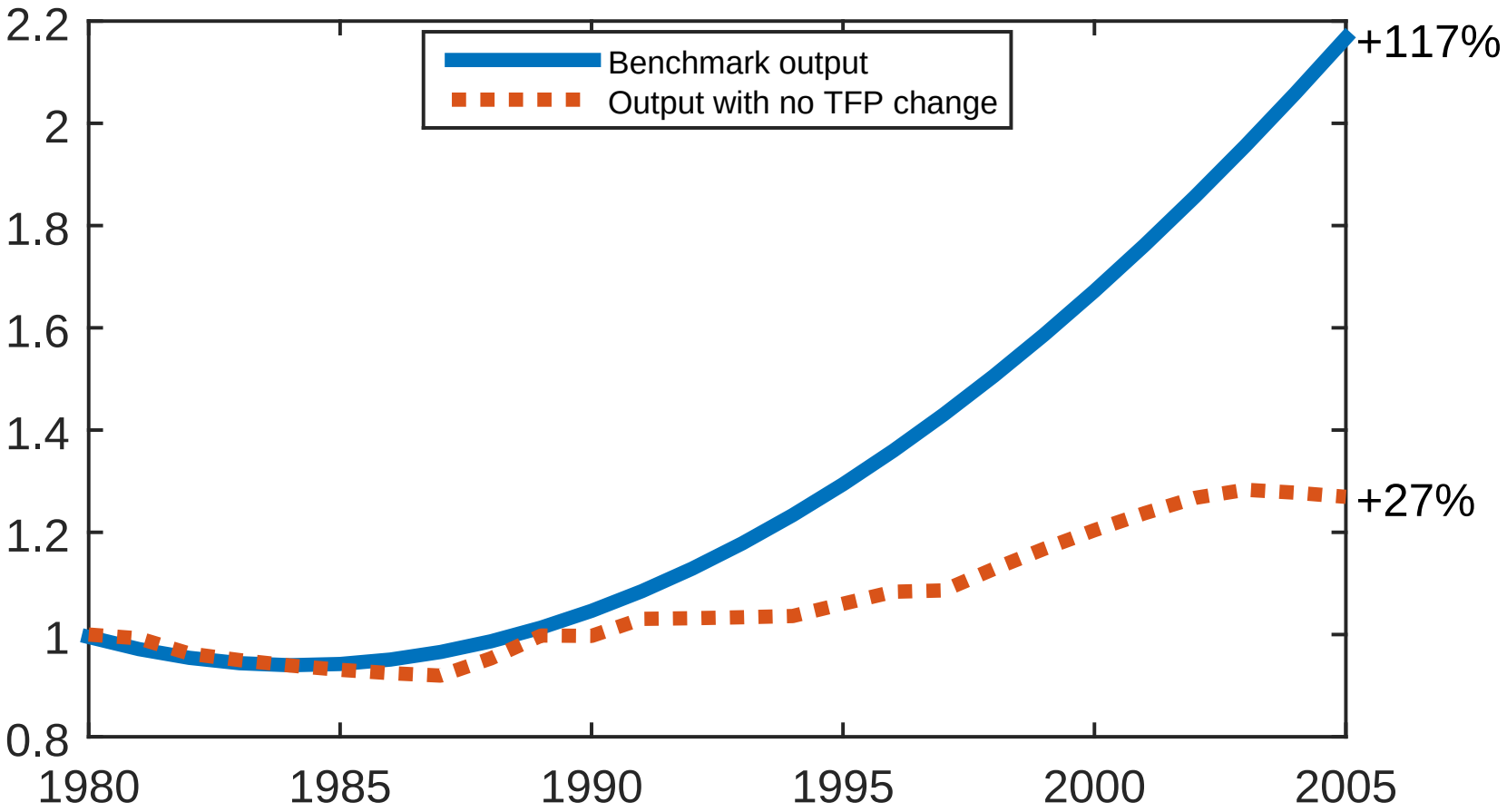
Results—TFP


TFP
Benchmark output
+117%
+24%
2.2
2
1.8
1.6
1.4
1.2
1
0.8
1980
1985
1990
1995
2000
2005

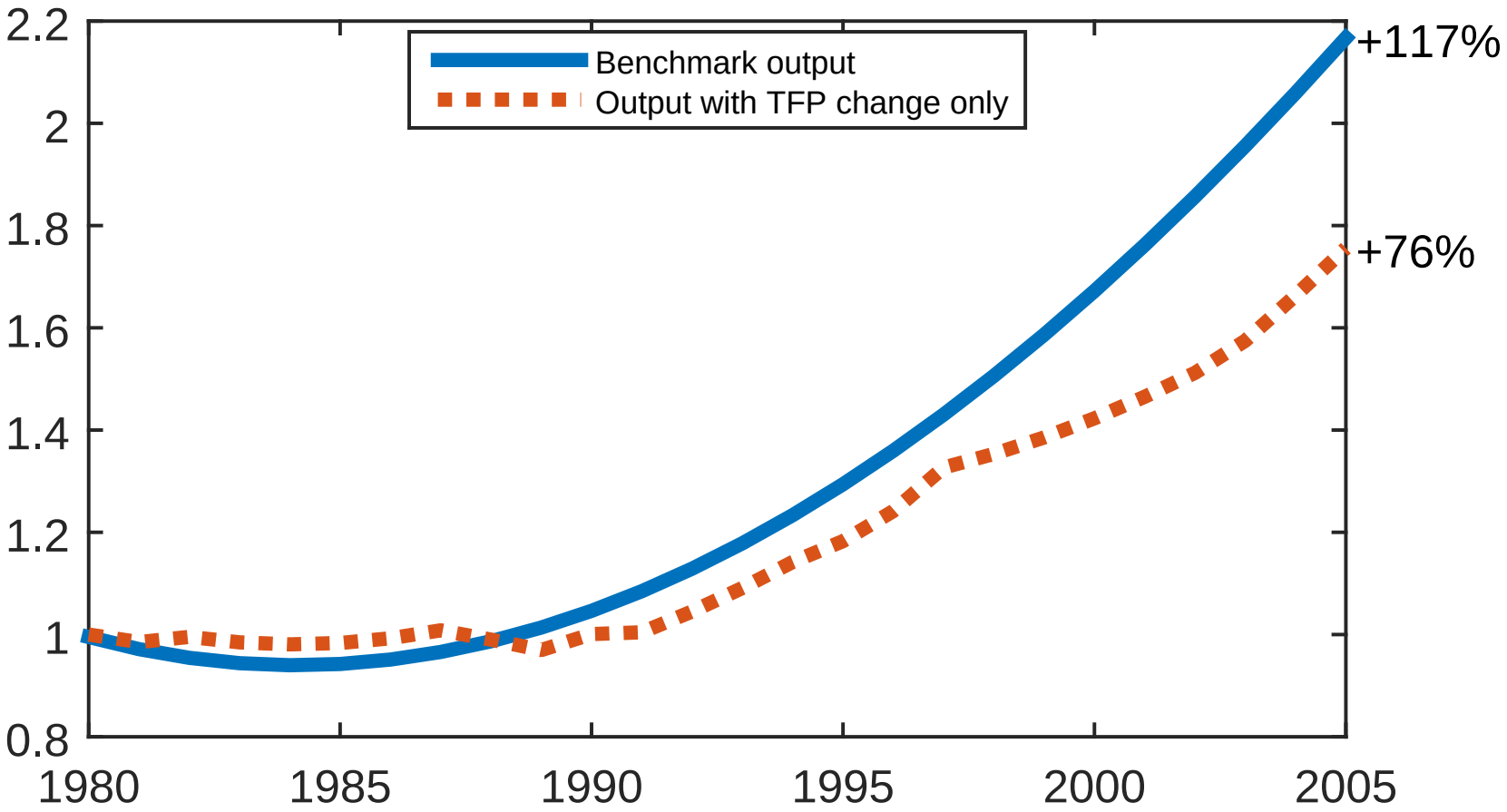
Driving Forces: Tax Reform Only



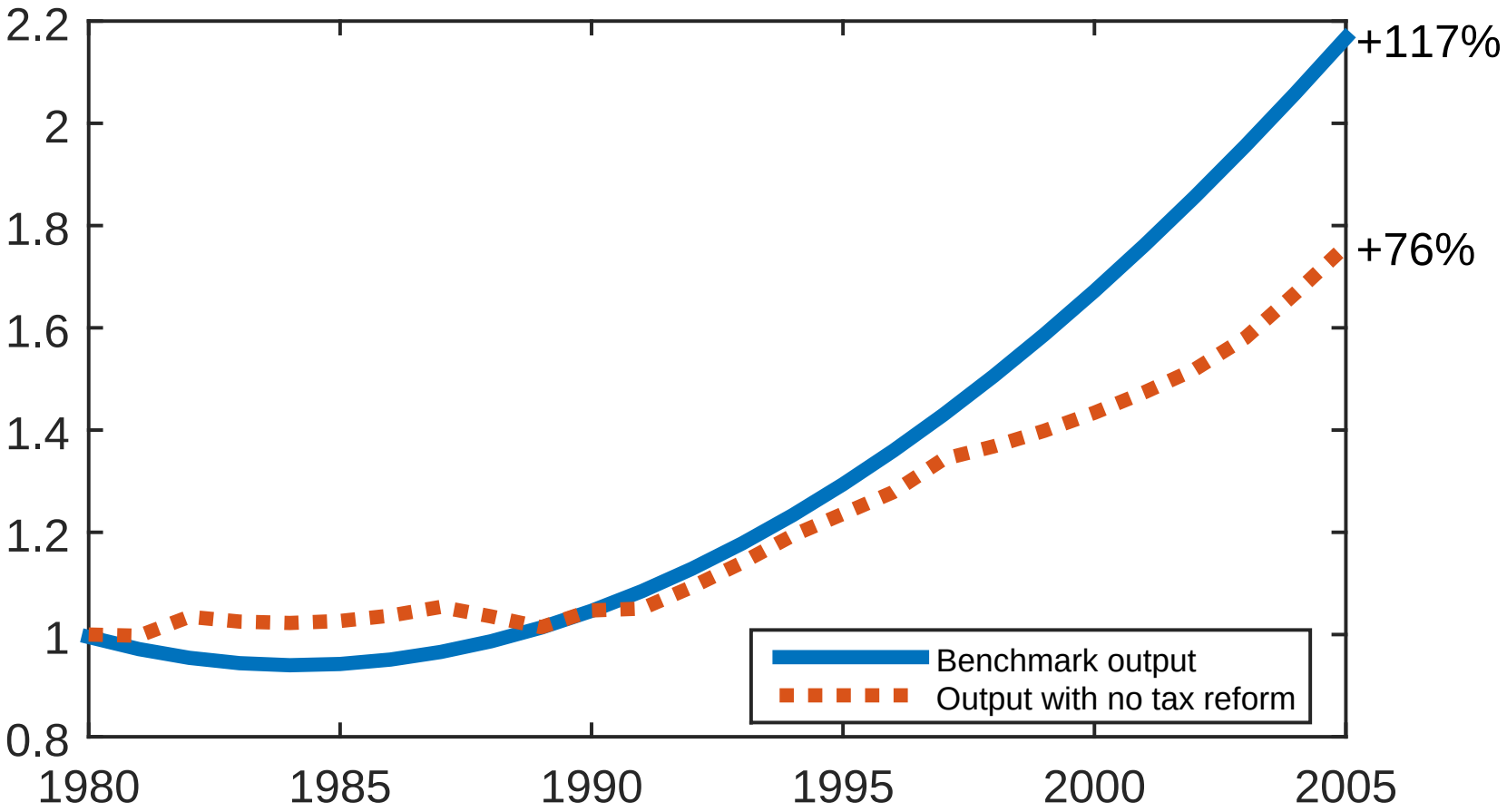
Driving Forces: All Fiscal Policy Changes



Driving Forces: TFP changes Only



Driving Forces: No Tax Reform



Taking Stock

- Tax reform leads to large effects over period. But quantitatively not the main culprit.

Taking Stock

- Tax reform leads to large effects over period. But quantitatively not the main culprit.

- Relative small—23%—increases in TFP look very important. In isolation, they account for about two thirds of output changes.

Taking Stock

- Tax reform leads to large effects over period. But quantitatively not the main culprit.
- Relative small—23%—increases in TFP look very important. In isolation, they account for about two thirds of output changes.
- There are important complementarities and interactions between driving forces over time:
  - Changes in isolation account for only 85% of total changes in output.

Importance of Openness

- Q: Is it important to study the Irish miracle from the standpoint of an open economy? Did openness to capital movements matter?

Importance of Openness

- Q: Is it important to study the Irish miracle from the standpoint of an open economy? Did openness to capital movements matter?

- A: YES. Big time.

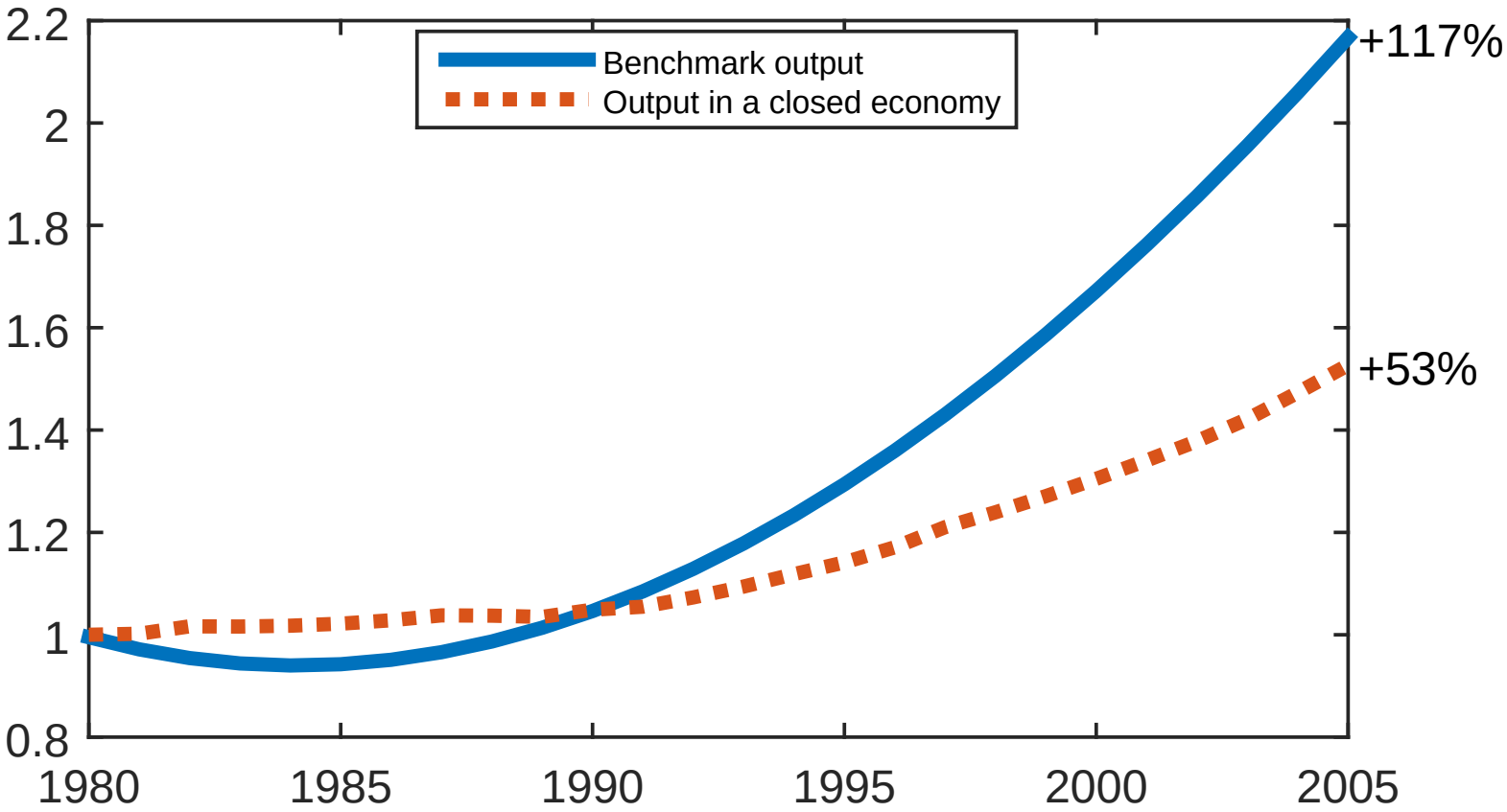
Importance of Openness

- Q: Is it important to study the Irish miracle from the standpoint of an open economy? Did openness to capital movements matter?
- A: YES. Big time.
- We evaluate the quantitative importance of the *same* driving forces when the economy is closed to capital movements (ignoring trade in goods and services).

Importance of Openness

- Q: Is it important to study the Irish miracle from the standpoint of an open economy? Did openness to capital movements matter?
- A: YES. Big time.
- We evaluate the quantitative importance of the *same* driving forces when the economy is closed to capital movements (ignoring trade in goods and services).
- We find that driving forces lead to changes in output that are **less than half** of observed ones by 2005.

Importance of Openness



Why Openness Matters

- Capital inflows in open economy accelerate response to driving forces.

Why Openness Matters

- Capital inflows in open economy accelerate response to driving forces.

  $\rightarrow$ Effects of driving forces appear later in closed economy.

Why Openness Matters

- Capital inflows in open economy accelerate response to driving forces.

  $\rightarrow$ Effects of driving forces appear later in closed economy.

- Decoupling of income and substitution effects in open economy.

Why Openness Matters

- Capital inflows in open economy accelerate response to driving forces.

  $\rightarrow$ Effects of driving forces appear later in closed economy.

- Decoupling of income and substitution effects in open economy.

  $\rightarrow$ Much larger effects on labour supply in open versus closed economy: 15.4% vs 1.5%.

Welfare Gains (%)

Baseline Experiment	Baseline Experiment (Closed)	Tax Reform Only
40.0	21.3	4.2

Note: The tax reform only case is computed keeping trend-adjusted *levels* of gov't consumption and transfers the same as in 1980.

Welfare Gains (%)

Baseline Experiment	Baseline Experiment (Closed)	Tax Reform Only
40.0	21.3	4.2

Note: The tax reform only case is computed keeping trend-adjusted *levels* of gov't consumption and transfers the same as in 1980.

- Openness is critical for welfare gains.

Welfare Gains (%)

Baseline Experiment	Baseline Experiment (Closed)	Tax Reform Only
40.0	21.3	4.2

Note: The tax reform only case is computed keeping trend-adjusted *levels* of gov't consumption and transfers the same as in 1980.

- Openness is critical for welfare gains.
- Small contribution of tax reform.
  - Harmonization most important for welfare, not reduction.

Facts—Labour supply

- Hours worked per adult went down by about 15 percent but then recovered and were about the same in 2005 as in 1980

Facts—Labour supply

- Hours worked per adult went down by about 15 percent but then recovered and were about the same in 2005 as in 1980
- Interesting underlying demographic and labour supply facts:

Facts—Labour supply

- Hours worked per adult went down by about 15 percent but then recovered and were about the same in 2005 as in 1980
- Interesting underlying demographic and labour supply facts:
  - Share of adults 16-65 went up: 58 to 68 percent

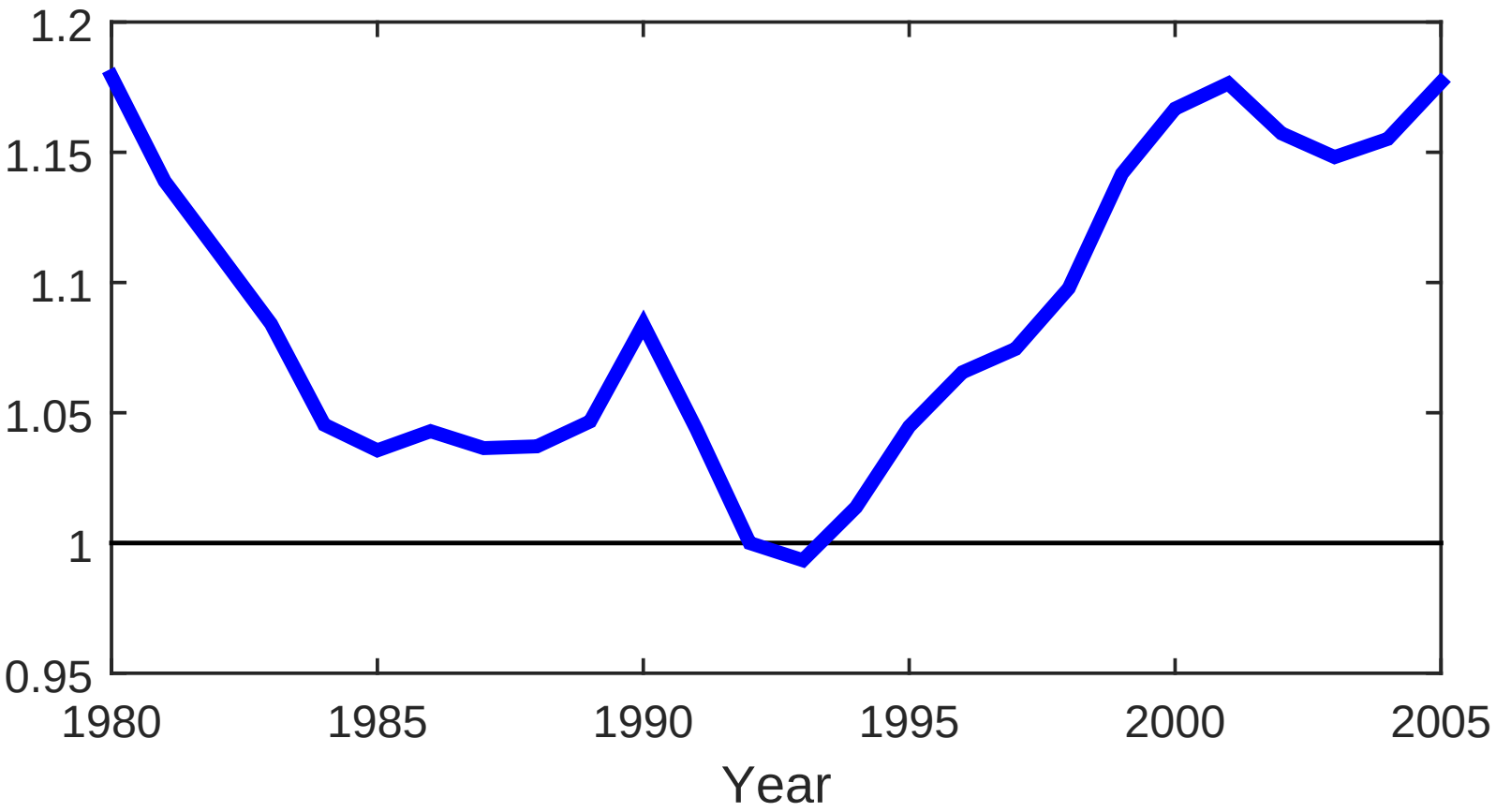
Facts—Labour supply

- Hours worked per adult went down by about 15 percent but then recovered and were about the same in 2005 as in 1980
- Interesting underlying demographic and labour supply facts:
  - Share of adults 16-65 went up: 58 to 68 percent
  - Employment rate went up: 59 percent to 69 percent.

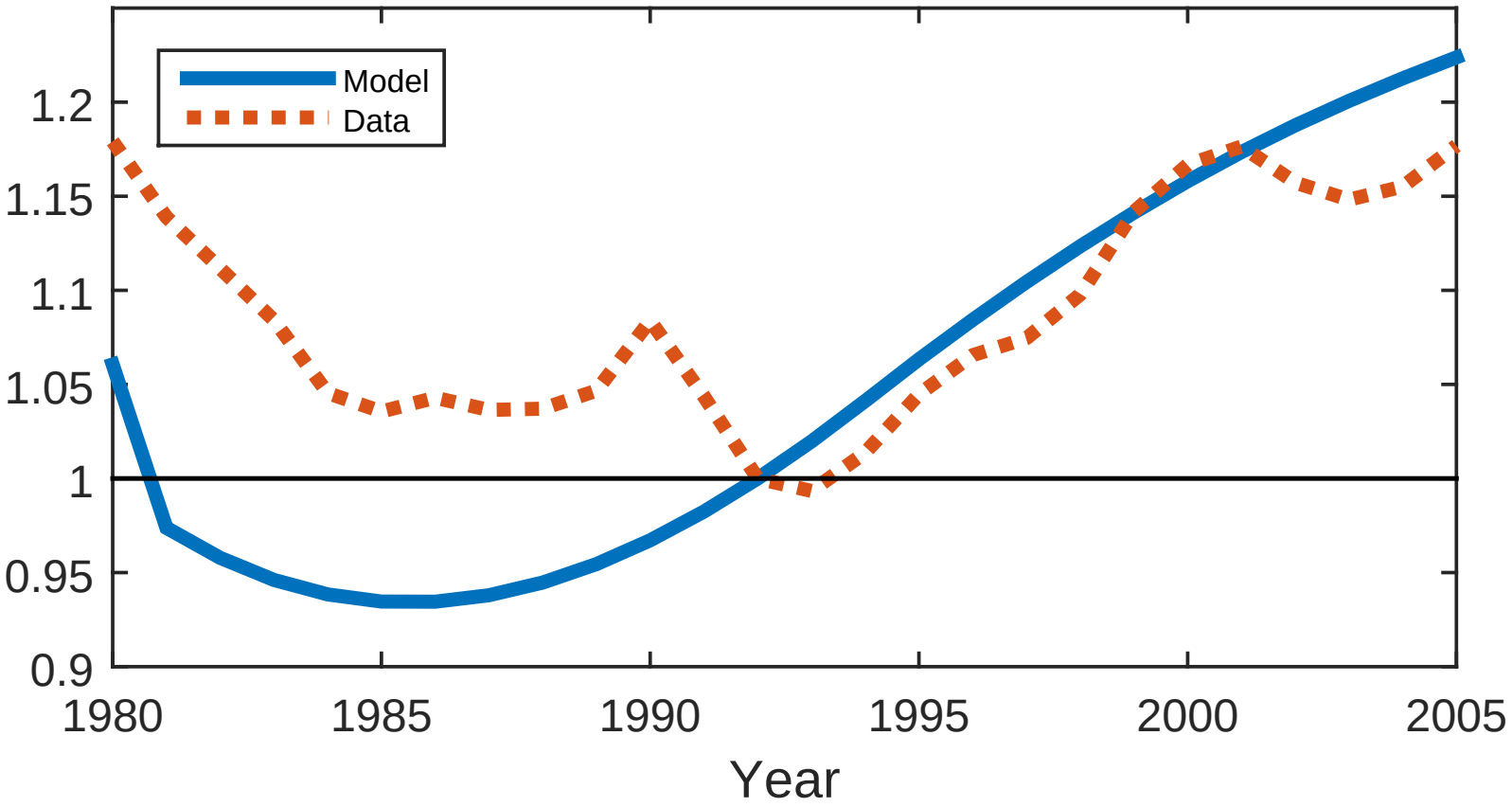
Facts—Labour supply

- Hours worked per adult went down by about 15 percent but then recovered and were about the same in 2005 as in 1980
- Interesting underlying demographic and labour supply facts:
  - Share of adults 16-65 went up: 58 to 68 percent
  - Employment rate went up: 59 percent to 69 percent.
  - Hours per worker went down (14-15 percent).

Hours worked (per adult)



Results—Hours per adult



Importance of Labour Supply Changes

- Q: What is the quantitative importance of labour supply for our analysis and conclusions?

Importance of Labour Supply Changes

- Q: What is the quantitative importance of labour supply for our analysis and conclusions?

- A(1): With low labour supply elasticity ($\epsilon = 0.25$), required TFP are larger (29.3% vs 23.0%).

Importance of Labour Supply Changes

- Q: What is the quantitative importance of labour supply for our analysis and conclusions?
- A(1): With low labour supply elasticity ($\epsilon = 0.25$), required TFP are larger (29.3% vs 23.0%).
- A(2): Accounting for changes in labour quality (via changes in years of education), required TFP changes are smaller (18.6% vs 23.0%).

Anticipation Effects

Q: What is the importance of perfect foresight for our findings?

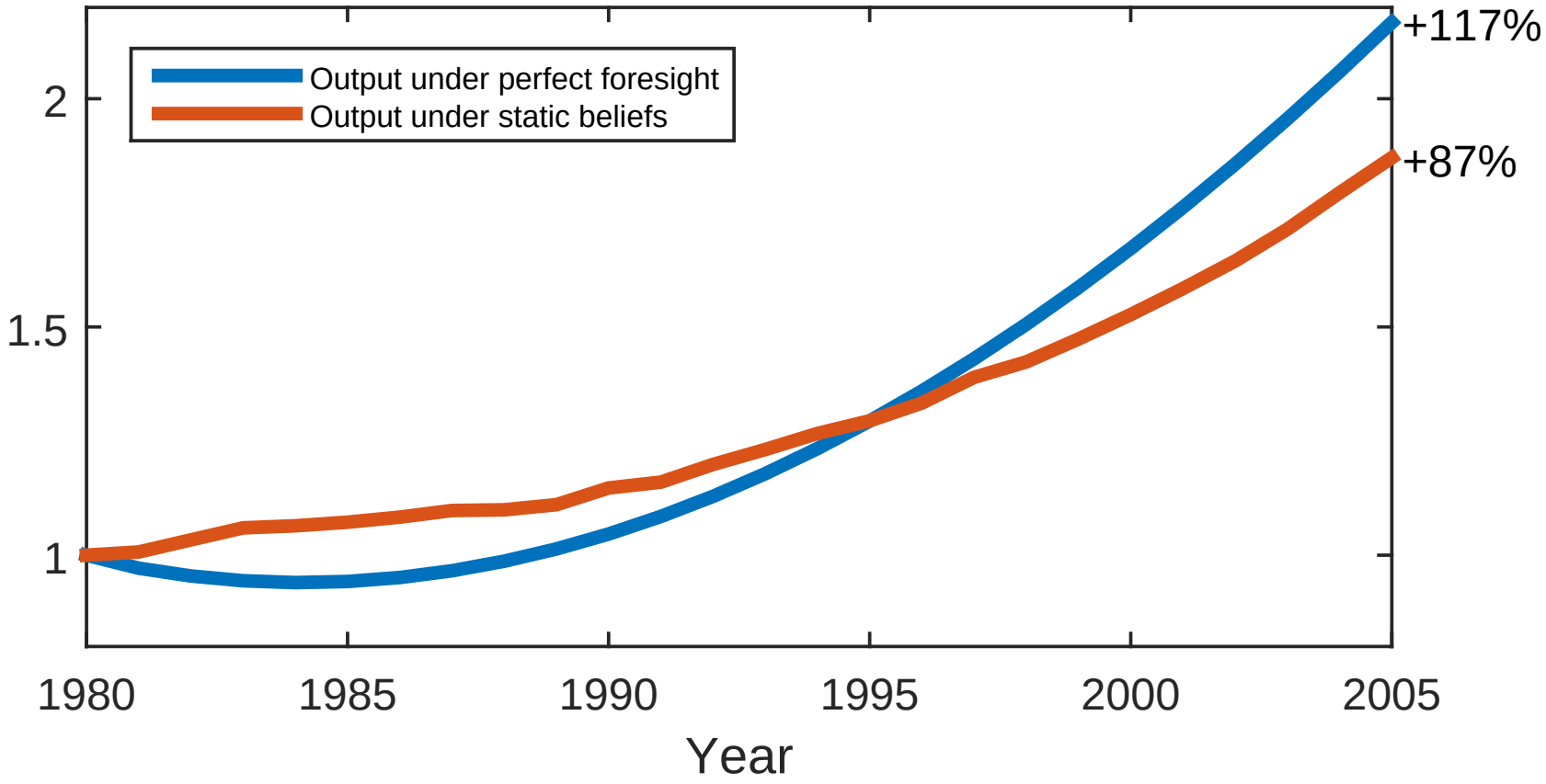
- We recompute equilibria and infer TFP values assuming each 'surprise' is permanent.
- At each date, we calculate the labour surtax rate that balances the intertemporal budget constraint.

Anticipation Effects

Q: What is the importance of perfect foresight for our findings?

- We recompute equilibria and infer TFP values assuming each 'surprise' is permanent.
- At each date, we calculate the labour surtax rate that balances the intertemporal budget constraint.
- We refer to this case as *'static beliefs'* case.

Anticipation Effects



Conclusions

- Tax reform mattered but not the major factor. This holds true even when the overall capital share is large and the economy is open.

Conclusions

- Tax reform mattered but not the major factor. This holds true even when the overall capital share is large and the economy is open.
- Openness appears of central importance. Same driving forces in closed economy lead to **less than half** of observed changes in output, and much lower welfare effects.

Conclusions

- Tax reform mattered but not the major factor. This holds true even when the overall capital share is large and the economy is open.
- Openness appears of central importance. Same driving forces in closed economy lead to **less than half** of observed changes in output, and much lower welfare effects.
- Perfect foresight matters

Conclusions

- Tax reform mattered but not the major factor. This holds true even when the overall capital share is large and the economy is open.
- Openness appears of central importance. Same driving forces in closed economy lead to **less than half** of observed changes in output, and much lower welfare effects.
- Perfect foresight matters
- What *really* happened in Ireland?
    - From the standpoint of our model, clearly we need to understand what led to changes in TFP.

Conclusions

- Tax reform mattered but not the major factor. This holds true even when the overall capital share is large and the economy is open.
- Openness appears of central importance. Same driving forces in closed economy lead to **less than half** of observed changes in output, and much lower welfare effects.
- Perfect foresight matters
- What *really* happened in Ireland?
  - From the standpoint of our model, clearly we need to understand what led to changes in TFP.
  - Changes in labour markets. Less industrial strife.

Conclusions

- Tax reform mattered but not the major factor. This holds true even when the overall capital share is large and the economy is open.
- Openness appears of central importance. Same driving forces in closed economy lead to **less than half** of observed changes in output, and much lower welfare effects.
- Perfect foresight matters
- What *really* happened in Ireland?
  - From the standpoint of our model, clearly we need to understand what led to changes in TFP.
  - Changes in labour markets. Less industrial strife.
  - Need deeper understanding of multinational production in dynamic settings. Interplay with EU integration.

AUXILIARY SLIDES

Model—resource constraint

Resource constraint/national budget constraint for the final good:

$$K_{t+1} + A_{t+1} + Z_{t+1} =$$
$$= (1 - \delta_k)K_t + (1 - \delta_z)Z_t + Y_t + R^a A_t - C_t - G_t$$

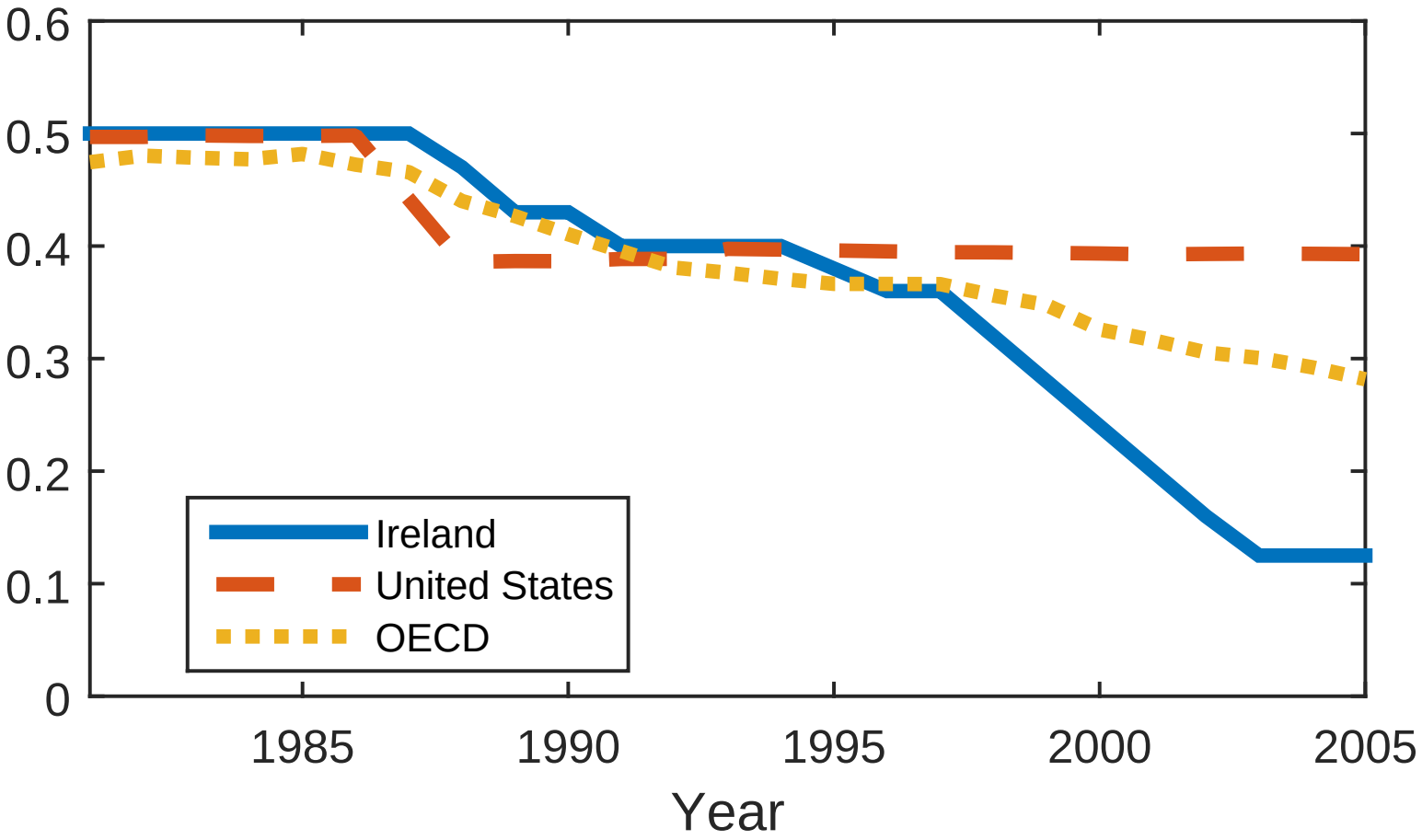
where A_t is the net foreign asset position (the aggregate counterpart of a_t).

Calibration Summary

β	Discount Factor $(1/R^a)$	0.961
θ_k	Share of Physical Capital	$1/3$
θ_z	Share of Intangible Capital	0.198
δ_k	Tangible Depreciation Rate	0.085
δ_z	Intangible Depreciation Rate	0.085
ε	Frisch Elasticity	0.75
α_s	Non-manufacturing Share	0.79
$1/(1-\xi)$	Substitution Elasticity Manufacturing vs Non-manufacturing	1.0
φ	Collateral Constraint	1.390

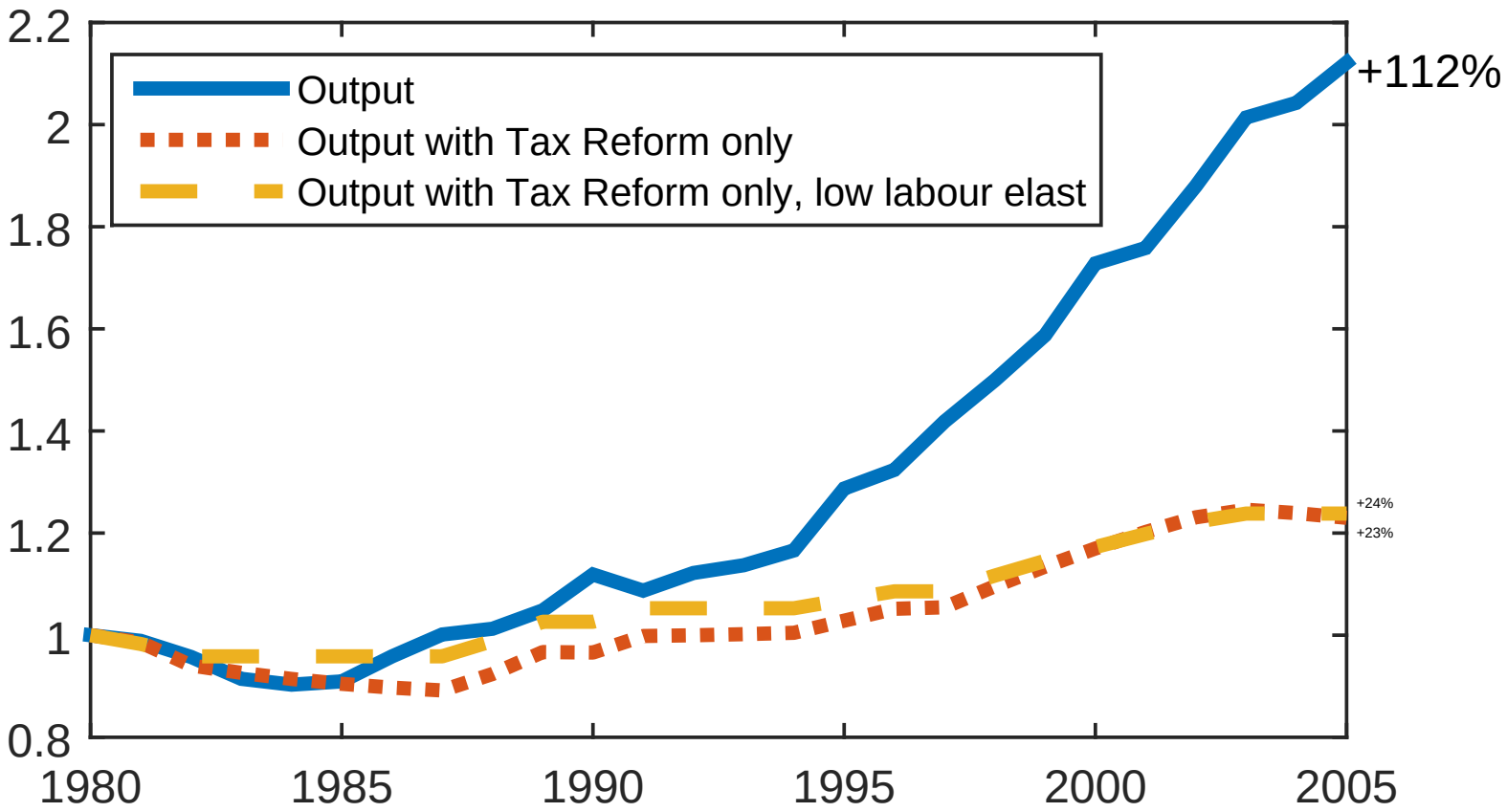
$\tau^{k,m}_{1980} = \tau^{z,m}_{1980}$	Manufacturing Tax Rate	0.10
$\tau^{k,s}_{1980} = \tau^{z,s}_{1980}$	Non-Manufacturing Tax Rate	0.50
$\tau^{k,m}_{2005} = \tau^{z,m}_{2005}$	Manufacturing Tax Rate	0.125
$\tau^{k,s}_{1980} = \tau^{z,s}_{2005}$	Non-Manufacturing Tax Rate	0.125
τ_{1980}	Labour Tax Rate in 1980	0.438
τ_{2005}	Labour Tax Rate in 2005	0.425

Tax rates



Source: OECD

Tax Reform and Labour Supply Elasticities



Tax Reform and Intangible Shares