Health & Working Time: A Macroeconomic Perspective on the American Puzzle

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"Mutual emulation and desire for a greater gain prompted them [workers] to over-work themselves, and to hurt their health by excessive labour" - Adam Smith, 1776

Warning

- Macroeconomists tell a story and show its plausibility
- Do not ask for a hard identification!
- There are plenty of explanations regarding the growing American health gap w.r.t. to other developed countries
  - Deaths of despair (Case & Deaton; 2015, 2017)
  - Smoking prevalence in the US
  - Inequality and access to health care

Originality

- We do not add an explanation of the American disadvantage in isolation to other phenomena
- We jointly explain that Americans have a poorer health and that they spend more in health care
- They work more (longer hours) and for a long time (at least 30-35 years)

The key link

- It appears there are some links between long hours of work and poor health
  - **Leisure and health**: Sickles & Yazbeck (1998); He, Huang & Hung (2013); Pressman et al. (2009)
  - **Work and health**: Sparks et al. (1997), White & Beswick (2003), Bamai & Tamakoshi (2014), Ruhm (2000, 2003,2007)
  - **Work and health behaviors**: Ruhm (1995, 2005), Ruhm & Black (2002), Berniell (2013), Ahn (2015)
- Bassanini & Caroli (2015) argue instead that the lack of control over one's hours of work is detrimental to health
  - Provided that the % of workers lacking control is not lower in the US than elsewhere, our story remains valid

Contribution

Can different preferences for leisure leading to a higher number of hours worked also explain the American health disadvantage despite the greater share of medical expenditure?

- We introduce health capital in a neoclassical exogenous growth model with endogenous labor supply
- The rate of depreciation of health capital is a positive function of individual labor supply
- We study how the steady state values of the variables of interest change with preferences for leisure

Outline

1. Stylized Facts
2. The Model
3. A (heroic) calibration
    - Counterfactual: the US with different preferences for leisure

Stylized Facts

A The overworked American

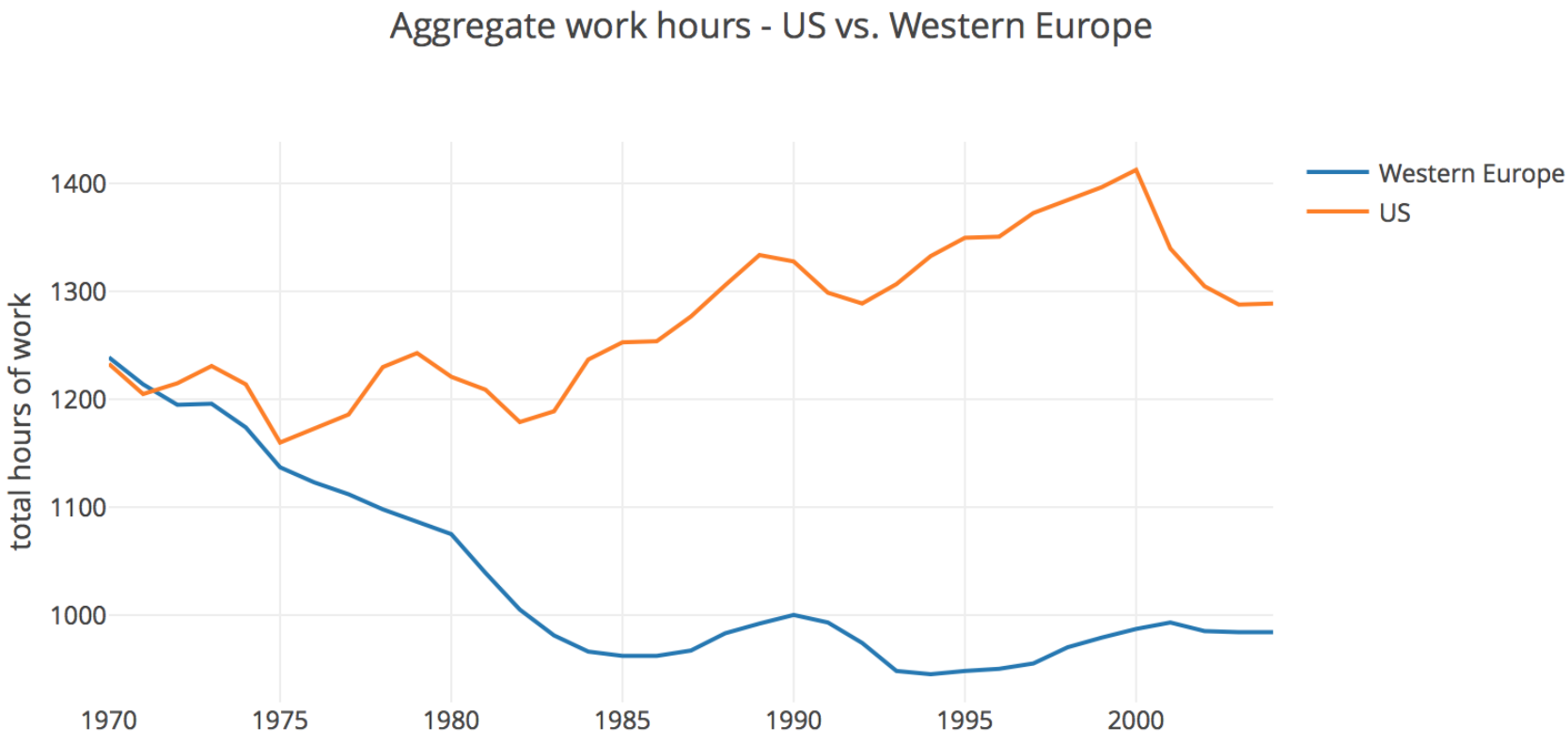
B The American health disadvantage

C The overspending American

The overworked American

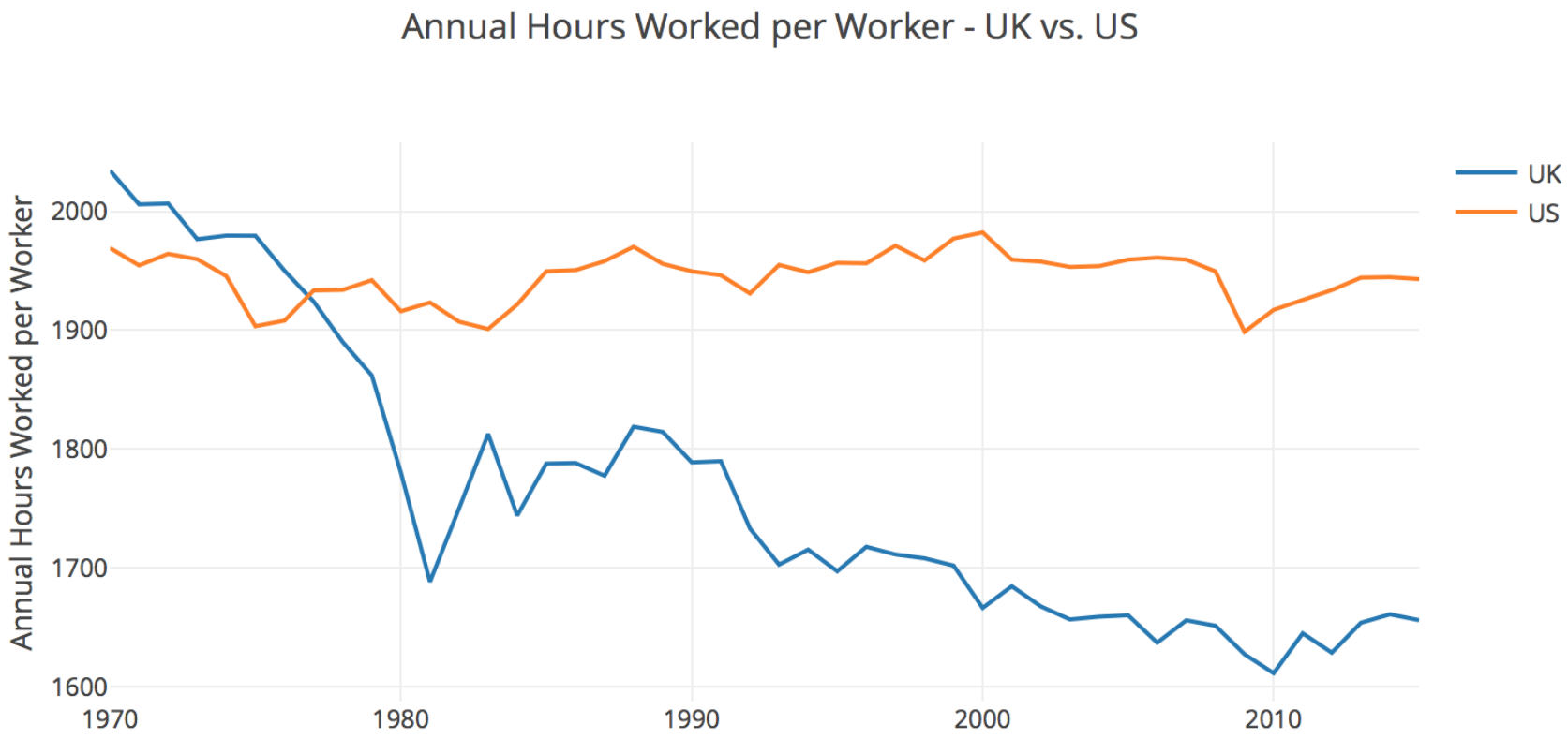
- Americans today work substantially more than European and the difference stems mostly from hours worked at the intensive margin (Bick et al, 2016)
- There is an ongoing debate about the reasons why
  - Prescott (2004): higher labor taxes in Europe dis-incentivize people to work and can account for all the difference in hours worked
  - Blanchard (2004): Europeans have used productivity gains to increase leisure rather than income
- Heterogeneity in preferences for leisure across countries, especially between Western Europe and the US (Bargain et al, 2012a)

The overworked American



Source: Ohanian, Raffo & Rogerson (2008)

The overworked American

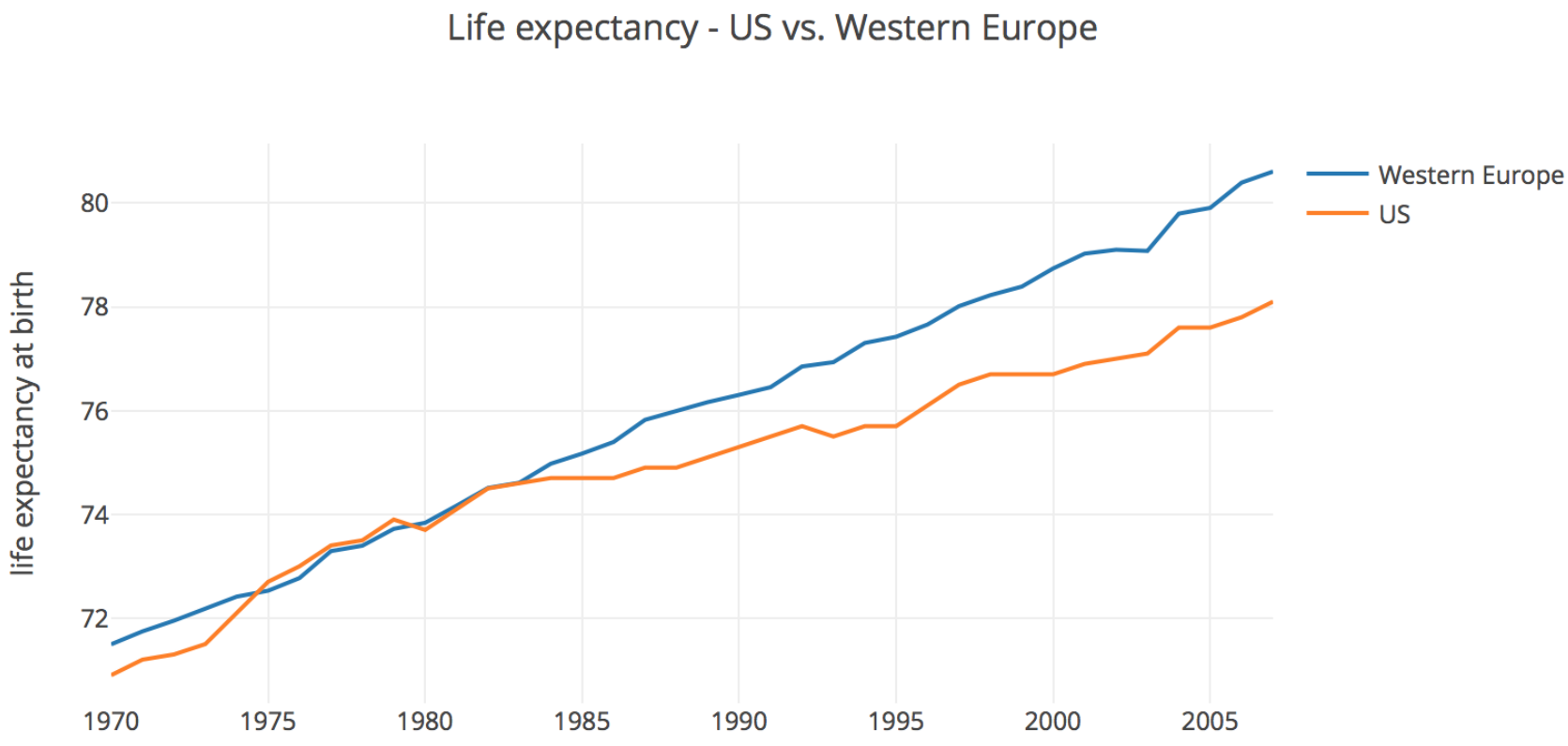


Source: Blundell, Bozio & Laroque (2011), extended by Bozio (2017)

The American health disadvantage

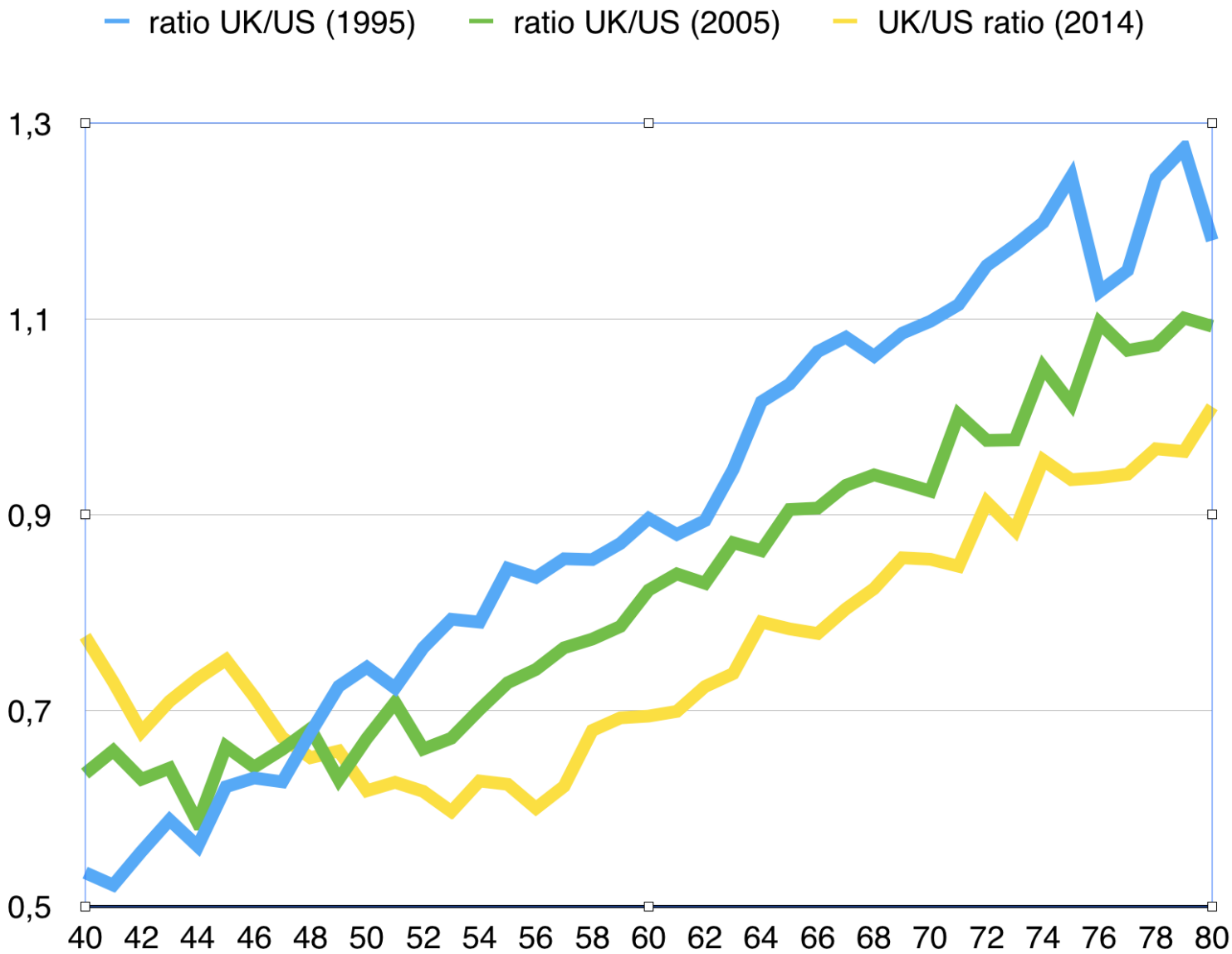
- Americans live shorter lives and are in poorer health throughout the life cycle (National Research Council, 2011; 2013) than their European counterparts
  - Americans report a greater disease burden: 30% higher for lung disease and myocardial infarction, 60% higher for heart disease and stroke, 100% for diabetes (Banks et al, 2006)
  - The disadvantage is pervasive across both age groups and the socio-economic distribution (Martinson et al, 2011a; Avendano et al, 2009, 2010; Crimmins et al, 2010; Glei et al, 2010)

The American health disadvantage



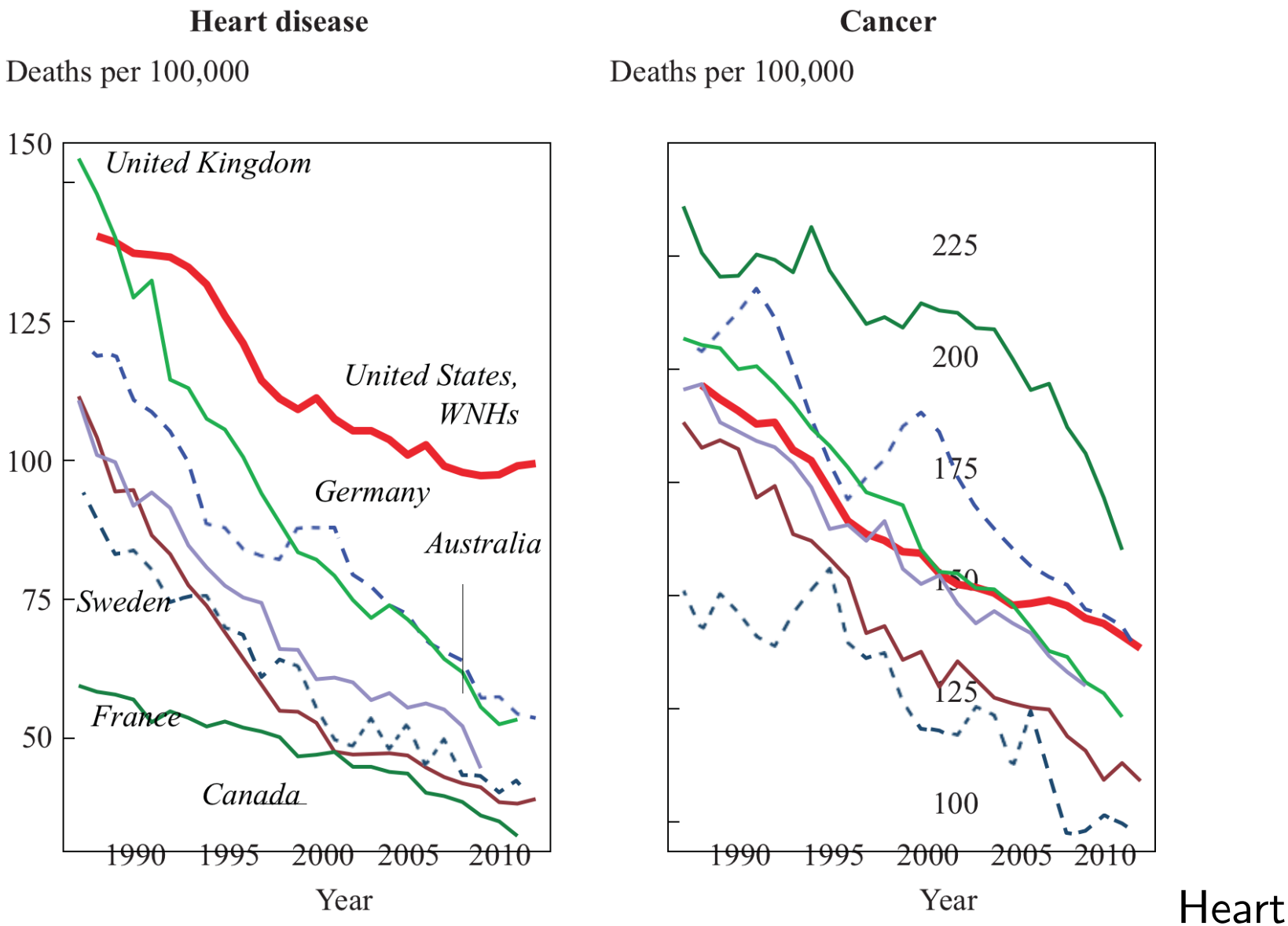
Source: OECD

The American health disadvantage



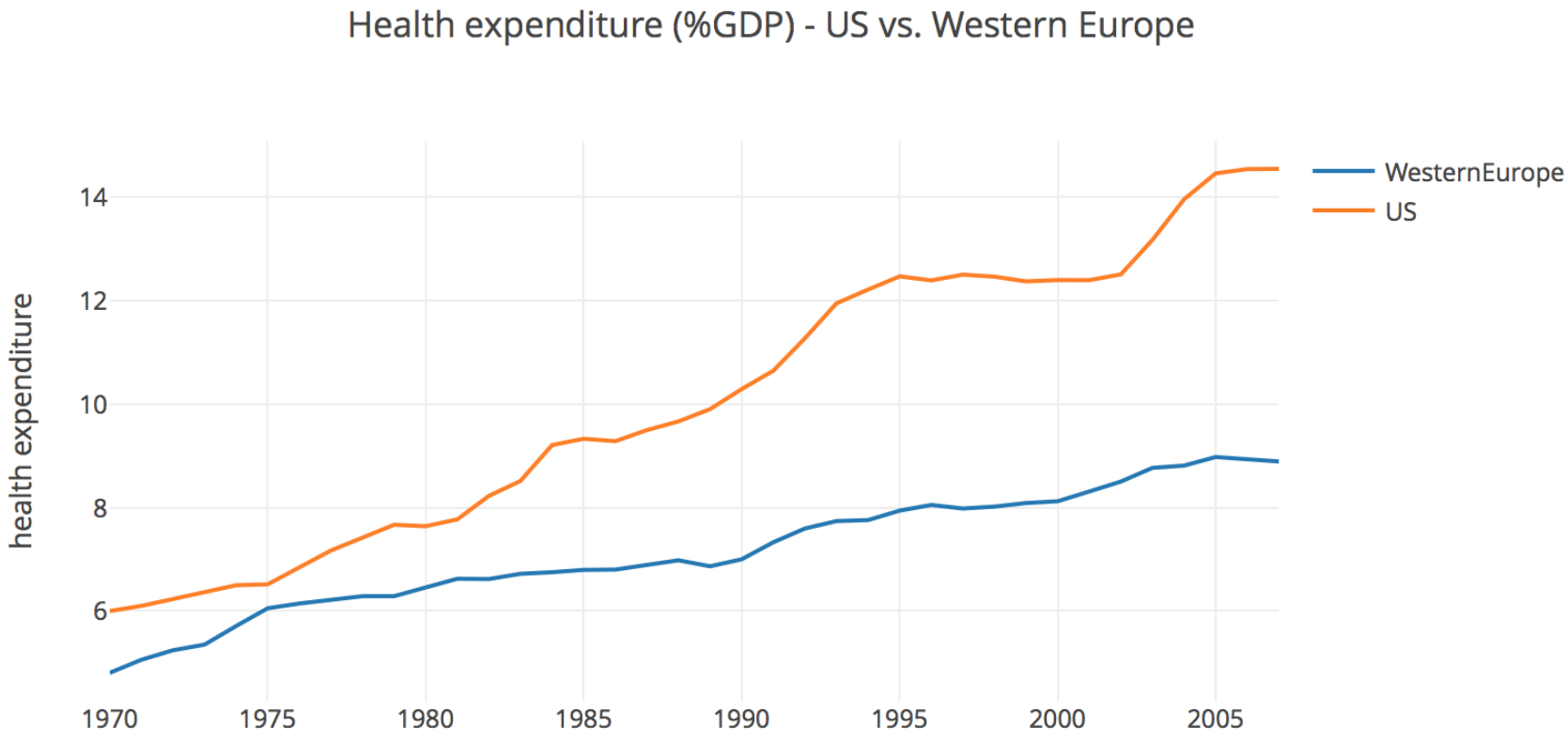
Mortality rates by age (UK/US). Source: HMD

The American health disadvantage



Heart Disease and Cancer Mortality by Country for Age 50-54, 1989-2014. (Source: Case & Deaton)

The overspending in health care



Source: OECD

The Model

Health capital

- We use Grossman's concept of health capital (1972)
  - Health as a capital stock that can be increased via medical investment and that depreciates over time.
  - We assume that its rate of depreciation δ_h is a function of individual labor supply

$$\dot{h(t)} = m(t)^{\sigma} - \underbrace{z \cdot l(t)^{\gamma}}_{\delta_h} \cdot h(t)$$

  - We assume medical investments are subject to decreasing returns ($\sigma < 1$) and that δ_h is a convex function of labor supply ($\gamma > 1$)

Health capital (ctd.)

- The general solution to the differential equation for health capital is:

$$h(t) = h_0 e^{-L(t)} + \int_0^t m(s)^\sigma e^{-L(s)} ds$$

where $L(t) = \frac{z}{1+\gamma} \int_0^t l(s)^{1+\gamma} ds$ and $L(t) = \frac{z}{1+\gamma} \int_s^t l(\tau)^{1+\gamma} d\tau$

- Medical expenditure in period s is discounted by the amount of work between periods s and t
  - Past hours of work lower the effect of health expenditure in later periods

Firms

- Firms produce a unique final good using a Cobb-Douglas technology:

$$y(t) = k(t)^{\alpha} l(t)^{1-\alpha}$$

- This final good can be used for consumption $c(t)$ or medical investment $m(t)$.

- Firms' optimization yields the usual first order conditions:

$$\begin{aligned} r(t) &= \alpha k(t)^{\alpha-1} l(t)^{1-\alpha} - \delta \\ w(t) &= (1-\alpha) k(t)^{\alpha} l(t)^{-\alpha} \end{aligned}$$

Households

- Households derive utility from consumption $c(t)$ and their health status $h(t)$, but dislike working $l(t)$

$$u(c, h, l) = \nu \cdot \log[c(t)] + (1 - \nu) \cdot \log[h(t)] - \phi \cdot l(t)$$

- They get income from the labor they supply $l(t)$ and the assets they hold $a(t)$, use it to consume $c(t)$ and purchase medical care $m(t)$ and save the rest

$$\dot{a(t)} = w(t)l(t) + r(t)a(t) - c(t) - p \cdot m(t)$$

First order conditions

- The households' utility maximization problems gives the familiar Euler equation for consumption:

$$\frac{\dot{c}(t)}{c(t)} = r(t) - \rho$$

- But also two novel features of the model:

$$\frac{\dot{m(t)}}{m(t)} = \frac{1}{1-\sigma}\left[r(t) + \delta_h(t) - \frac{\sigma}{p}m(t)^{\sigma-1}\text{MRS}_{h,c}\right]$$

$$\text{MRS}_{l,c} = w(t) - \frac{p}{\sigma}m(t)^{1-\sigma}l(t)^{\gamma-1}h(t)$$

Long run analysis

Health Expenditure

- How do health expenditure vary with preferences for leisure?

$$\frac{\partial(p\cdot m/y)^{\star}}{\partial l(\phi)^{\star}} = \left[\frac{(1-\alpha)\delta+\rho}{\rho+\delta}\left(\frac{\alpha}{\delta+\rho}\right)^{\frac{\alpha}{1-\alpha}}\right]\frac{\gamma\sigma(1-\nu)\nu\rho z l(\phi)^{\star\,\gamma-1}}{([\sigma(1-\nu)+\nu]z l(\phi)^{\star\,\gamma}+\nu\rho)^2} > 0$$

Proposition 1

Medical expenditure as a share of GDP decreases with preferences for leisure ϕ.

Health Capital Stock

- How does the health capital stock vary with preferences for leisure?

$$h^{\star} = \frac{1}{z}\left[\left(\frac{1}{p}\right)\frac{(1-\alpha)\delta+\rho}{\rho+\delta}\left(\frac{\alpha}{\delta+\rho}\right)^{\frac{\alpha}{1-\alpha}}\right]^{\sigma}\left[\frac{\sigma(1-\nu)}{z[\sigma(1-\nu)+\nu]I^{\star\gamma}+\nu\rho}\right]^{\sigma} I(\phi)^{\star(1+\gamma)\sigma-\gamma}$$

  - The sign of the derivative is ambiguous and ultimately depends on the returns to health investments σ

Proposition 2

There exists a unique value $0 < \sigma^{\star} < 1$ *below which the steady state health capital stock increases with preferences for leisure* ϕ.

Calibration exercise

Health capital parameters

- $\delta_h = z \cdot I^{\gamma}$: Scholz & Seshadri (2010) take a value of 5%; Lawver (2012) between 0 and 5%
  - We choose $\delta_h = 2.5\%$ as a benchmark and let it vary
  - We set $\gamma = 2$ to have a unique root and calibrate z accordingly
- We set σ between 0.7 and 0.9 to indicate decreasing returns
  - $\sigma = 0.8$ as a benchmark

Health capital and mortality

- We also need to draw a relation between the steady state health capital stock $h^\star$ and mortality rates
  - To do so, we use a logistic function

$$T = \frac{T_0}{T_0 + (1 - T_0)\,\mathrm{e}^{-\psi \cdot h^\star}}$$

  - $T \in [0; 1]$ can be interpreted as a survival probability
  - T_0 is the survival probability without any health capital
- We then calibrate the parameter ψ to match the survival probability between age 55-64 in the US

Calibration

- We want to investigate the effect of a reduction in hours worked on both the share of health expenditure and the health capital stock
- To do so we calibrate the model to the US economy, and especially:
  - ν (relative taste for consumption) to match the average share of health expenditure: 16.5%
  - ϕ (preferences for leisure) to match the fraction of time spent in market work: 0.334

Calibration

- Other parameters are calibrated as is standard in the literature

Parameter		Target	US
α	Capital share	Capital/output ratio	0.3
δ	Capital rate of depreciation	Investment/output ratio	0.08
ρ	Discount factor	Interest rate	0.04
γ	Health capital depreciation	Chosen	2
σ	Returns to health investment	Chosen	[0.7 ; 0.9]
z	Scaling parameter	US rate of depreciation	[0.09 ; 0.45]
p	Relative price of health care goods	OECD data	1.24
T_0	Survival probability without health capital	Mortality rates 1810	0.934
ψ	Steepness of the logistic function	Survival probability (age 55 - 64)	0.077
ν	Relative preferences for consumption	Share of health expenditure	0.539
ϕ	Preferences for leisure	Hours worked	0.213

A reduction of hours worked in the US

- What if Americans worked as much as Europeans?
- We re-calibrate preferences for leisure ϕ to match not American but European labor supply
  - We choose the UK as our benchmark European country: $l^{\star}_{uk} = 0.284 < l^{\star}_{us} = 0.334$
- We then solve for the share of medical expenditure and the health capital stock at the steady state

A reduction of hours worked in the US

- In our baseline calibration, if Americans worked as much as Britons, their share of health expenditure would be of 13.9% instead of 16.5%
- The steady state health capital stock also increases, which translates into lower mortality rates and thereby into a greater survival probability
  - Around 140 deaths per thousand of people aged 55-64 per year would be avoided
- We do the same exercise for different values of the rate of depreciation of health capital the returns to medical investment
  - Only when $\delta_h = 1\%$ and $\sigma = 0.9$ the reduction in hours worked actually increases mortality rates

Robustness checks

Specification		Health expenditure[1]	Mortality[2]
	$\sigma = 0.7$	3.2	143
$\delta_h = 1\%$	$\sigma = 0.8$	3.2	50
	$\sigma = 0.9$	3.2	-43
	$\sigma = 0.7$	2.6	220
$\delta_h = 2.5\%$	$\sigma = 0.8$	2.6	138
	$\sigma = 0.9$	2.6	56
	$\sigma = 0.7$	2	298
$\delta_h = 5\%$	$\sigma = 0.8$	2	228
	$\sigma = 0.9$	2	158

[1]: Reduction in the share of health expenditure (p.p.);
[2]: Lives saved per hundred thousand people

Conclusion

- We build an exogenous growth model with elastic labor supply and health capital that depreciates with work to answer several questions
- Theoretically, a higher number of hours worked increases the share of resources devoted to health care and potentially lowers the health capital stock, provided the returns to health investment are not high enough
- The calibrated model predicts that Americans could reduce their share of medical expenditure and improve mortality rates of workers by reducing the number of hours they work