R&D Tax Credit and Declining Business Dynamism

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Outline

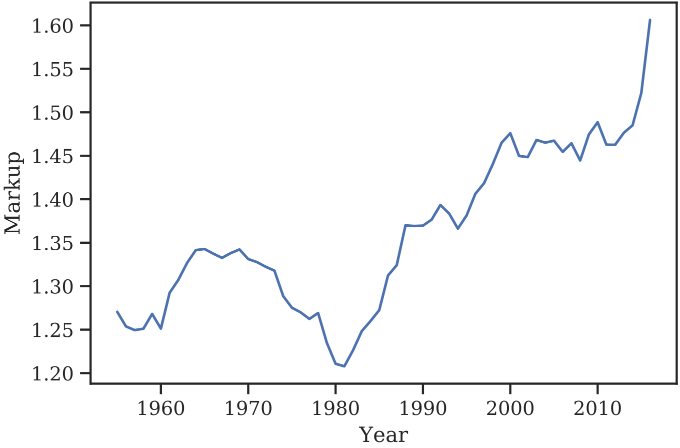
Introduction

Motivation

The U.S. economy has changed during the past decades.

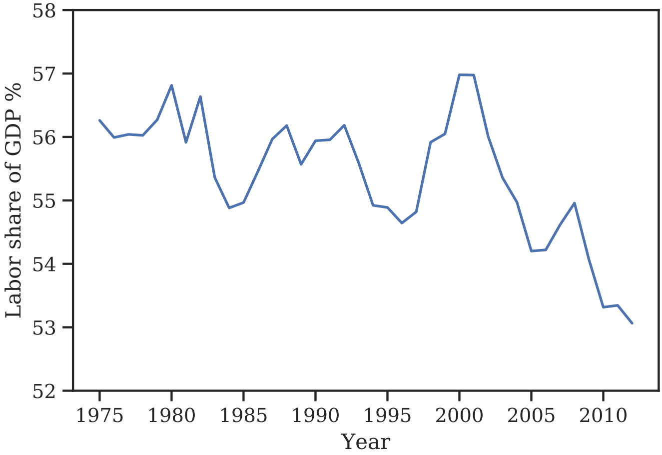
- The economy has become more concentrated.
- Average markup rate has risen over time. Figure
- Profit share of GDP has recovered at the level in 1970s.
- Labor share of GDP has been decreasing over time. Figure
- The formation rate of new firms has slowed down. Figure

Increase in the average markup



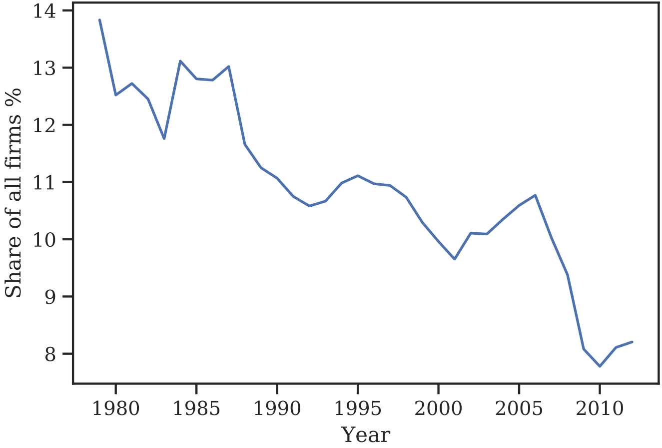
Source: De Loecker and Eeckhout (2017) Back

Decline in the labor share in the U.S.



Source: Karabarbounis and Neiman (2013) Back

Startup rate has been decreasing in the U.S.



Source: U.S. Census Bureau Business Dynamics Statistics Back

Research Question

We consider

- What is the cause of these phenomena?
- How does it affect the welfare?

Study the impact of R&D Tax Credit on them quantitatively.

Research and Development Tax Credit

- It takes 11 billion dollars in 2012.
- 4.4% of company-funded domestic R&D in 2013. Detail
- Impullitti (2010) shows that government financial support to the private R&D, when converted to subsidies
  - from 6% in 1979 to 18% in 1991

Pros of R&D Tax Credit

- Increases R&D expenditure
  - 10% fall in tax price of R&D leads to a 10% increase in R&D. (Bloom, Van Reenen, and Williams (2019))
- Increases total employment growth of establishments (Lucking (2019))

Cons of R&D Tax Credit

- Non-refundability of R&D Tax Credit
  - useful for only firms with taxable profit
- Partially offset by induced higher wages. (Aerts (2008),Goolsbee (1998))

Asymmetric impact on incumbents and entrants.

Contribution

Explicitly emphasize the role of government.

Three closest papers.

- Decline in the knowledge diffusion: Akcigit and Ates (2019)
- IT improvements: Aghion et al. (2019)
- Decline in the interest rate: Liu, Mian, and Sufi (2019)

Related Literature

Decline in business dynamics

- Aghion et al. (2019), Akcigit and Ates (2019), Liu, Mian, and Sufi (2019), De Loecker and Eeckhout (2017), Autor et al. (2017), Karahan, Pugsley, and Șahin (2019)

R&D Tax Credit

- Goolsbee (1998), Aerts (2008), Lokshin and Mohnen (2013), Romer (2000), Acemoglu et al. (2018)
- Impullitti (2010), Lucking (2019), Wilson (2009), Dechezleprêtre et al. (2016), Bloom, Van Reenen, and Williams (2019)

Model

Consumer

Representative consumer maximizes their utility

$$\sum_{t=0}^{\infty} \beta^t \ln(C_t)$$

subject to

$$A_{t+1} + C_t = (1 + r_t)A_t + w_t^p L^p + w_t^s L^s - T_t$$

Labor markets for workers and scientists are different.

Final Goods Producers

The final goods is in the competitive market, given the following technology.

$$\ln Y_t = \int_0^1 \ln y_{jt} \, dj$$

This technology leads to the intermediate goods demand.

$$y_{jt} = \frac{Y_t}{p_{jt}}$$

Intermediate Goods Producers - Static Problem

- Intermediate Goods Producer j's technology

$$y_{jt} = q_{jt} l_{jt}^{p}$$

- A leading-edge firm follows a limit pricing.

$$p_{jt} = \frac{w_t^p}{q_{jt}^F}$$

- The equilibrium markup rate

$$\mu_{jt} = \frac{p_{jt}}{w_t^p / q_{jt}} = \frac{q_{jt}}{q_{jt}^F}$$

R&D technology

A successful innovation increases products' quality by $\lambda > 1$

- Incumbents' R&D technology and cost

$$x_{jt} = \alpha(\ell_{jt}^{s})^{\gamma}$$

$$C_I(x_{jt}) = (1 - s) w_t^s \alpha^{-\frac{1}{\gamma}} x_{jt}^{\frac{1}{\gamma}}$$

- Potential entrants's R&D technology and cost

$$x_t = \alpha \left(\frac{\ell_t^s}{\bar{\mu}_t} \right)^{\gamma}$$

$$C_E(x_t) = w_t^s \bar{\mu}_t \alpha^{-\frac{1}{\gamma}} x_t^{\frac{1}{\gamma}}$$

where $\bar{\mu}_t = \int \lambda^{\Delta_{jt}} \, dj$.

Incumbents

Since R&D decision is dynamic, incumbents' Bellman equation

$$V_{It}(\Delta_t) = \max_{x_{It}} \left\{ \pi(\Delta_t) - C(x_{It}) + \frac{1}{1 + r_{t+1}} (1 - p(\Delta_t))\, S_{t+1}(\Delta_t, x_{It}) \right\}$$

The continuation value of incumbents consists of two parts.

$$S_{t+1}(\Delta_t, x_{it}) = \underbrace{(1 - x_{It}) V_{It+1}(\Delta_t)}_{\text{Fails to R\&D}} + \underbrace{x_{It} V_{It+1}(\Delta_t + 1)}_{\text{Successful innovation}}$$

replacement

Entrants

There are a unit measure of potential entrants.

After the successful innovation, entrants can randomly enter the market.

The maximization problem for potential entrants is

$$\max_{x_{Et}} \left\{ \frac{1}{1 + r_{t+1}} x_{Et} V_{t+1}(1) - C(x_{Et}) \right\}$$

Quantitative Analysis

Calibratied Parameters

Table 1: Calibration

Description	Parameters	Values
Number of scientists	L^s	0.0256
Subjective discount factor	β	0.95
Innovation elasticity	γ	0.5
Innovation efficiency	α	1.65
Innovation step size	λ	1.04
Weight function parameter	χ_1	4.78
Weight function parameter	χ_2	0.168

Moments Comparison

Table 2: Comparison between U.S. data and the model

Description	Data	Model	Source
Profit share of GDP	7.97%	7.97%	NIPA
Growth rate of output	1.45%	1.45%	Fernald(2014)
Average markup	1.24	1.24	DLE(2017)
Entry rate	14.35%	14.35%	BDS

Quantitative results

Table 3: The effect of R&D tax credit

Moments	$s = 0.06$	$s = 0.18$
Profit share of GDP	7.97%	8.98%
Growth rate of output	1.45%	1.453%
Average markup	1.24	1.307
Entry rate	14.35%	12.83%
Wage for workers	0.848	0.821
Wage for scientists	1.946	2.297
Skill premium	2.29	2.796

Mechanism

- Incumbents increase R&D due to higher R&D subsidy.
- Higher scientists demand increases their wage.
- The rise in wage discourages entrants' innovation, the entry rate decrease.
- The market becomes more concentrated.
- Change of R&D decisions induces the larger markup.
- Higher markup distorts allocations

Welfare loss

R&D tax credit leads to

- allocative inefficiency
- slightly higher aggregate growth rate

We evaluate how these affect the welfare by CEV.

- allocative inefficiency leads to 0.88% decline in consumption
- higher aggregate growth rate is equal to 0.05% rise in consumption

Conclusion

Since 1980s, the U.S have experienced the decline in business dynamism.

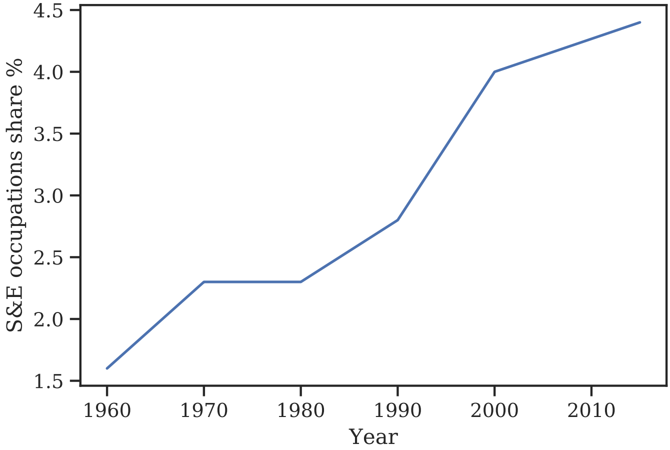
R&D Tax Credit can explain

1. 30.4% of the increase in markup
2. 41.7% of the decline in the entry rate

Although it increases TFP, it also generates about 0.8% welfare loss due to allocative inefficiency.

Appendix

Scientists and engineers share has risen over time



Source: National Science Board (2018)

Effect of an increase in L^s

Table 4: Sensitivity Analysis

Moments	Baseline	Experiment 1	Experiment 2
Profit share of GDP	7.97%	8.98%	8.66%
Growth rate of output	1.45%	1.453%	1.87%
Average markup	1.24	1.307	1.343
Entry rate	14.35%	12.83%	16.17%
Wage for workers	0.848	0.821	0.812
Wage for scientists	1.946	2.297	1.448
Skill premium	2.29	2.796	1.782

Institutional details of the R&D Tax Credit

- Only *Incremental* R&D cost is eligible.
  - The base is average R&D in the previous 3 years
  - Since 1990, the base becomes average R&D-sales ratio over the last 3 years
- The amount of tax credit is 20% of the incremental R&D expenditure.
- Excludes
  - durable assets
  - overhead expenses
  - fringe benefit

back

Replacement by creative destruction

As in Mukoyama and Osotimehin (2019), we assume potential entrants are more likely to innovate products with small productivity gap.

probability that incumbents are taken over depends on the technological gap, $p(\Delta)$.

$$p(\Delta) \equiv \frac{\omega(\Delta)}{\bar{\omega}} \kappa$$

The aggregate probability is equal to the replacement probability due to creative destruction

$$\int p(\Delta)\, f(\Delta)\; d\Delta = \kappa$$

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Functional Form

$$\omega(\Delta) = 1 + \chi_1 \exp(-\chi_2 \Delta)$$

χ_1 determines the ratio of the replacement probabilities of firms with large gaps to those with small gaps.

χ_2 represents the slope of the replacement probability relative to the productivity gap.