Open Policy Analysis: A Case Study of the Minimum Wage Policy Estimate

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Berkeley Initiative for Transparency in the Social Sciences

Congressional Budget Office, March 2018

Slides at

`http://www.github.com/fhoces/CBO2018`

Outline

1 Motivation

2 Approach

3 Description of Case Study

4 Guidelines

5 Application

6 Sensitivity Analysis

7 Discussion and Next Steps

Motivation

OPA - Minimum Wage

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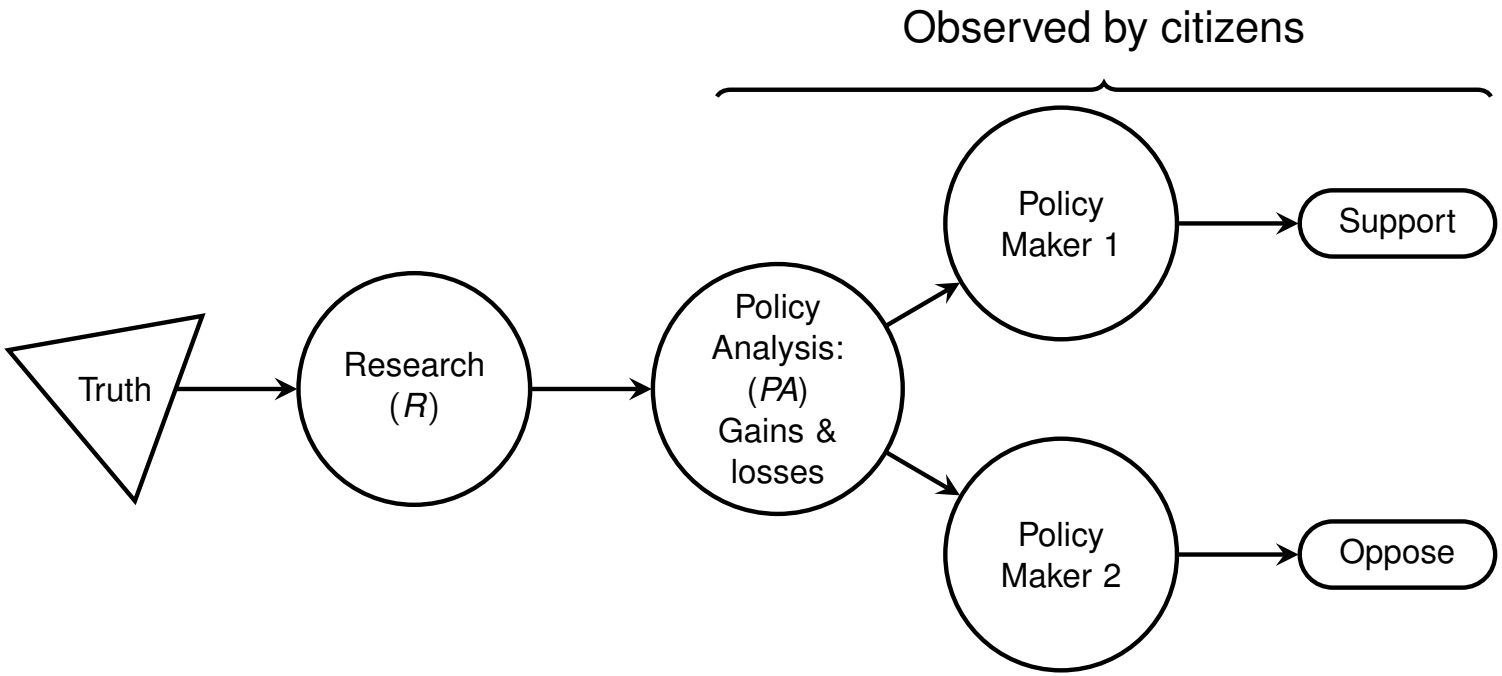
Approach
Case Study
Guidelines
Application
Sensitivity Analysis
Discussion

- Manski
- Report Wars
- Hoces de la Guardia, Grant & Miguel

Ideal Connection Between Evidence and Policy



Current Connection Between Evidence and Policy

OPA - Minimum Wage

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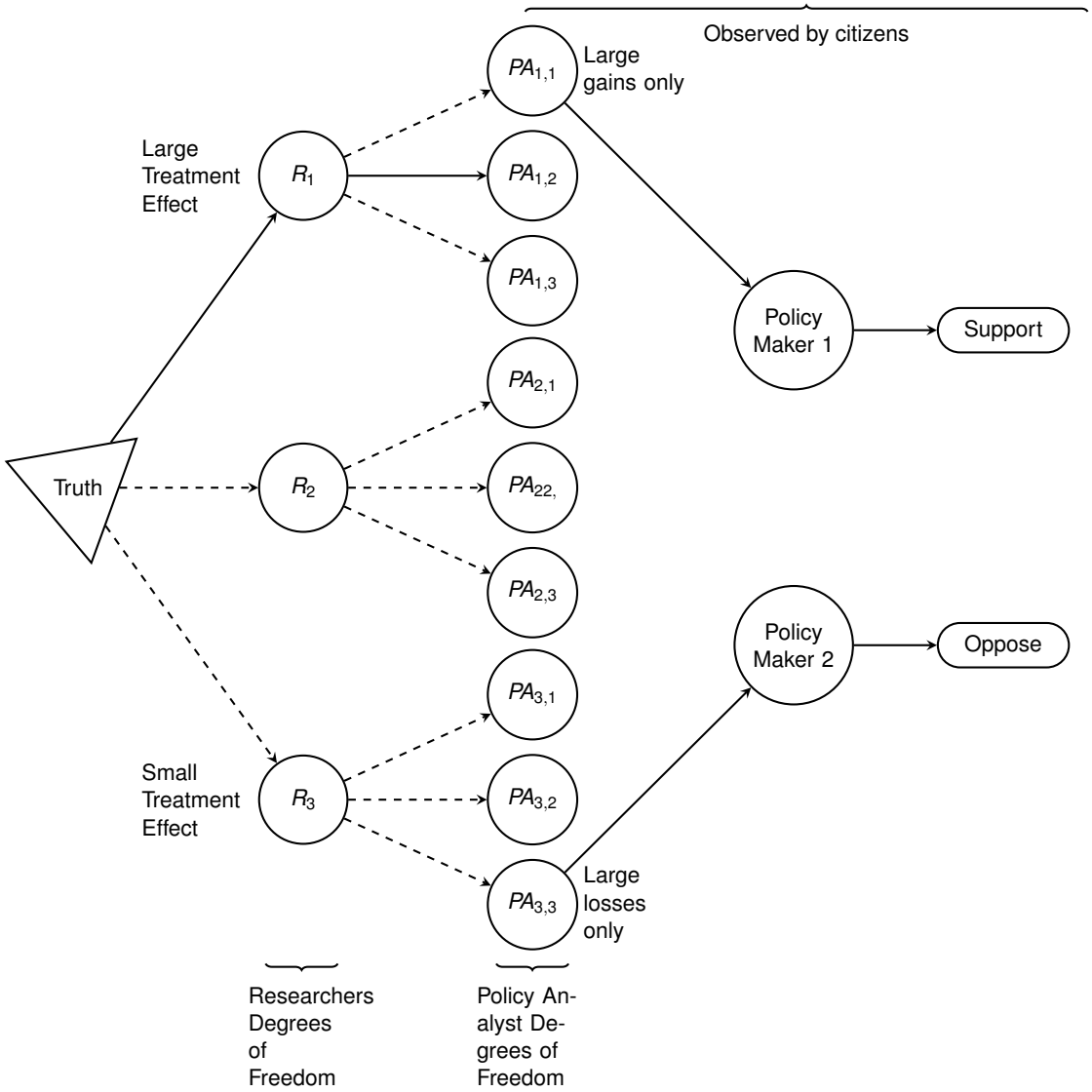

Approach

OPA - Minimum Wage

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- Identify a case study
- Define guidelines
- Demonstrate how to achieve highest standards of OPA
- Use sensitivity analysis to explore biggest policy unknowns
  - Surprisingly academic debate around one specific parameter seems less relevant from policy perspective

Description of Case study

"The Effects of a Minimum-Wage Increase on Employment and Family Income" Congressional Budget Office (2014)

Description: CBO estimated the effects of a raise in the federal minimum wage from $7.25/hr to $10.10/hr.

Main policy estimates:

- 500,000 jobs would be lost.
- 16.5 million workers would receive a salary increase.
- Distributional effects: below poverty line (PL) +$5billion; between one and three PL +$12billion; between three and six PL +$2billion; above six PL -$17billion

Key research estimate: Elasticity of labor demand for teenagers in the labor force.

Reasons for Selecting the Case Study

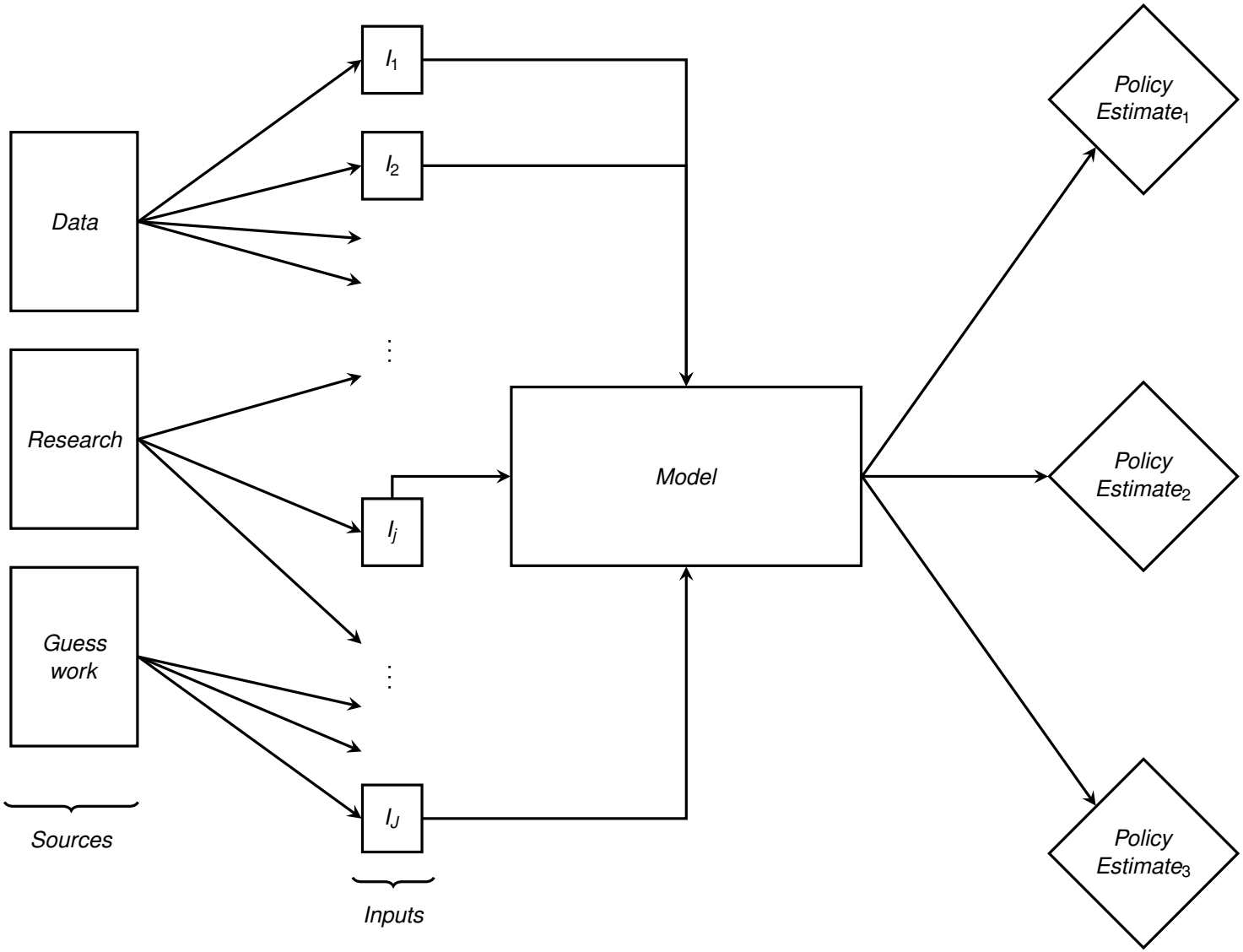
- *Scalable*: CBO's reputation: among the most transparent and rigorous policy analysis offices. Lessons from TR that apply to CBO should apply also to most agencies. Additionally the policy issue is widely known which facilitates parallels.
- *Recurrent*: This policy analysis will be conducted again in the future. The case study can be directly used in future calculations.

Reasons for Selecting the Case Study

- *Feasible*: available data, good description of the analysis, and only one policy lever to analyze.
- *Relevant*:

Figure: Google Search Intensity of “Minimum Wage”

Guidelines Goal: Reproducibility & Transparency



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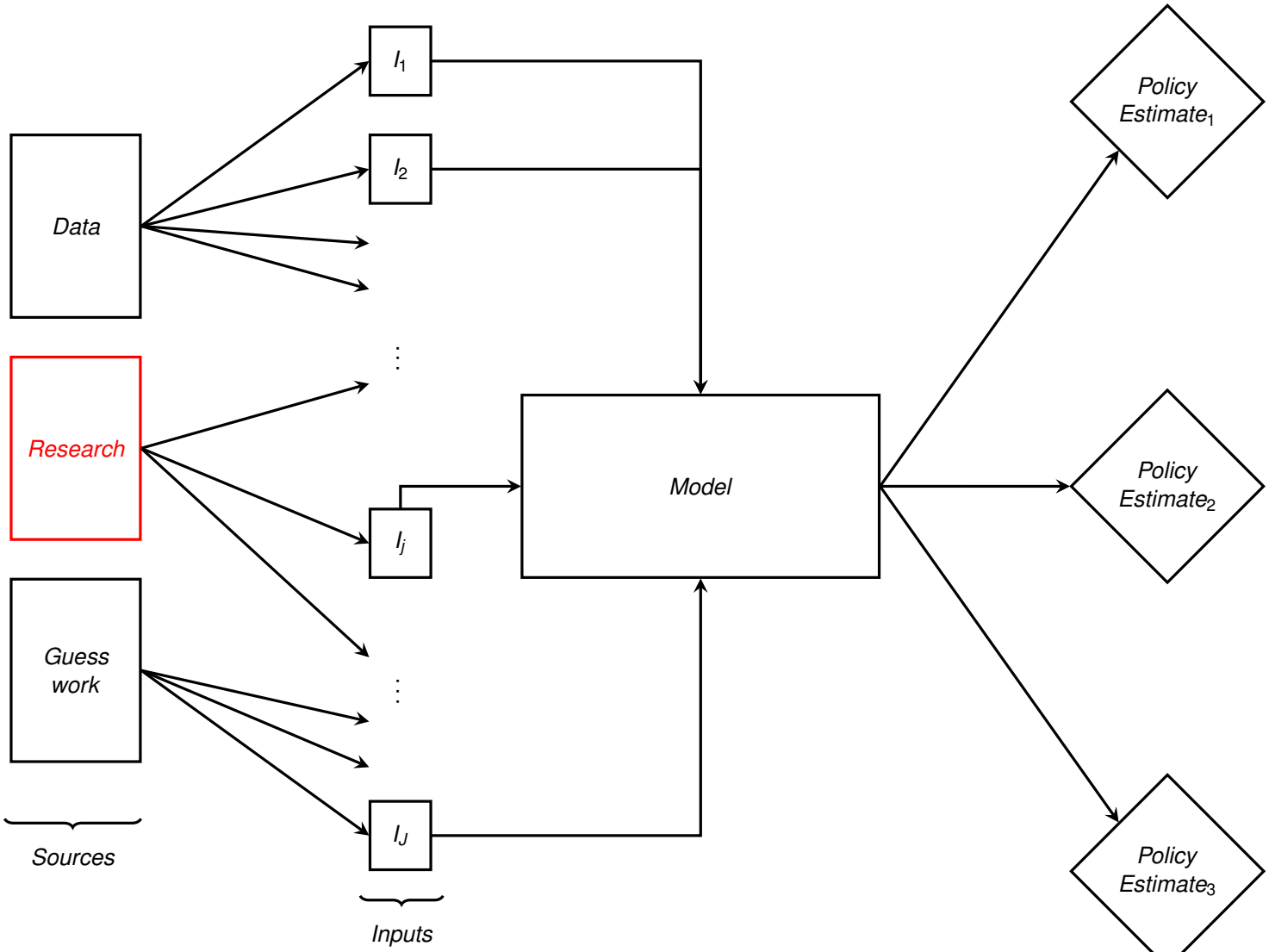

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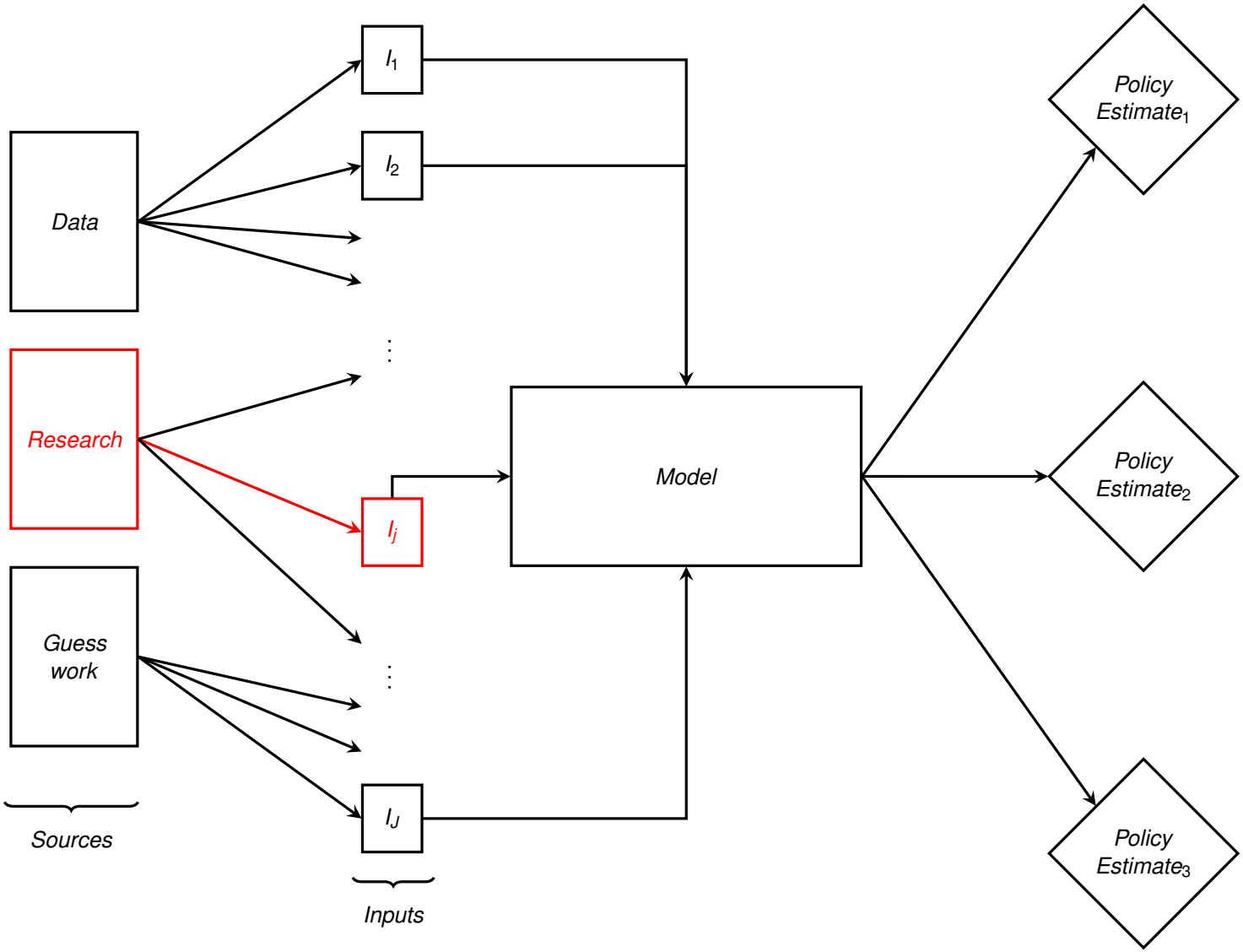

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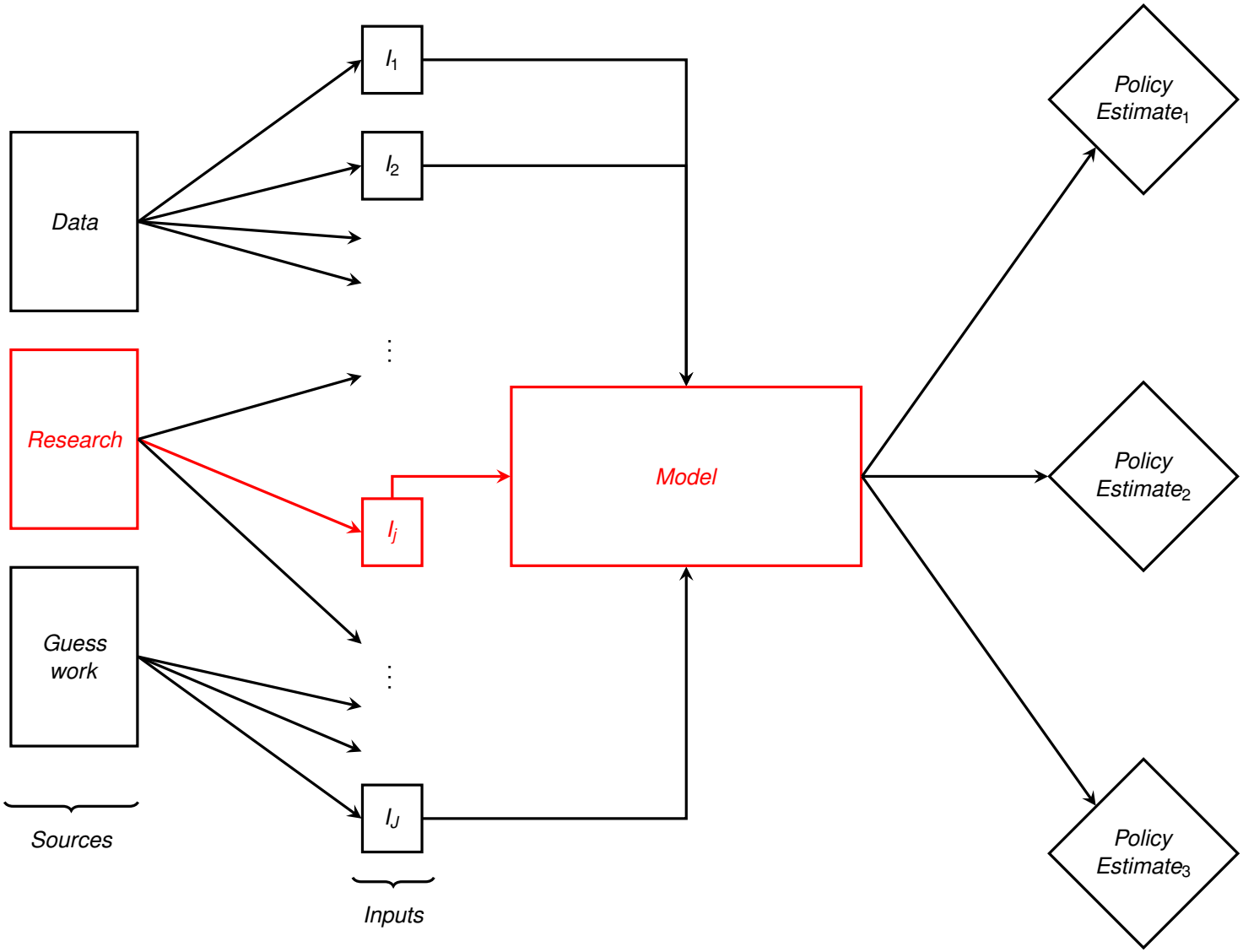

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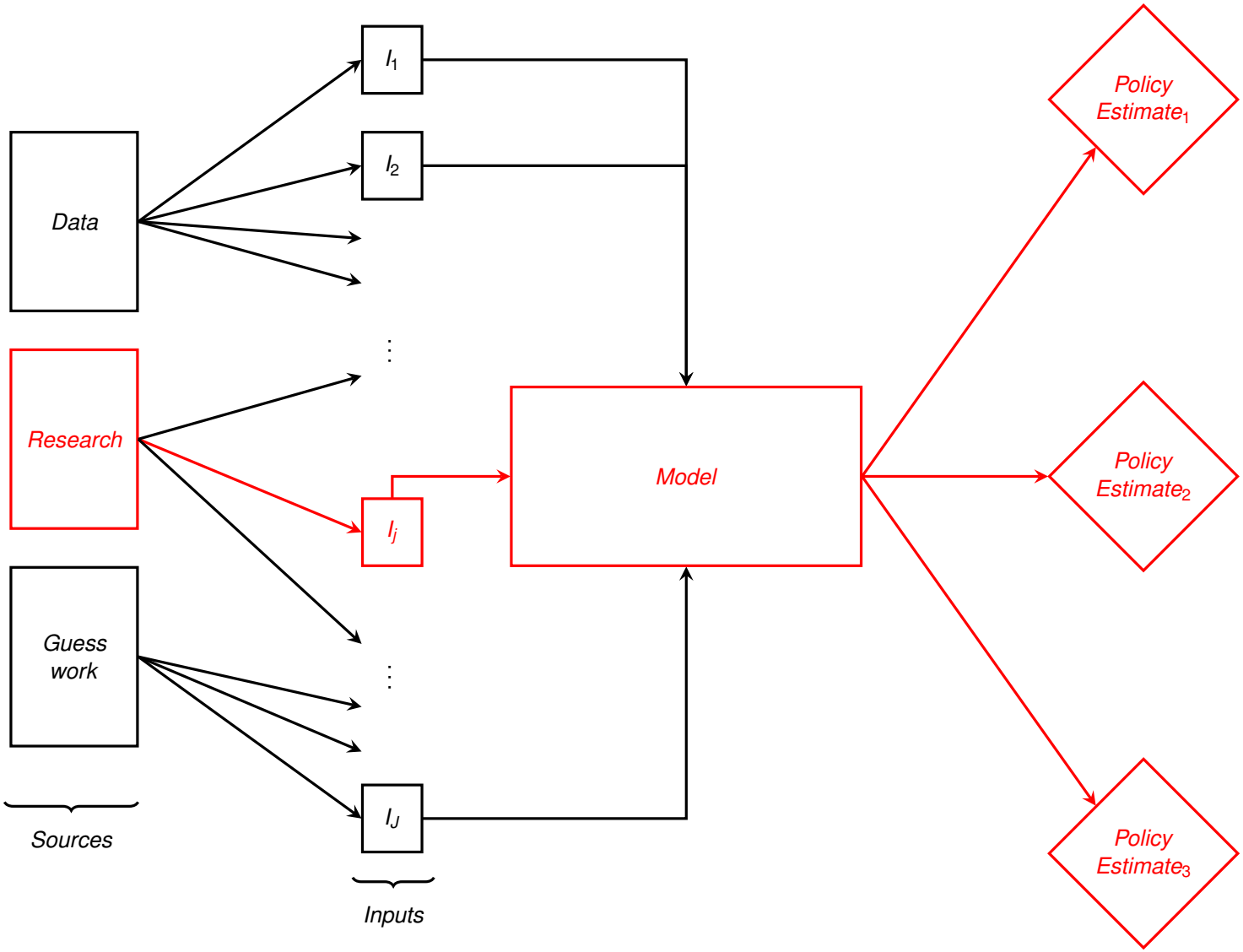

Summary of Adapted Guidelines

Standard	Level 0	Level 1	Level 2	Level 3
Workflow	Policy estimates vaguely described	All the inputs, and their corresponding sources, used in the calculations are listed	Lvl 1 + Policy estimates are listed, in same unit if possible	Lvl 2 + all the components can be modified with little effort
Data	Report says nothing	Clearly stated whether all, some components, or none of the data is available, with instructions for access when possible.	Lvl 1 + report and data are in same place	Lvl 2 + Report has specific lines of code that call the data and changes in the data produce traceable changes in the report
Methods & Code	Key assumption are listed	Methods are described in prose. Large amount of work is required to reproduce qualitatively similar estimates	Methods and described in prose, with detailed formulas, and code is provided as supplementary material	Lvl 2 + All is in the same document where changes in the code affect the output automatically

From TOP guidelines [Brown, 1999] v1.0.1

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Before: Applying Guidelines to CBO Report

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After: Applying Guidelines to Build Dynamic Document

DEMO

Benefit 1: Map the complete policy analysis

OPA - Minimum Wage

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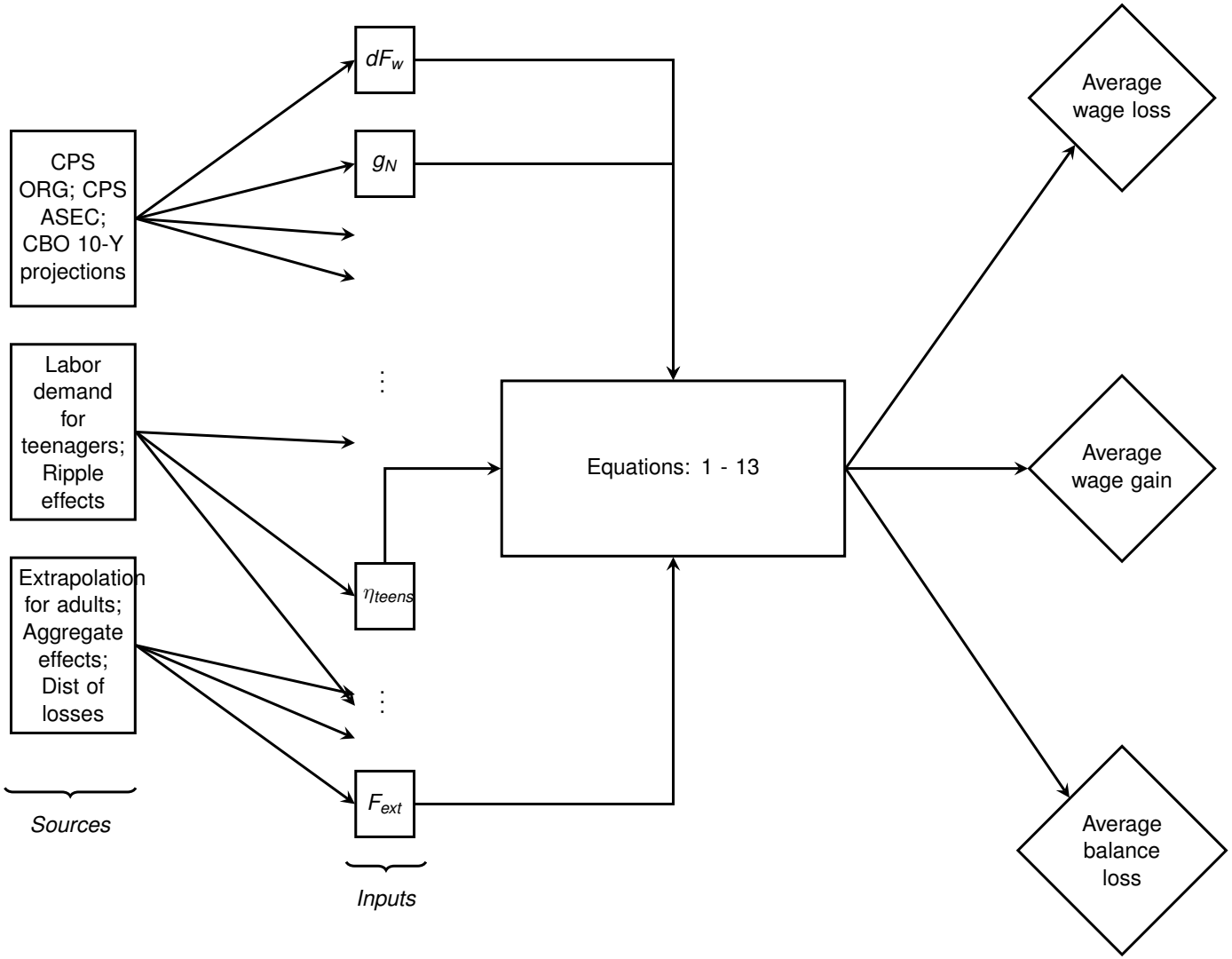

Benefit 2: Easier Methodological Appraisal. Example: dis-employment effects **Before**

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Steps taken to verify the analysis & employment variation ($\widehat{\Delta E} \times 1000$) at each line[1]

1. Find an elasticity: -0.1 (page 25): $\widehat{\Delta E} \approx 300$
2. What about adults? $\eta^{adults} = \frac{1}{3}\eta^{teens}$ (page 28): $\widehat{\Delta E} \approx 100$
3. What about the adjustment? $\widehat{\eta^{g}_{w \leq MW}} = \frac{\eta^{g}_{llt}}{p^{g}_{w \leq MW}} \times \frac{\%\Delta MW}{\%\Delta w^{g}}$ (page 26-28 + 2 papers): $\widehat{\Delta E} \approx 1,100$
4. The adjustment factors $\frac{1}{p^{g}_{w \leq MW}} \times \frac{\%\Delta MW}{\%\Delta w^{g}} = F^{g}_{adj}$ are not computed from the data (3.2 teens, 19.5 adults). Instead: $F^{teen}_{adj} = F^{adult}_{adj} = 4.5$ (page 28) $\widehat{\Delta E} \approx 500$

Steps 2-4 took several days of work!

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Benefit 3: All in one Output 1/3

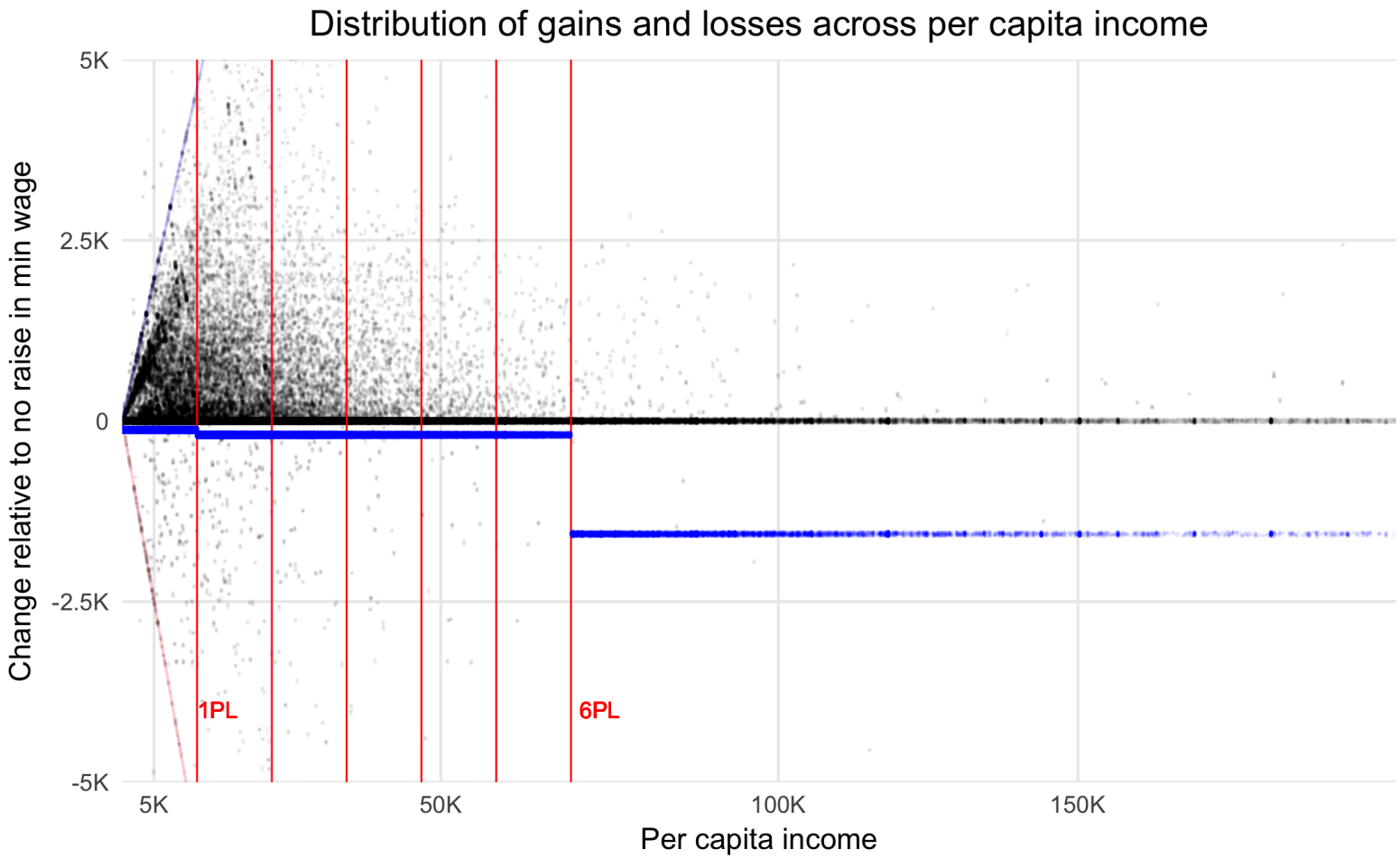

Figure: Gains and losses. Different Units

Benefit 3: All in one Output 2/3

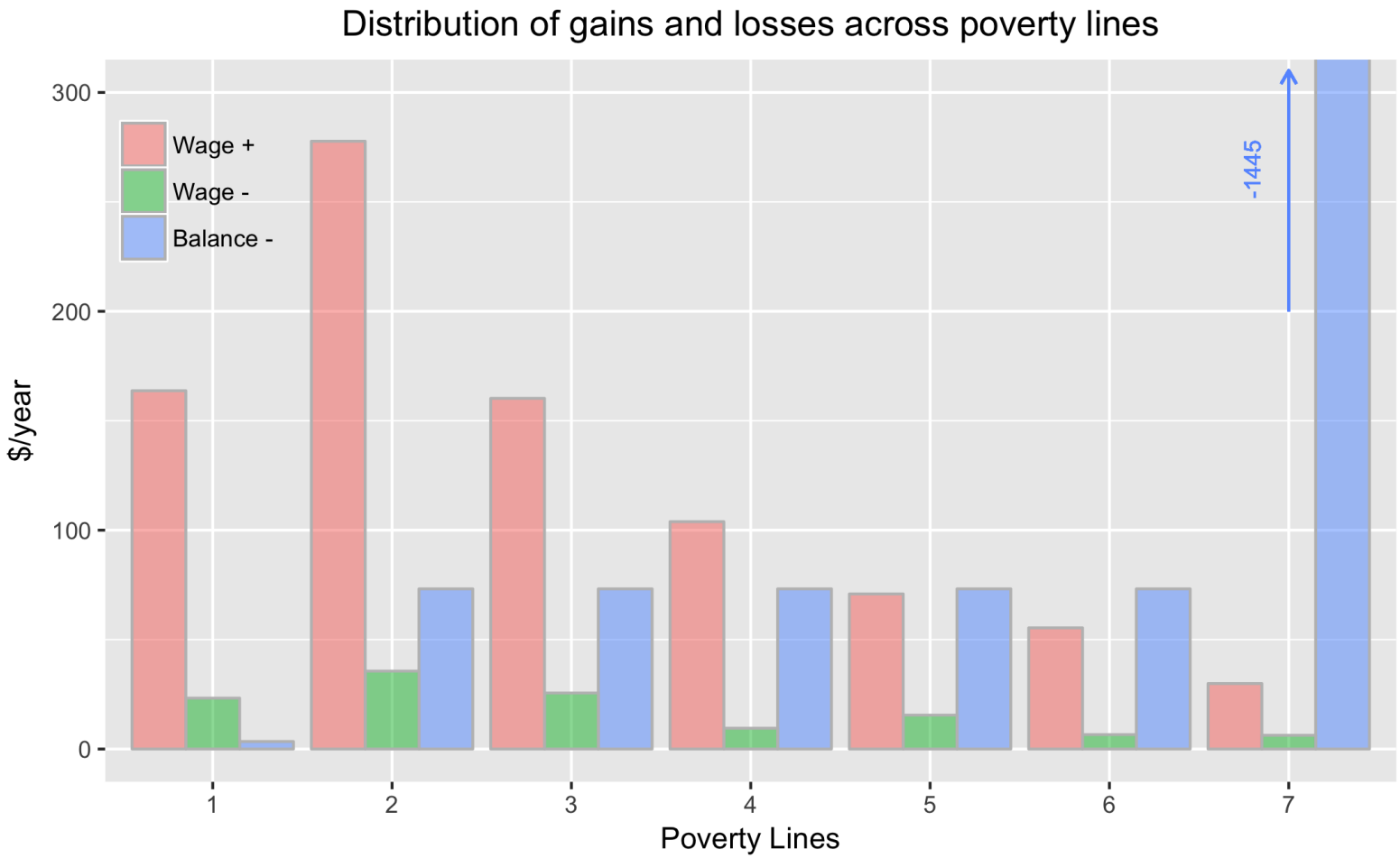

Figure: Gains and losses. Different Denominator

Benefit 3: All in one Output 3/3

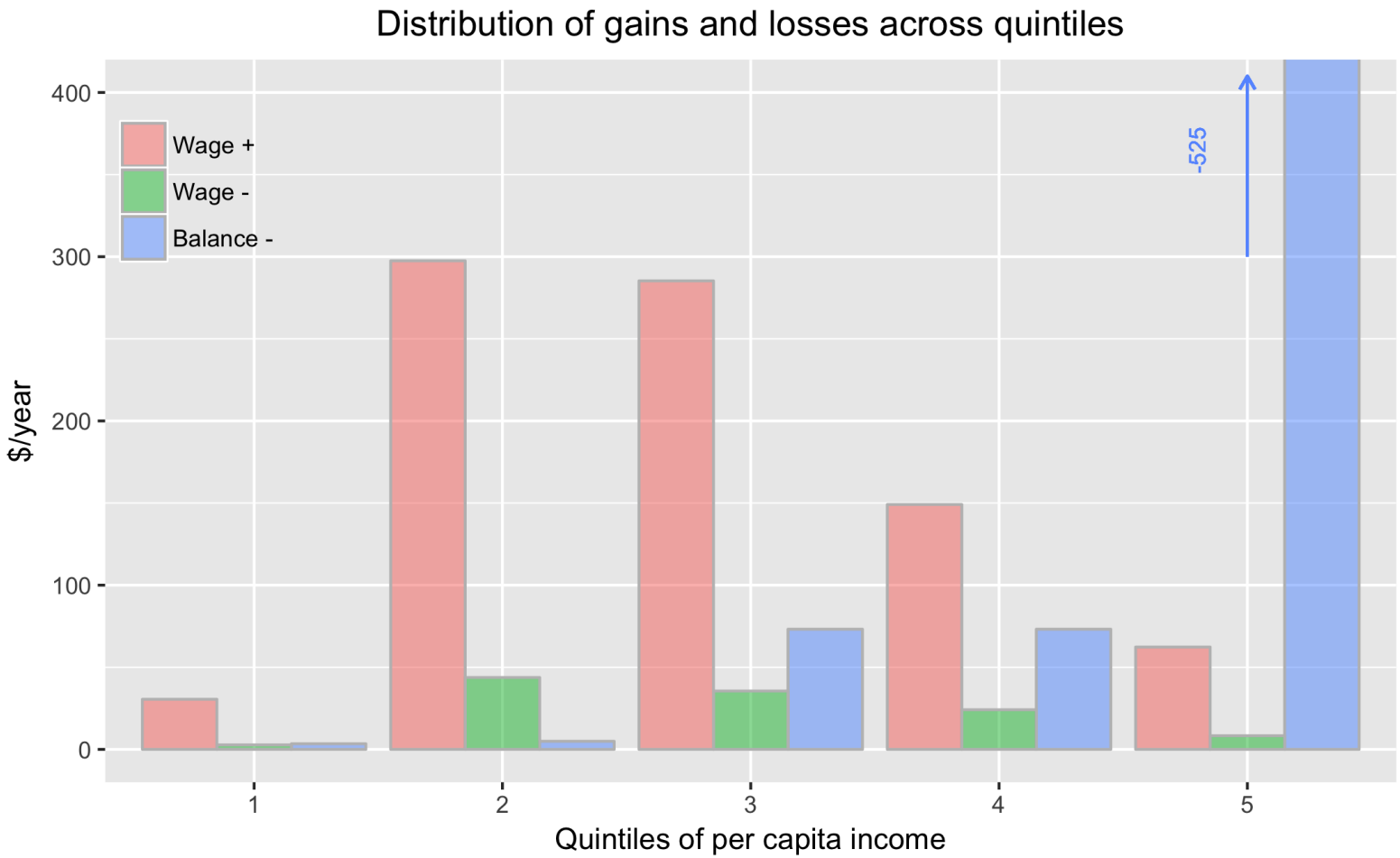

Figure: Gains and losses. Same units and denominator

Sensitivity Analysis: Status Quo

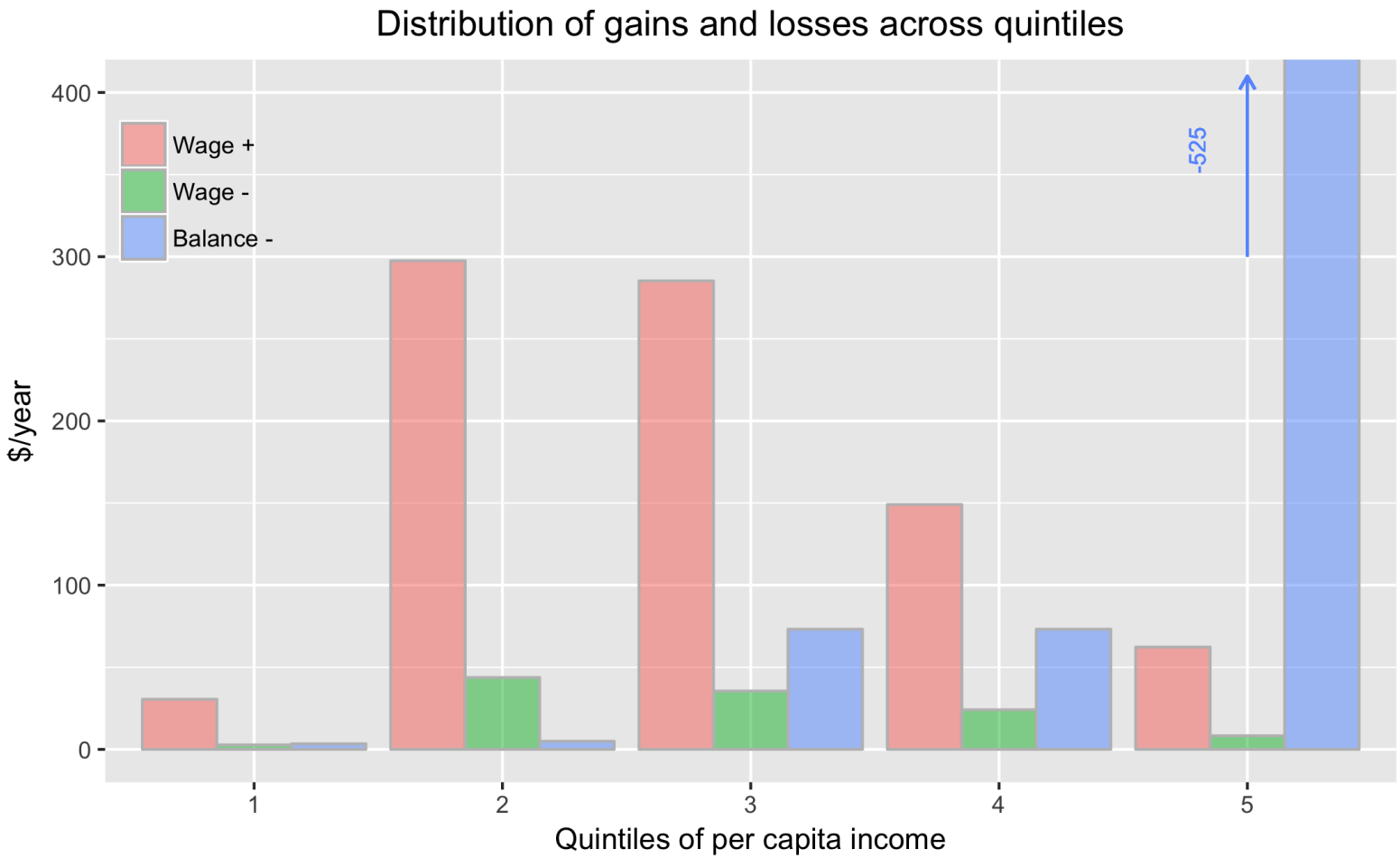

Figure: Default settings

SA: Change in Elasticity of Labor Demand

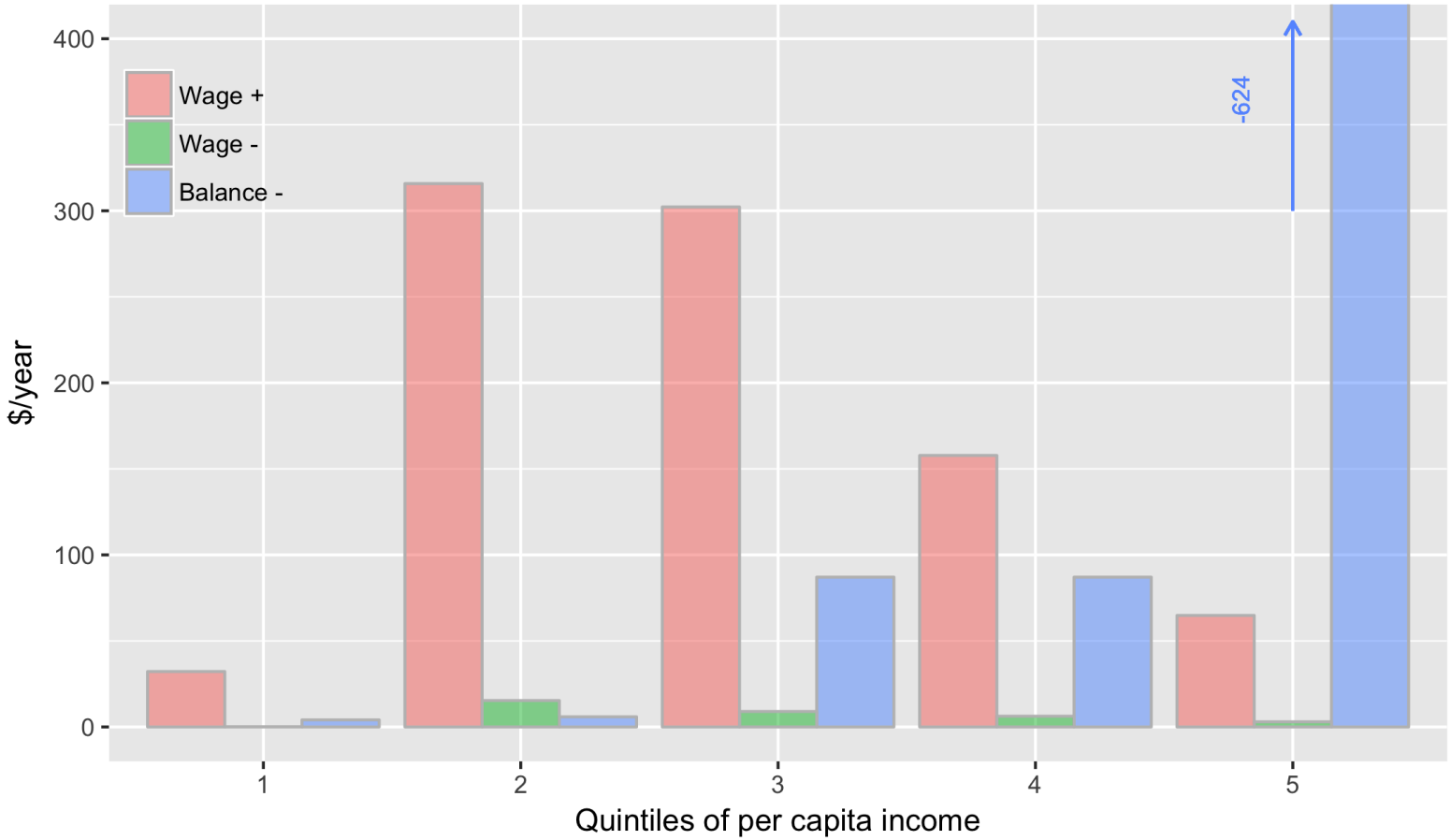

Figure: From $\eta_{lit}^{teens} = -0.1$ to $\eta_{lit}^{teens} = -0.01 (\Delta^{-} 90\%)$

Sensitivity Analysis: Status Quo

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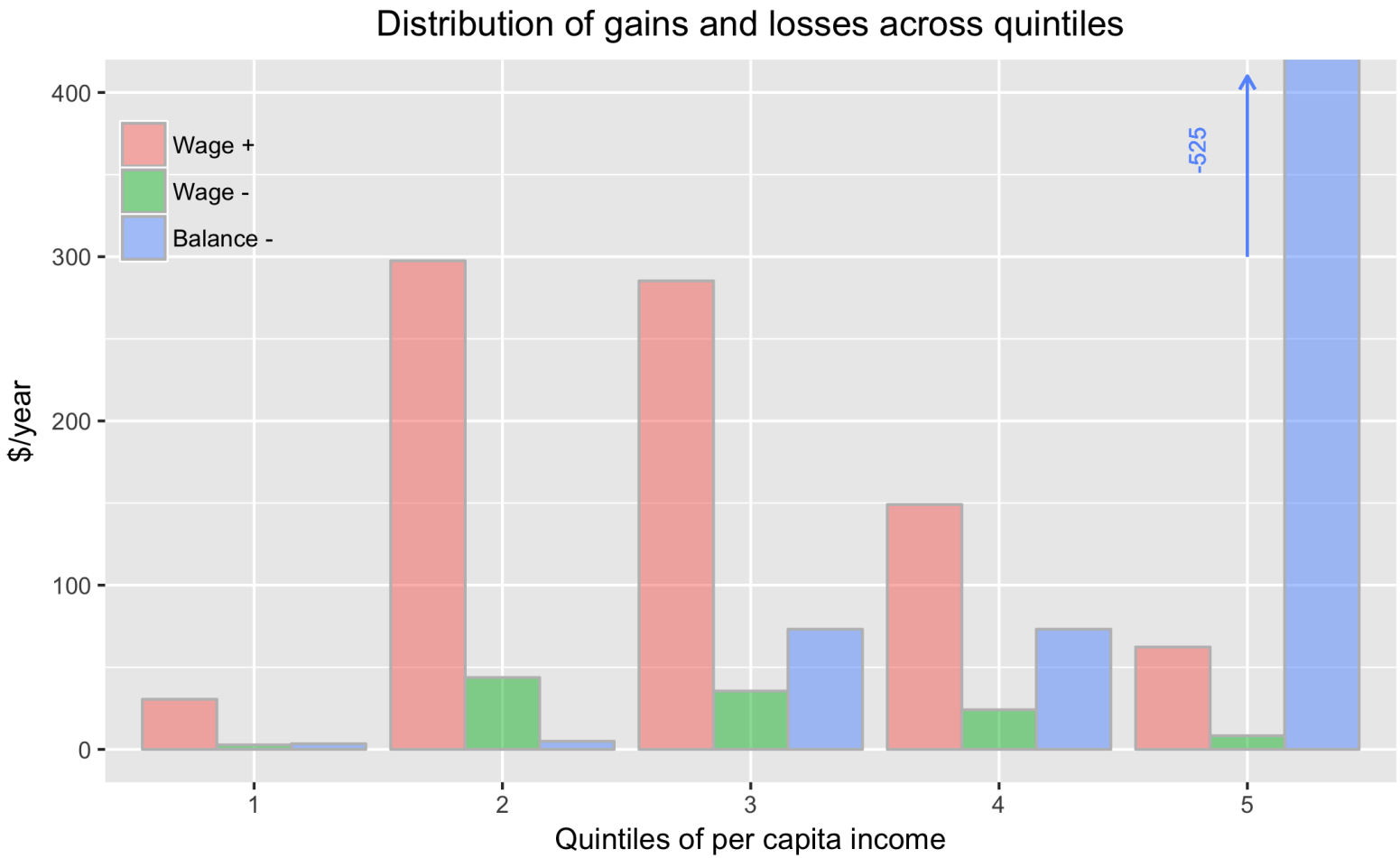

Figure: Default settings

SA: Change in Distribution of Balance Loses

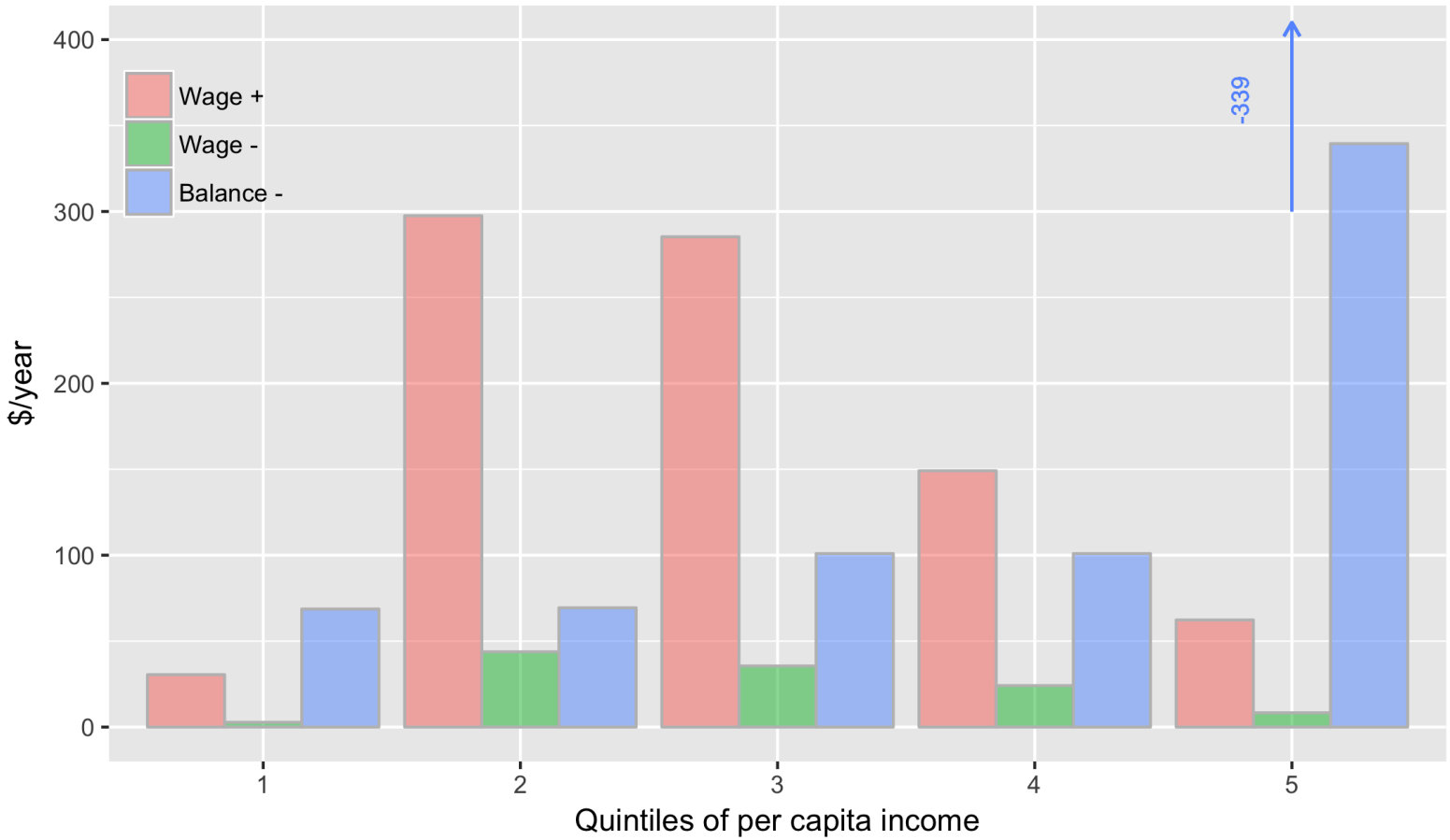

Figure: From $(1PL, 6PL) \sim (1\%, 29\%, 70\%)$ to $(20\%, 40\%, 40\%)$

Comparing the Trade-offs: A Toy Example

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Model for the normative comparison made by a policy maker (welfare function):

$$W(\rho) = \sum_{i \in N} \left(\omega_{wg} wg_i + \omega_{wl} wl_i + \omega_{bl} bl_i\right) \omega_i^d(Q_i, \rho)$$

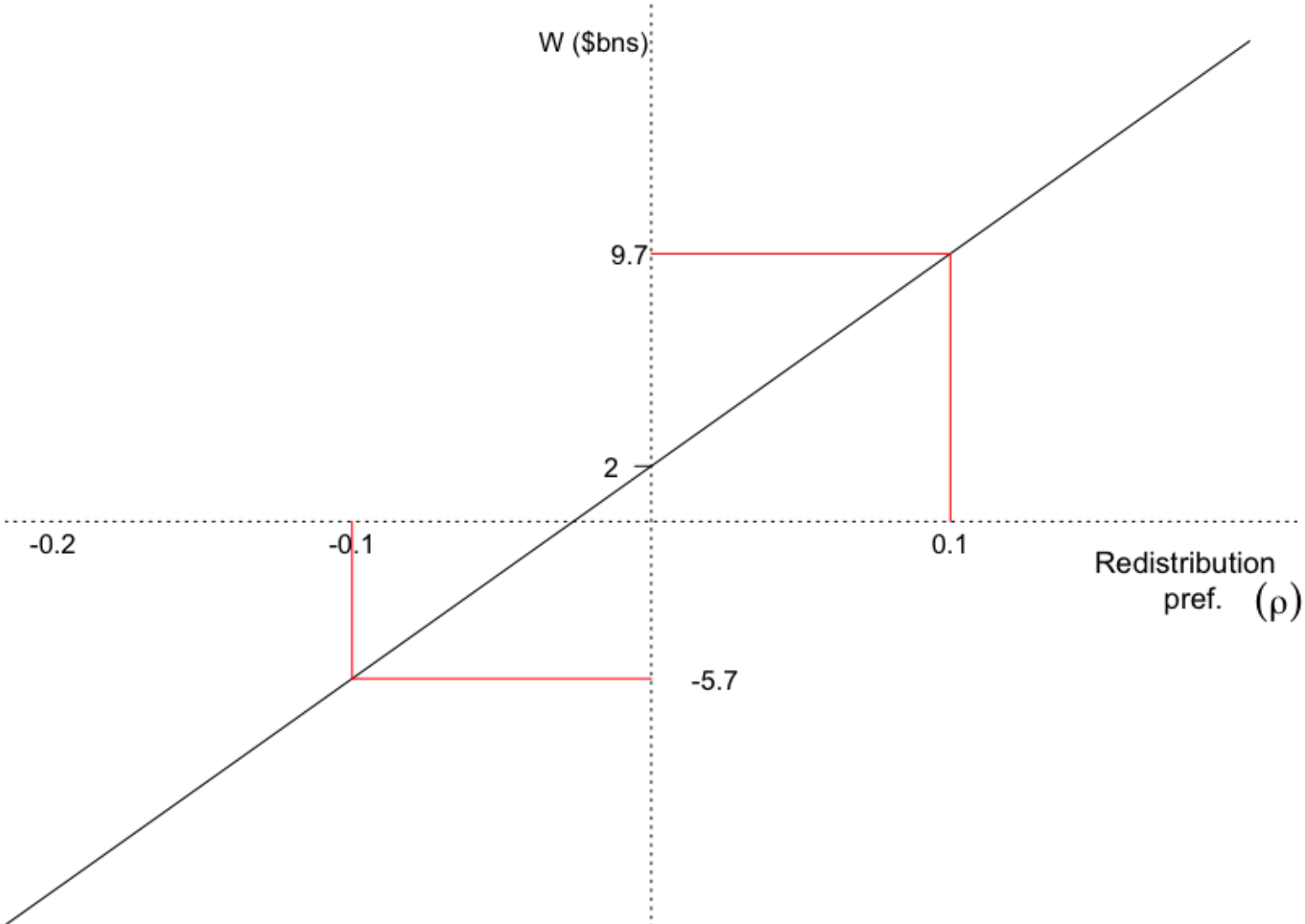
with:

$$\omega_i^d(Q_i, \rho) = \frac{(1 - \rho(Q_i - Q_{median}))}{\sum_i \omega_i^d(Q_i)} Q_{max} \quad \text{for } \rho \in \left(-\frac{1}{2}, \frac{1}{2}\right)$$

$\rho > 0$ represent positive valuation of progressive redistribution. $\rho < 0$ represents positive valuation of regressive redistribution (dis-utility from self loss greater than utility from others gain).

Normative Valuations and Redistribiutional Preferences

Toy Example (1)



Sensitivity Analysis For Multiple Parameters

Table: $\%\Delta W$ for a $\%\Delta$ in inputs. Two sample policy makers: dislikes ($W(-0.1) = -\$5.3bn$) and likes ($W(0.1) = \$10.1bn$) redistribution

		Re-distributional Preferences			
		Dislikes ($\rho = -0.1$)		Likes ($\rho = 0.1$)	
Source	Input	$10\%\Delta^+$	$10\%\Delta^-$	$10\%\Delta^+$	$10\%\Delta^-$
Data					
	Annual wage growth (g_w)	-3%	2%	-2%	1%
	Annual growth in N	0.8%	-0.9%	0.5%	-0.5%
Research					
	η_{teen}	-4%	4%	-2%	2%
	Ripple Scope $(8.7, 11.5)$	37%	-24%	21%	-14%
	Ripple Intensity $(50\%\Delta w)$	5%	-5%	3%	-3%
Guess Work					
	Extrapolation factor (F_{ex})	-3%	2%	-1%	1%
	Non compliance (α_1)	-7%	7%	-4%	4%
	Substitution factor (F_{sub})		20%		-8%
	Net benefits	-5%	5%	2%	-2%
	Distribution of balance losses				
	Current: $(1\%, 29\%, 70\%)$				
	$(1\%, 4\%, 95\%)$	22%		13%	
	$(5\%, 35\%, 60\%)$	17%		9%	

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	$(5\%, 35\%, 60\%)$		17%		9%

Sensitivity Analysis For Multiple Parameters

Table: $\%\Delta W$ for a $\%\Delta$ in inputs. Two sample policy makers: dislikes ($W(-0.1) = -\$5.3bn$) and likes ($W(0.1) = \$10.1bn$) redistribution

		Re-distributional Preferences			
		Dislikes ($\rho = -0.1$)		Likes ($\rho = 0.1$)	
Source	Input	$10\%\Delta^+$	$10\%\Delta^-$	$10\%\Delta^+$	$10\%\Delta^-$
Data					
	Annual wage growth (g_w)	-3%	2%	-2%	1%
	Annual growth in N	0.8%	-0.9%	0.5%	-0.5%
Research					
	η_{teen}	-4%	4%	-2%	2%
	Ripple Scope $(8.7, 11.5)$	37%	-24%	21%	-14%
	Ripple Intensity ($50\%\Delta w$)	5%	-5%	3%	-3%
Guess Work					
	Extrapolation factor (F_{ex})	-3%	2%	-1%	1%
	Non compliance (α_1)	-7%	7%	-4%	4%
	Substitution factor (F_{sub})		20%		-8%
	Net benefits	-5%	5%	2%	-2%
	Distribution of balance losses				
	Current: $(1\%, 29\%, 70\%)$				
	$(1\%, 4\%, 95\%)$	22%		13%	
	$(5\%, 35\%, 60\%)$	-17%		-9%	

Welfare Effects: Elasticity of Labor Demand $W(\eta(F_{ext}, F_{adj}, \eta_{lit}))$

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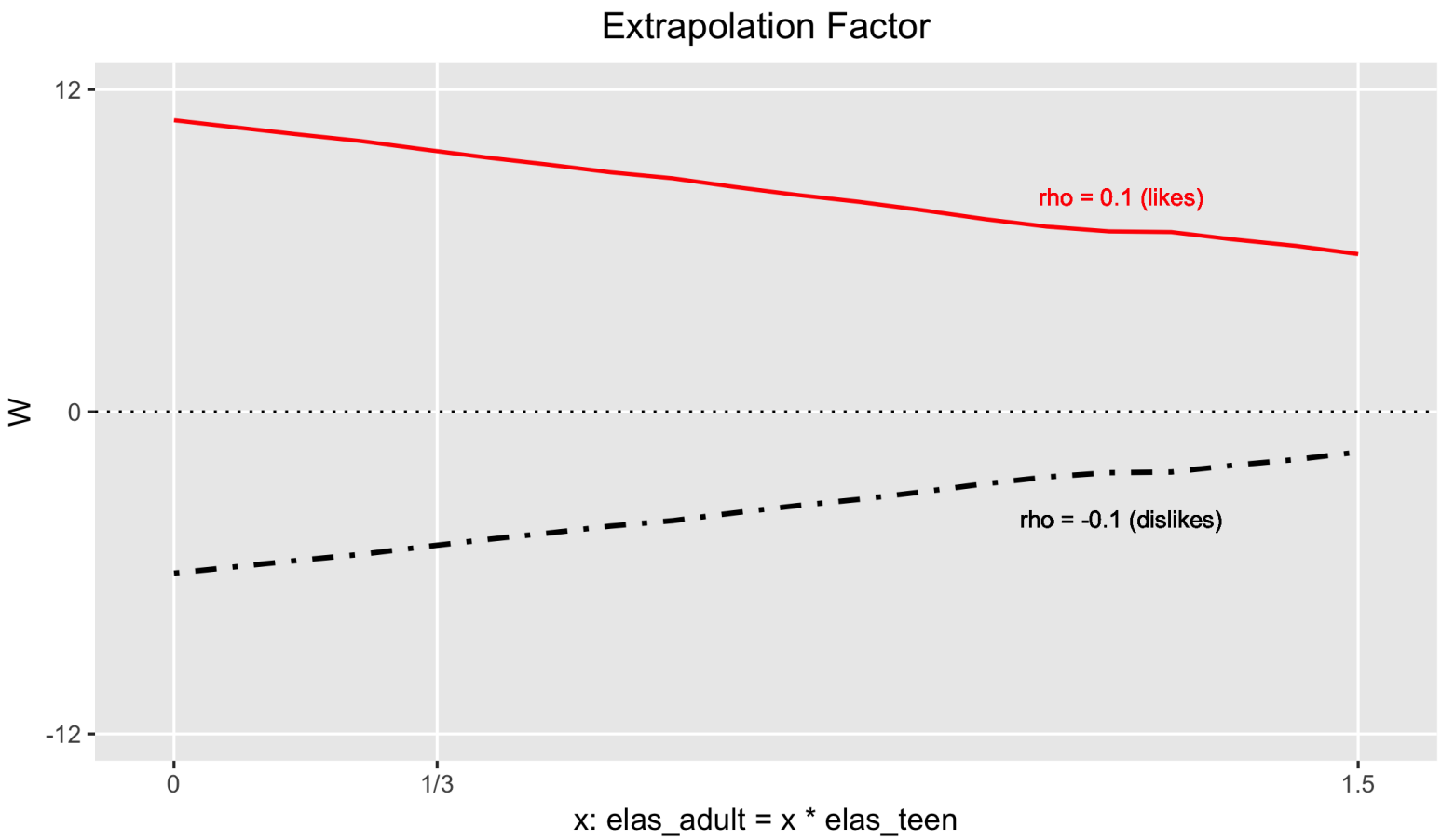
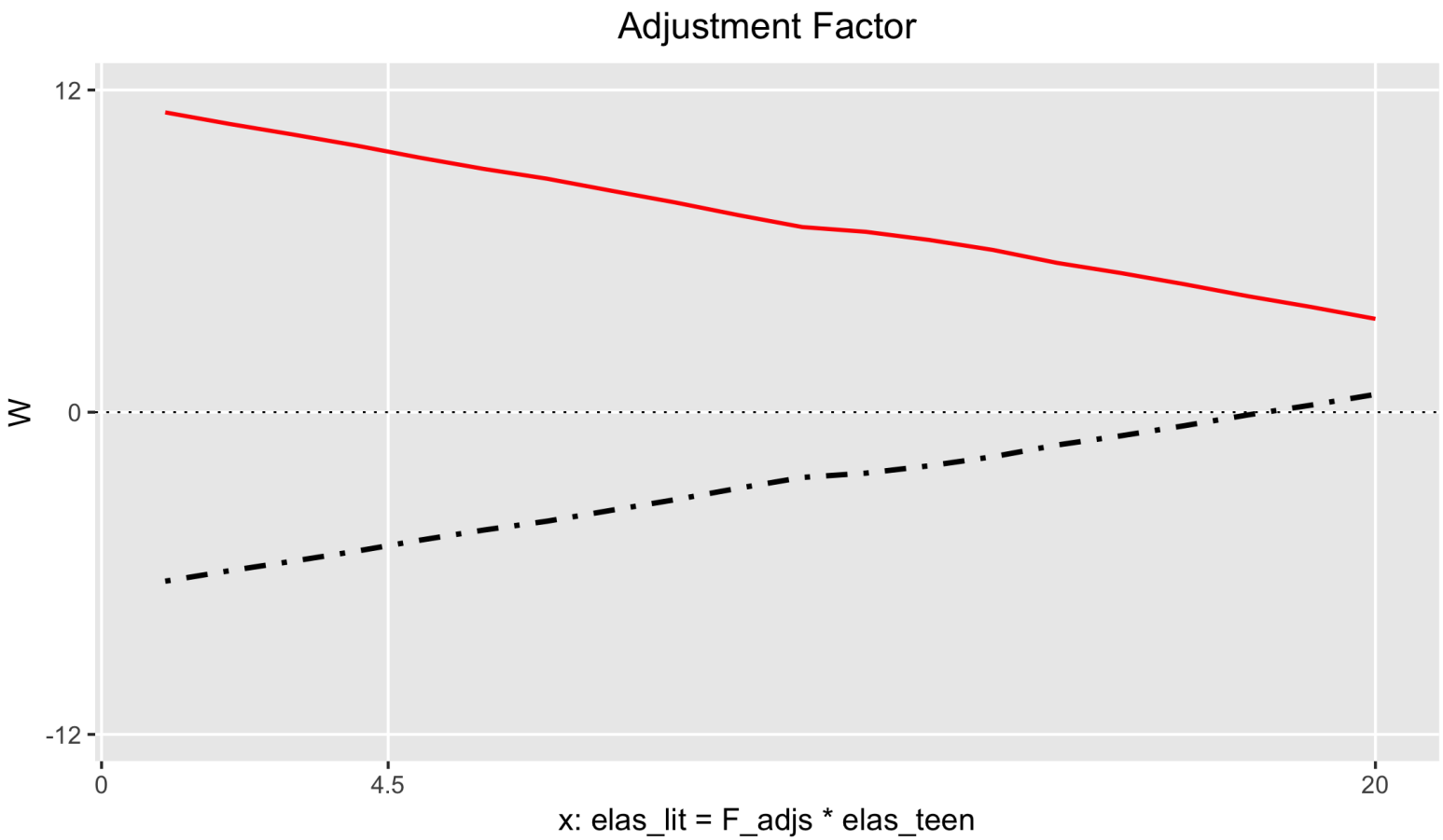
Welfare Effects: Elasticity of Labor Demand

$W(\eta(F_{ext}, \square, \square))$



Welfare Effects: Elasticity of Labor Demand

$W(\eta(\square, F_{adj}, \square))$



Welfare Effects: Elasticity of Labor Demand

$W(\eta(\square, \square, \eta_{lit}))$

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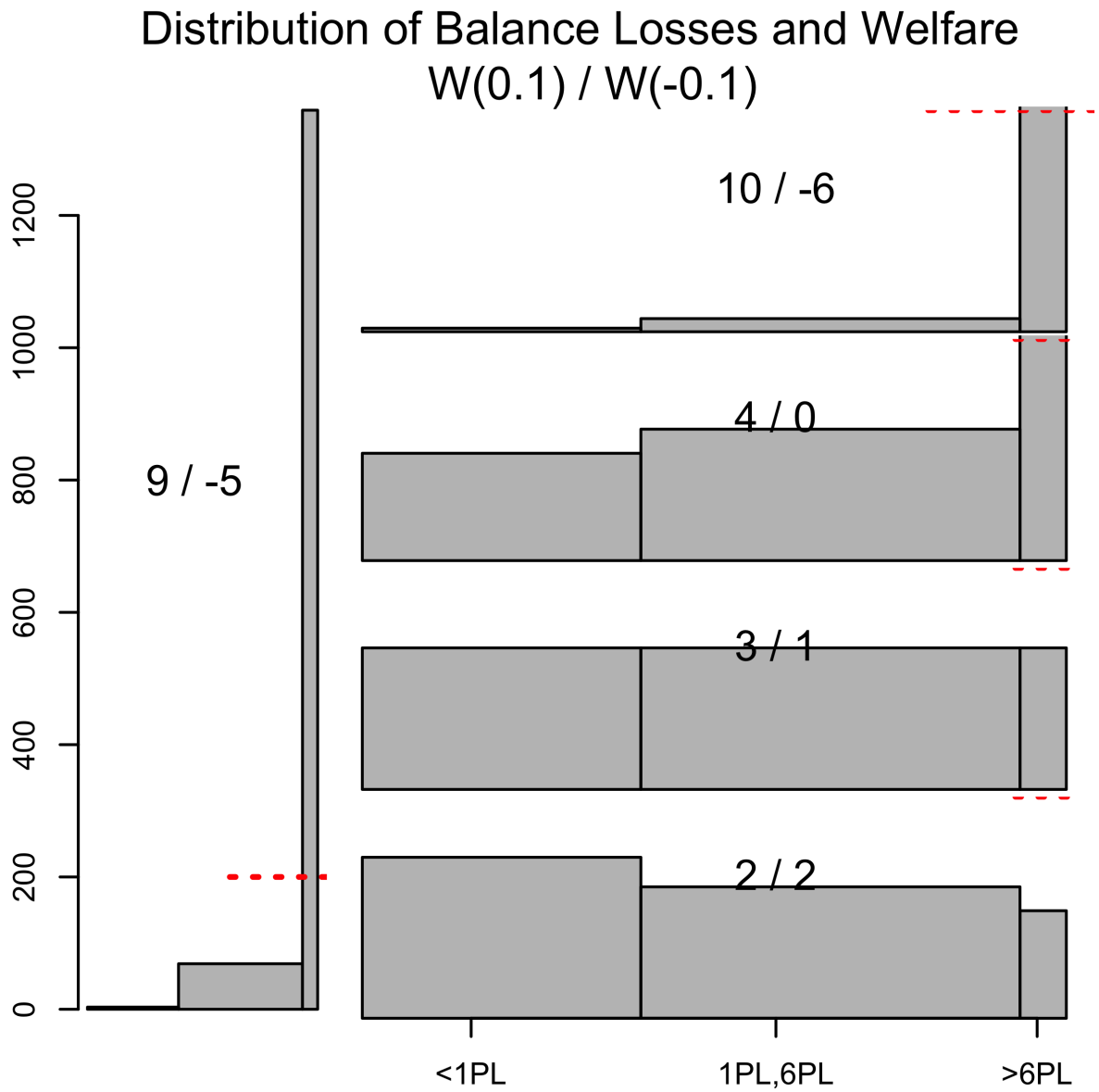
Much More Policy Relevant To Learn Who Pays For Wage Raise



Discussion

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Let's assume this becomes the new status quo.

- Costs of producing the next report on effects of min wage will be very small.
- Every additional effort will imply improvements on the "state of the art" report (e. g. *dBL*; $\eta(MW), \alpha_1(MW)$)
- Learning about one parameter (QALYs, DWL) will update estimates *across* reports.
- Much easier to have a substantive and normative policy debate (pilot example:`Shiny App!`)

Next Steps

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- Publish a motivation/concept-note paper why and how do we need reproducible and transparent policy analysis
- **Find next case study, now with buy-in from a policy agency**
  - **Cost Benefit Analysis**
  - **Ex ante economic analysis/Micro-simulation study**
- Review and publish guidelines

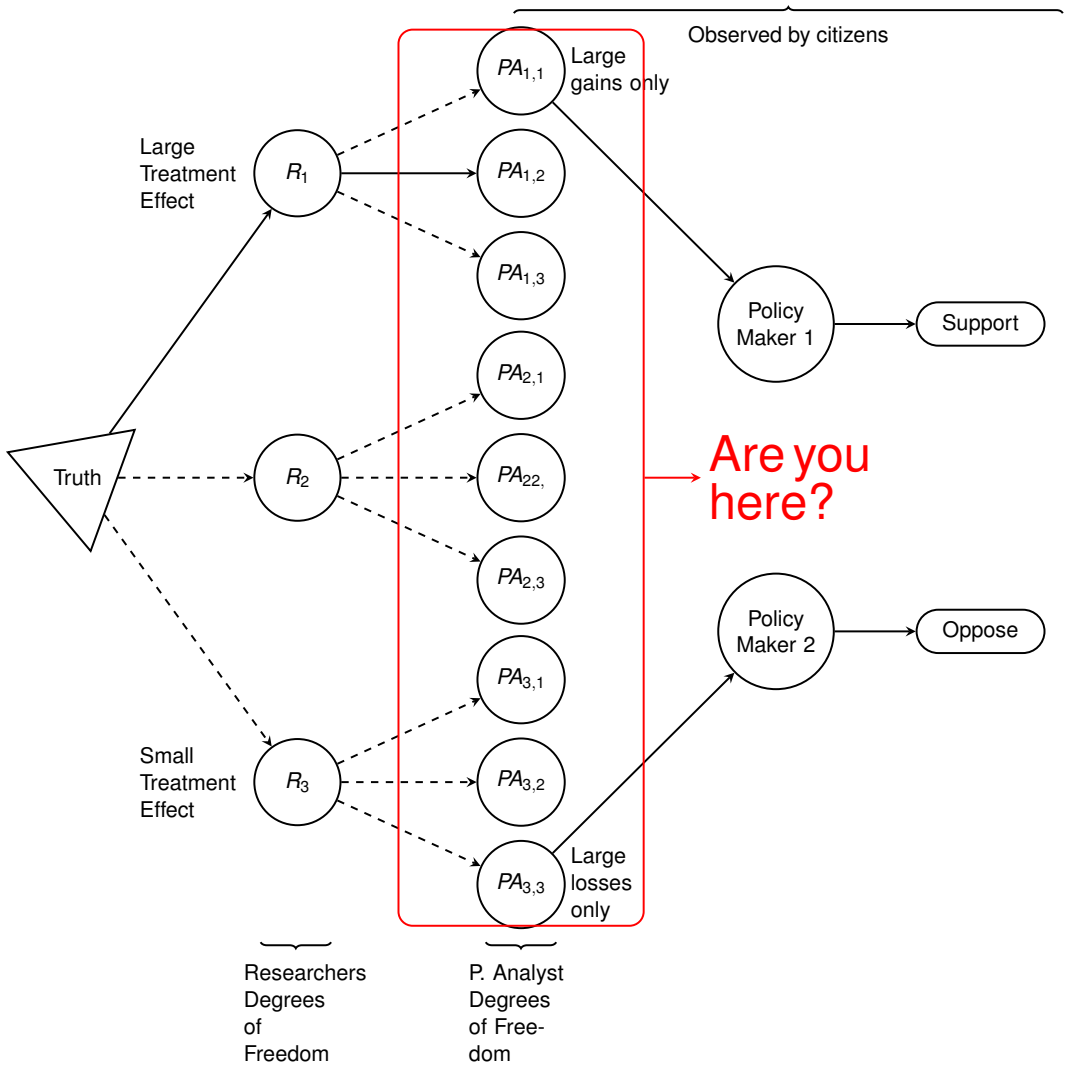

Figure: Policy-making with low TR in research and policy analysis

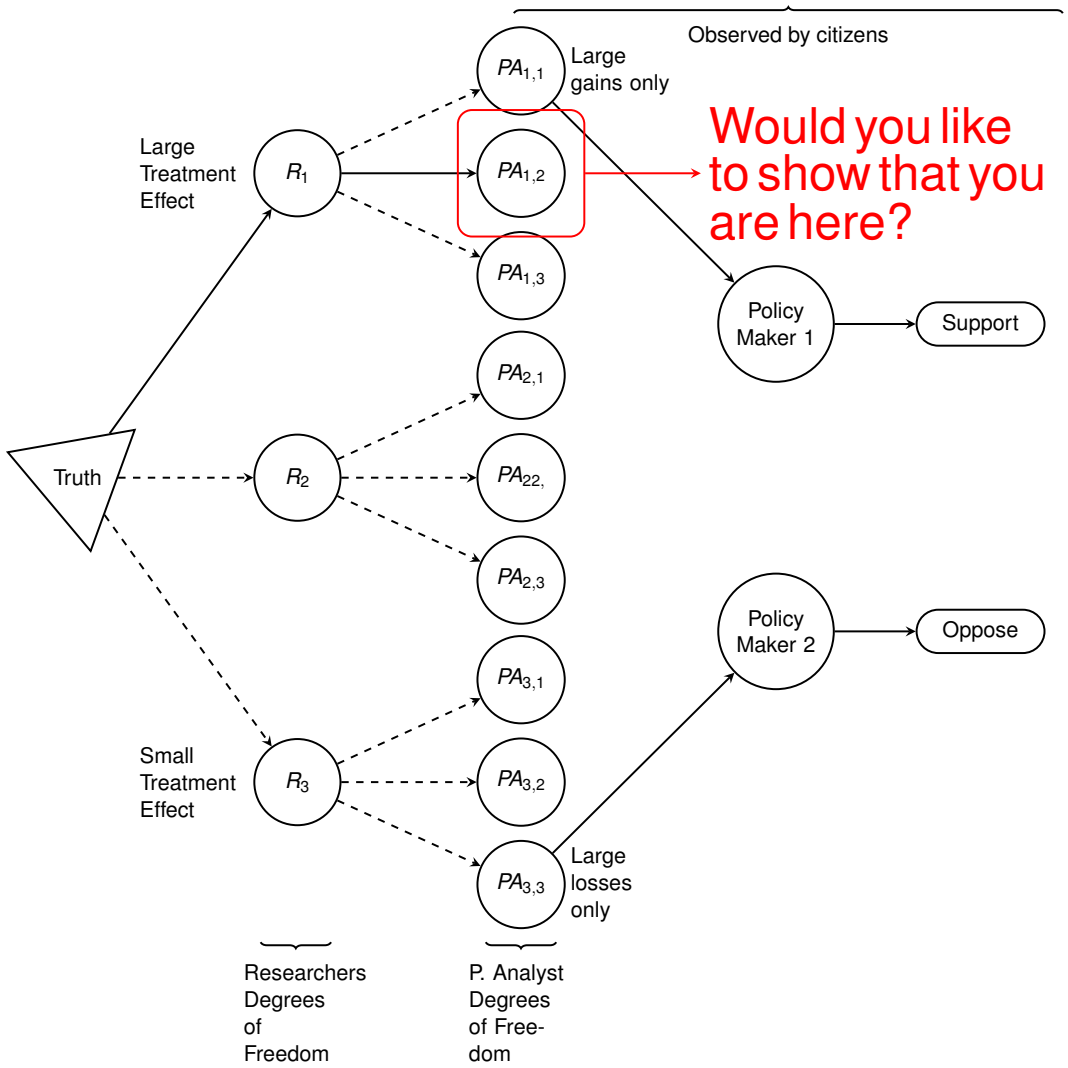

Figure: Policy-making with low TR in research and policy analysis

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Thank you.

Pre-print: [PP URL HERE]
Contact: fhoces@berkeley.edu

Back-up slides

Charles Brown. Minimum wages, employment, and the distribution of income. *Handbook of labor economics*, 3: 2101–2163, 1999.

David Neumark and William L Wascher. *Minimum wages*. MIT Press, 2008.

BA Nosek, G Alter, GC Banks, D Borsboom, SD Bowman, SJ Breckler, S Buck, CD Chambers, G Chin, G Christensen, et al. Promoting an open research culture: Author guidelines for journals could help to promote transparency, openness, and reproducibility. *Science (New York, NY)*, 348(6242):1422, 2015.

Equations from Model in DD

$$\widehat{\Delta E} = N \times \eta \times \%\Delta w + \text{Other factors} \tag{1}$$

$$\widehat{N^s_{final}} = g_N(\hat{t}'|t) \times \hat{N}^s_t \times P(\hat{w}' \leq MW^{new}|s) \times (1 - \hat{\alpha}^s_1 - \hat{\alpha}^s_2) \tag{2}$$

The elasticity for adults from the literature is define as the one for teenagers with an extrapolation factor.

$$\eta^{adults}_{lit} = \eta^{teens}_{lit} \times F_{extrapolation} \tag{3}$$

Adjustments to the elasticity of labor demand

Following Brown [1999,?]. First:

$$\eta^s_{lit} = p^s_{w\leq MW}\eta^s_{w\leq MW} + (1 - p^s_{w\leq MW})\eta^s_{w>MW} \qquad s = \{teens,\ adu$$

Second, assume $\eta^s_{w\leq MW} = 0$:

$$\eta^s_{w\leq MW} = \frac{\eta^s_{lit}}{p^s_{w\leq MW}} \qquad s = \{teens,\ adults\}$$

And third, adjust for the effective average wage variation for each group ($\overline{\%\Delta w^s}$):

$$\widetilde{\eta^s_{w\leq MW}} = \frac{\eta^s_{lit}}{p^s_{w\leq MW}} \times \frac{\%\Delta MW}{\overline{\%\Delta w^s}} = \eta^s_{lit} \times F^s_{adjs} \qquad s = \{teens,\ adu$$

(4)

Final Effect on Employment

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$$\widehat{\Delta E} = \sum_{g \in \{A,T\}} \left(\widehat{N_g^{final}} \times \widetilde{\eta_{w \leq MW}^{g}} \times \overline{\%\Delta w^g} \right) - \widehat{OF} \tag{5}$$

Effect on Wages

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$$w'' = \begin{cases} w' & if \quad w \in U[0,1] < \alpha_1 \\ w^{new} & o/w \end{cases} \tag{6}$$

$$w^{new} = \begin{cases} w'/2 & if \quad w \in U[0,1] < \alpha_{aux} \\ \widetilde{w^{new}} & o/w \end{cases} \tag{7}$$

Ripple Effects

$$\widetilde{w^{new}} = \begin{cases} MW' & if \quad w' < R_{lb} \\ MW' + R^I(w' - R^s_{lb}) & if \quad w' \in [R_{lb}, MW') \\ w' + R^I(R^s_{ub} - w') & if \quad w' \in [MW', R_{ub}) \\ w' & o/w \end{cases} \tag{8}$$

Computing Income

$$y'_{i,h} = \sum_{i \in N_h} \left(g_{nw}(t'|t) nw_i + w'_i \right) / N_h$$

$$y''_{i,h} = \sum_{i \in N_h} \left(g_{nw}(t'|t) nw_i + w''_i \right) / N_h \tag{9}$$

Final Policy Estimates

$$WG_i = \left(y''_i - y'_i \right) \mathbf{I} \left(y''_i > y'_i \right) \tag{10}$$

$$WL_i = \left(y'_i - y''_i \right) \mathbf{I} \left(y''_i < y'_i \right) \tag{11}$$

$$BL = \sum_i WG_i - F_{sub} \sum_i WL_i; \quad BL_i = BL \times dBL \tag{12}$$

$$\overline{WG_Q} = \frac{\sum_{i \in Q} WG_i}{N_{pop}/5} \quad \overline{WL_Q} = \frac{\sum_{i \in Q} WL_i}{N_{pop}/5}$$

$$\overline{BL_Q} = \frac{\sum_{i \in Q} BL_i}{N_{pop}/5} \tag{13}$$

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Reader Companion for CBO report on Min Wage (Preliminary Version. Do Not Circulate)

Fernando Hoces de la Guardia + (hopefully) a lot more people

Last edit: 2016-10-16

1 Introduction

The role of policy analysis is to connect research with policy. Because of heavy time constrains, policy analyses are typically ambiguous regarding the details of how the analysis was carried out. This creates three problems: (i) its hard to understand the connection between research and policy, (ii) allows policy makers to cherry pick policy reports, and (iii) hinders systematic improvement and/or automation of parts of the analysis. In this document we demonstrate the use of a reproducible workflow to reduce the ambiguity in policy analysis.

Here we attempt to contribute to the policy discussion of the minimum wage. The minimum wage is a contentious policy issue in the US. Increasing it has positive and negative effects that different policymakers value differently. We aim to add clarity on what those effects are, how much do we know about them, and how those effects vary when elements of the analysis change. We select the most up-to-date, non-partisan, policy analysis of the effects of raising the minimum wage, and build an open-source reproducible analysis on top of it.

In 2014 the Congressional Budget Office published the report titled "The Effects of a Minimum-Wage Increase on Employment and Family Income". The report receive wide attention from key stakeholders and has been used extensible as an input in the debate around the minimum wage[1]. To this date we consider the CBO report to be the best non-partisan estimation of the effects of raising the minimum wage at the federal level. Although there was disagreement among experts around some technical issues, this disagreement has been mainly circumscribed around one of the many inputs used in the analysis, and we can fit the opposing positions in to our framework.

Our purposes are twofold: First, promote the technical discussion around a recurrent policy issue (minimum wage) by making explicit and visible all the components and key assumptions of its most up-to-date official policy analysis. Second, demonstrate how new scientific practices of transparency and reproducibility (T & R) can be applied to policy analysis. We encourage the reader to collaborate in this document and help develop an ever-improving version of the important policy estimates[2] (re)produced here.

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2 Employment effects

At a general level the effects on employment ($\widehat{\Delta E}$) will be calculated using a more detailed version of the following equation:

$$\widehat{\Delta E} = N \times \eta \times \%\Delta w + \text{Other factors}$$

Where N represents the relevant population, η the elasticity of labor demand, Δw the relevant percentual variation in wages, and the *Other factors* will encapsulate effects on employment through an increase in the aggregate demand.

To describe the methodology behind each of those four components we first describe the data used, the wage variable choose, and the procedure used to forecast the wage and population distribution of 2016 using data from 2013.

2.1 Data, wages, and forecast

To simulate the policy effects we need the distribution of wages and employment under the status quo. From the perspective of 2013, this implies forecasting to 2016 data on employment and wages.

2.1.1 Data

The Current Population Survey (CPS) was used to compute the effects on employment. From the analysis in the section on distributional effects we can deduce that the data corresponds to the Outgoing Rotation Group (ORG). CPS is a monthly cross sectional survey. The same individual is interviewed eight times over a period of 12 months. The interviews take place in the first and last 4 months of that period. By the 4th and 12th interview, individuals are asked detailed information on earnings. The CPS ORG file contains the information on this interviews for a given year. We analyze the data for 2013.

Currently three versions of these data sets can be found online: CPS raw files, ORG NBER and ORG CEPR. The analysis will be performed using the CPER ORG data base.

The weights used in our analysis will be `orgwgt/12`

2.1.1.1 Code to load the data

`R`
`Stata`

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performed using the CPER ORG data base.

The weights used in our analysis will be `orgwgt/12`

2.1.1.1 Code to load the data

R

```
call.cps.org.data <- function(){
  data_use <- "CPER_ORG"

  # Using CEPR ORG data
  if (data_use == "CPER_ORG") {
  # Checking if working directory contains data, download if not.
    if ( !("cepr_org_2013.dta" %in% dir()) ) {
        # create name of file to store data
        tf <- "cepr_org_2013.zip"

        # download the CPS repwgts zipped file to the local computer
        download.file(url =  "http://ceprdata.org/wp-content/cps/data/cepr_org_2013.zip", tf , mode
= "wb" )

        # unzip the file's contents and store the file name within the temporary directory
        fn <- unzip( zipfile = tf , overwrite = T )
    }
    df <- read.dta("cepr_org_2013.dta")
  }

  # Using NBER ORG data
  if (data_use == "NBER_ORG") {
    # Checking if working directory contains data, download if not.
    if ( !("morg13.dta" %in% dir()) ) {
      # Downloading data 53mb
      df <- read.dta("http://www.nber.org/morg/annual/morg13.dta")
    }
    df <- read.dta("morg13.dta")
```

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2.5 Computing effects on employment

Putting all elements together we get:

$$\widehat{\Delta E} = \sum_{g \in \{A,T\}} \left(\widehat{N_g^{final}} \times \widetilde{\eta^g_{w \leq MW}} \times \overline{\%\Delta w^g} \right) - \widehat{OF}$$

2.5.1 Code to compute each component

`R`
`Stata`

Components of Elasticities

	Adult	Teen
η_{lit}	-0.03	-0.10
$\eta_{w \leq MW'}$	-0.23	-0.13
F_{adj}	4.50	4.50
$\overline{\%\Delta w}$	13.81	16.65
$\widetilde{\eta_{w \leq MW}}$	-0.15	-0.45

Using all the components described above we get $\widehat{\Delta^- E}$ = -478 thousand jobs. The report however computes F^g_{adjs} in a different fashion and gets a value of 4.5 (when computing the values of F^g_{adjs} from the table below - as oppose to using historical values - we get $\widehat{\Delta^- E}$ = -321 thousand jobs).

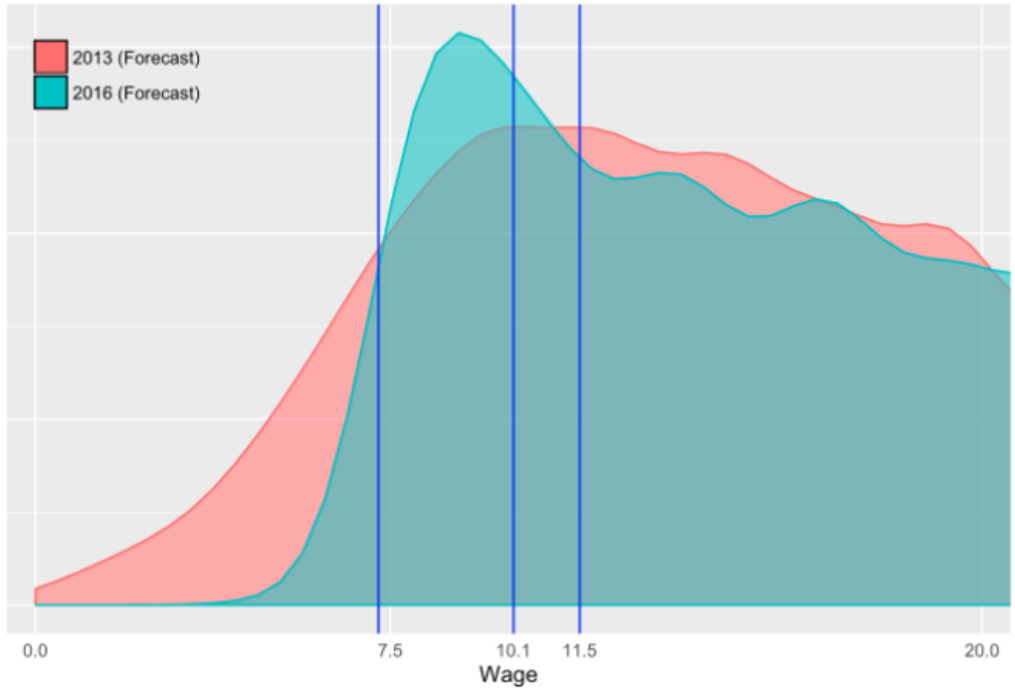
3 Distributional effects

In the first step towards obtaining the policy estimates presented in the introduction we concluded with

R

Stata

Figure 4: Distribution of wages in 2013 and 2016(forecast)



Comparison of 2013 and 2016 under the status quo

	2013	2016: status quo
Salary workers	122,593,557	129,545,571
Median wage	17.79	20.56

Final replication output (nothing in the "learn more" button yet)

Policy estimates in CBO report and Replication Results

	Effects/Policy Estimates	Replication
wage gains (billions of $)	31	53.4
wage losses (bns of $)	~5	7.4
Balance losses (bns of $)	~24	43.9
Net effect (bns of $)	2	2
# of Wage gainers (millions)	16.5	23.1/16.9
#of Wage losers (millions)	0.5	0.5

	<1PL	[1PL, 3PL)	[3PL, 6PL)	>6PL
Balance losses (bns of $)	~0.3	~3.4	~3.4	~17
Net effect (bns of $)	5	12	2	-17
Replication loses	-0.4	-6.4	-6.4	-30.8
Replication NE	17.6	14.6	-0.1	-30.1

Learn more