

ONLINE APPENDIX A

Descriptive Comparisons to Previous Citywide Minimum Wage Changes

To help assess and compare our model's conclusion of relatively modest disemployment between years 2016 and 2020—when a 30 percent increase to the MWP occurs—we tabulate employment changes following a statutory 39 percent increase in the city's minimum wage (\$8.25 to \$11.50) between 2014 and 2016. To do so, we examine employment in the city's food industry from 2014 to 2017 (one year after full implementation) and compare it to the 2011-2014 time period. Although REMI is a forecasting model that incorporates all current DC area macroeconomic data, it cannot run historical forecasts or control for historical variables. We are thus unable to control for the range of prior historical economic factors, thereby preventing us from using REMI to formally assess previous minimum wage increases over the 2014-2016 period. We instead observe employment shifts following this prior minimum wage change, noting that the magnitude of this 2014-2016 policy change was similar to that of the \$15 MWP.

We find that, after the city minimum wage increased between 2014 and 2017, employment in the city's food industry decreased 6.1 percent relative to the 2011-2014 period. Simultaneously, employment in the region's food industry increased 0.82 percent over the two time periods. We compared these employment levels to those in the city's business and financial occupations in order to assess a worker-group less likely to be affected over the same two time periods. Jobs in these select occupations, which account for a large share of private city employment and are sensitive to citywide economic conditions, increased 2.5 percent. To be clear, we cannot attribute the difference in employment changes to the minimum wage policy. On the other hand, we cannot rule out the possibility of some previous labor market disruption from minimum wage increases.

To summarize, the region's employment data indicates that jobs in the city's food industry decreased by 4.4 percent (2,379 actual jobs) from 2014 to 2017, after controlling for employment changes in the region's food industry and the city's business and financial occupations.¹ While the statutory 39 percent increase (\$8.25 to \$11.50) in the city's minimum

¹ We estimated that the net 4.4 percentage point decrease in the city's food occupation resulted in 2,379 fewer jobs in the 2014-2017 time period compared to the 2011-2014 time period. With a standard error of 1,287, the 95 percent confidence interval for the 2,379 fewer jobs estimate -4,953 and 195. Because we use jurisdictions close to the city as a control, the estimates may also be biased due to spillover effects on wages into these nearby localities.

wage between years 2014 and 2017 is correlated with a simultaneous decline in the employment level in the city's food industry, it is not possible to rule out other factors that are unobserved, including zoning and land use policy, local development initiatives, economic conditions, and technological change. Moreover, it is not possible to rule out mobility across other non-food related occupations within the low wage labor market.

Other Safety Net Program Interactions

An additional concern is that increased income from the \$15 MWP may be so large as to disqualify low-wage residents for one or more important social welfare benefits. While beyond the scope of this study, it is nonetheless important to consider how minimum wages interact with the safety net, as well as whether and how the workforce and job training system can absorb workers if they are impacted by the policy change (Grogger 2003, Moffitt 2015). As program eligibility is concerned, many programs contain a range of provisions to enhance work incentives, including gradual phase-outs of near-cash program benefits, standard deductions for household size, earnings disregards, and allowances for heating cooking, electricity, and other utilities (e.g. Steuerle 2015).² Many part-time and full-time workers would still qualify for safety net benefits. For example, low income families in the city with incomes below \$35,000 in 2018 for a family of four are eligible—though not entitled—to receive rental housing subsidies.³ For food assistance (SNAP), a household of two must have a maximum salary of \$20,000 or less to be eligible. If anything, minimum wage workers would likely combine higher earnings with SNAP and the EITC (Hardy et al. 2018).

ONLINE APPENDIX B: Selected REMI PI+ Equations and Parameters

REMI CGE Labor Demand Elasticities

Below, we provide a more detailed description of the REMI computable general equilibrium model, adapted from descriptions of the model provided by REMI (2017).

²<https://www.fns.usda.gov/snap/fact-sheet-resources-income-and-benefits>

³ US Department of Housing and Urban Development, Program Income Limits, 2018. <https://www.huduser.gov/portal/datasets/il.html>

With an output in sector i and intermediate input determined, the optimal labor and capital demand in sector i can be calculated from a constant returns to scale Cobb-Douglas function of value added for sector i :

$$VA_i = A_i(L_i)^{\alpha_i}(K_i)^{\beta_i}(F_i)^{\gamma_i}, \quad (1)$$

where A_i is total factor productivity, L_i , K_i , and F_i are labor, capital and fuel sector i respectively, and $\alpha+\beta+\gamma=1$.

Demand for labor can be derived through cost minimization and be expressed as

$$L_i = VA_i \left(\frac{1}{A_i}\right) \left(\frac{w_i}{\alpha_i}\right)^{\alpha_i-1} \left(\frac{r_i}{\beta_i}\right)^{\beta_i-1} \left(\frac{f_i}{\gamma_i}\right)^{\gamma_i-1} \quad (2)$$

Where w_i is the wage rate, r_i is the cost of capital, and f_i the cost of fuel, the short run labor demand elasticity (assuming constant product price and fixed level of capital) is given by:

$$\sigma_L = \frac{\partial \ln(L_i)}{\partial \ln(w_i)} = -\frac{1}{1-\alpha_i} \quad (3)$$

However, beyond the very immediate short run, our assumption of constant product price and fixed level of capital will not hold. As the cost of production increases (thus less is produced), the demand for labor will fall. Also when the wage for labor in industry i increases, demand for labor decreases as the price of capital is now relatively cheaper, and it pays to substitute capital for labor until the share of income going to labor, capital and fuel are equal to α , β and γ respectively. Our CGE model generates long run elasticities that reflect the product demand elasticity and capital labor substitution.

The long run elasticity is given by $n + (1 - \alpha_i)r$, where n is the product demand elasticity and r is capital labor substitution elasticity, which is 1 for Cobb-Douglas production function (Benewitz and Weintraub, 1964). Note that labor demand elasticities for each industry generated by our CGE model not only reflect labor wage relationship for each industry, but also reflect the wage increase in other industries. For example, rising wage in industry i will impact product price and product demand for industry i , and through input-output relationships, may impact product demand for all other industries, hence may impact labor demand by these industries. Table A1 shows the short run labor demand elasticity assuming constant product price, fixed level of capital and no change in capital, labor nor technological productivity for select industries in the District of Columbia. However, to allow for a new regional general equilibrium, the model allows for price adjustments, capital-labor substitutions, labor force migration, and technological changes. These binding dynamics produce a labor demand elasticity in 2021 vis-à-vis the respective employment and wage changes also in 2021.

Table A1. Select Short Run Labor Demand Elasticities and Employment Impacts

Industry	Labor Demand Elasticity (Short Run)	Labor Demand Elasticity in 2021 (CGE)	Employment change in 2021(CG E)	Wage Change in 2021(CG E)
22 - Utilities	-1.38	-0.80	-0.1%	0.1%
23 - Construction	-2.44	-1.64	-0.5%	0.3%
334 - Computer and electronic product manufacturing	-2.49	-0.17	0.0%	0.1%
42 - Wholesale trade	-2.01	-0.41	-0.1%	0.2%
44-45 - Retail trade	-2.33	-0.32	-1.1%	3.4%
492 - Couriers and messengers	-2.82	-0.26	-0.2%	0.8%
485 - Transit and ground passenger transportation	-1.94	-0.23	-0.7%	3.0%
487-488 - Scenic and sightseeing transportation and support activities	-2.94	-0.23	-0.2%	0.8%
524 - Insurance carriers and related activities	-2.02	-0.05	0.0%	0.1%
55 - Management of companies and enterprises	-6.02	-1.60	-0.1%	0.1%
561 - Administrative and support services	-3.83	-0.13	-0.1%	0.8%
562 - Waste management and remediation services	-2.16	-0.26	-0.1%	0.5%
61 - Educational services; private	-5.89	-0.09	0.0%	0.5%
621 - Ambulatory health care services	-4.30	-0.32	-0.2%	0.6%
622 - Hospitals; private	-8.51	-0.06	0.0%	0.4%
623 - Nursing and residential care facilities	-7.52	-0.24	-0.6%	2.7%
624 - Social assistance	-5.19	-0.19	-0.3%	1.5%
711 - Performing arts and spectator sports	-1.98	-0.16	-0.3%	1.6%
712 - Museums, historical sites, zoos, and parks	-4.58	-0.09	-0.1%	1.6%
713 - Amusement, gambling, and recreation	-2.52	-0.18	-0.7%	4.2%
721 - Accommodation	-2.02	-0.16	-0.3%	2.2%
722 - Food services and drinking places	-2.89	-0.22	-1.4%	6.4%
811 - Repair and maintenance	-2.98	-0.27	-0.5%	1.8%
812 - Personal and laundry services	-2.15	-0.19	-0.7%	3.6%
813 - Membership associations and organizations	-4.38	-0.26	-0.1%	0.5%

Table A2. Price and Income Elasticities in Consumption Equation (Equation 1-7)

Commodity	Elasticity Type	Necessities	Luxuries
All Commodities	Income Elasticity	0.61	1.34
All Commodities	Price Elasticity	-0.66	-1.65

Notes: All parameters and elasticities for Tables A2 – A9 are based on proprietary information from REMI Inc. Equations for each of the following tables can be found in REMI (2017).

Table A3. Consumer Price Elasticity (α and β in commuter share equation, equation 1-17)

Region	α	β
All Regions	2.89	1.62

Table A4. λ in the moving average of gap between optimal and actual capital stock equation (equations 2-12 and 2-13). Speed of adjustment by investment type:

Region	λ Value:
All Regions	0.5

Table A5. Parameters in the Economic Migration Equation (Equation 3-6 Through 3-9), β_1 : Responses to Changes in Relative Employment Opportunity; β_2 : Responses to Changes in Relative Wage Rate

Region	Parameter	Default	Alternative
All Regions	β_1	0.455	0.28
All Regions	β_2	0.271	0.28

Table A6. α_1 in the compensation, wage, and earnings rate equations (equations 4-13 through 4-18)

Panel 1: Responses to Changes in Employment Opportunity

Equation	Default	Alternative
Compensation Rate	0.0605	0.0645
Wage Rate	0.0627	0.0819
Earnings Rate	0.0894	0.0852

Panel 2: Responses to Changes in Occupational Demand

Equation	Default	Alternative
Compensation Rate	0.0378	0.0388
Wage Rate	0.0303	0.0364
Earnings Rate	0.0174	0.0146

Table A7. Elasticity of substitution α in the Labor Productivity Equation Depending on Occupational Labor Access for Selected Occupations (Equation 2-1)

Occupation	Elasticity of Substitution
Counselors and Social workers	14.57
Miscellaneous community and social service specialists	14.57
Legal support workers	14.57
Preschool, primary, secondary, and special education school teachers	14.57
Other teachers and instructors	14.57

Librarians, curators, and archivists	14.57
Other education, training, and library occupations	14.57
Nursing, psychiatric, and home health aides	14.57
Occupational therapy and physical therapist assistants and aides	14.57
Cooks and food preparation workers	16.49
Food and beverage serving workers	16.49
Other food preparation and serving related workers	16.49
Building cleaning and pest control workers	16.49
Grounds maintenance workers	16.49
Animal care and service workers	16.49
Entertainment attendants and related workers	16.49
Funeral service workers	16.49
Personal appearance workers	16.49
Baggage porters, bellhops, and concierges; Tour and travel guides	16.49
Other personal care and service workers	16.49
Retail sales workers	13.75
Sales representatives, services	13.75
Sales representatives, wholesale and manufacturing	13.75
Other sales and related workers	13.75
Material recording, scheduling, dispatching, and distributing workers	13.75
Secretaries and administrative assistants	13.75
Food processing workers	11.27
Material moving workers	11.35

Table A8. Price Elasticity of Demand (α) in the Market Share, International Exports Market Share, and Domestic Demand Market Share Equations for Selected Industries (Equation 5-1 through 5-5)

Industry	Default Price Elasticity of Demand	Alternative Price Elasticity of Demand
Utilities	2.37	2.93
Construction	3.07	1.68
Computer and electronic product manufacturing	4.62	2.96
Wholesale trade	1.64	2.04
Retail trade	3.33	3.61
Couriers and messengers	3.16	1.50
Transit and ground passenger transportation	2.79	3.16
Scenic and sightseeing transportation; Support activities for transportation	1.85	2.65
Insurance carriers and related activities	1.22	1.50
Management of companies and enterprises	2.92	2.98
Waste management and remediation services	1.82	2.35
Educational services; private	1.30	1.55

Ambulatory health care services	1.96	2.86
Hospitals; private	1.46	4.40
Nursing and residential care facilities	2.13	2.90
Social assistance	2.20	1.50
Performing arts, spectator sports, and related industries	2.53	1.50
Museums, historical sites, and similar institutions	1.75	2.64
Amusement, gambling, and recreation industries	1.65	2.02
Accommodation	2.85	4.32
Food services and drinking places	2.85	4.93
Repair and maintenance	2.52	3.87
Personal and laundry services	2.52	3.16

Table A9. β in the Market Share Equation, Distance Decay Parameter in a Gravity Model for Selected Industries (Equation 5-2)

Industry	β Value
Utilities	2.71
Construction	2.91
Computer and electronic product manufacturing	1.88
Wholesale trade	1.36
Retail trade	2.54
Couriers and messengers	1.34
Transit and ground passenger transportation	2.28
Scenic and sightseeing transportation; Support activities for transportation	1.91
Insurance carriers and related activities	1.09
Management of companies and enterprises	2.83
Waste management and remediation services	1.62
Educational services; private	1.03
Ambulatory health care services	1.97
Hospitals; private	1.11
Nursing and residential care facilities	1.23
Social assistance	2.11
Performing arts, spectator sports, and related industries	1.68
Museums, historical sites, and similar institutions	0.81
Amusement, gambling, and recreation industries	1.04
Accommodation	1.93
Food services and drinking places	1.93
Repair and maintenance	1.74
Personal and laundry services	1.74