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Labor Market Effects of Minimum Wage Shocks

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Martin Micheli[1]

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Abstract

The theoretical literature argues that labor markets outcomes are affected by real minimum wages. Real minimum wages, however, co-move with the business cycle; their correlation with labor market outcomes should therefore not be interpreted causally. We employ structural vector autoregression to distinguish between endogenous variation in real minimum wages, e.g. due to changes in the stance of the business cycle, and exogenous shocks. Impulse responses show that in the US, real minimum wage shocks increased teen wages and lowered employment and working hours of teenagers.

JEL-Code: J3, J48

Keywords: Minimum wage; panel VAR; teen employment; teen working hours; teen wages; US

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1 Introduction

How do minimum wages affect the labor market? This question has occupied labor economists for decades. There seems to be a consensus among economists that minimum wages increase wages of affected individuals. No consensus, however, has emerged with regard to employment effects of minimum wages.

The literature typically estimates the employment response after a change in the nominal minimum wage. The resulting employment elasticity is typically interpreted as causal effect of a nominal minimum wage change.[1] Employing this strategy, negative employment effects have e.g. been documented by Neumark et al. (2014), Meer and West (2016), and Clemens and Wither (2019)[2]. Focusing on spatially close regions, Dube et al. (2010), Allegretto et al. (2011), and Dube et al. (2016) do not find significant dis-employment effects of minimum wages, which started a fierce debate about the appropriate control group in minimum wage research (Allegretto et al., 2017; Neumark and Wascher, 2017).

Economic theory suggests that real minimum wages, not nominal ones, drive labor market outcomes. Using this insight, Micheli (2019) documents a negative correlation between real minimum wages and teen employment and teen working hours and a positive one between real minimum wages and real teen wages in the US. These correlations, however, should not be interpreted as causal effects. Real minimum wages obviously comove with the business cycle, which raises concerns with regard to endogeneity of real minimum wages.[3]

This paper contributes to the literature by estimating the effects of real minimum wage shocks on labor market outcomes. Structural vector autoregression (VAR) is well suited to disentangle an endogenous response of a policy variable from an exogenous policy shock. It is therefore widely used in the analysis of monetary and fiscal policy. We apply this method to the analysis of minimum wage policy. We estimate a panel VAR for the 50 US states and the District of Columbia, identify shocks, and calculate the responses of teen employment, teen wages, and teen working hours to these real minimum wage shocks.

Real minimum wage shocks increase hourly wages of teenagers. Employment and working hours of teenagers decrease significantly. These results are robust to different

[1] Some papers deflate nominal minimum wages by an all country price index. When controlling for time-fixed effects in the estimation, the estimated coefficient, however, still represents the nominal minimum wage elasticity (Meer and West, 2016, footnote 10).

[2] Clemens and Wither (2019) also compare affected and unaffected individuals within a state, the estimated elasticities are very similar.

[3] The literature also discusses whether nominal minimum wages might be endogenous and its implications for the interpretation of estimated nominal elasticities (Reich, 2009; Neumark et al., 2014).

assumptions in the identification of minimum wage shocks, different lag lengths, and the inclusion of different variables that capture the stance of the business cycle.

2 Data

This study uses a panel of the 50 US states and the District of Columbia. The data has a quarterly frequency and covers the years from 1991 to 2017. We use state level information on real minimum wages, the unemployment rate, real wages of teenagers, the teen employment share, and working hours of teenager. In a robustness check we also use information on real house prices.

Our main data source is the Current Population Survey (CPS), we use the Integrated Public Use Microdata Series database (Flood et al., 2018). We construct state level averages for teen wages, the teen employment share, and teen working hours based on this dataset. We interpret teenagers as individuals between 16 and 19. The teen employment share is the average number of working teenagers divided by teen population in the respective quarter and state.[4] For teen working hours, we use average working hours by teenagers in the previous week.[5] Nominal hourly wages of teenagers are average earnings per hour for teens that are paid an hourly wage.[6]

Neumark (2019) provides information on state level nominal minimum wages on a monthly frequency. The minimum wage is the maximum of the state specific and the federal minimum wage. We convert this monthly dataset to the quarterly frequency by averaging observations. State level unemployment rates are available at the BLS.

We use state level GDP deflators as proxies for the price level. We construct deflators based on nominal and real GDP, which are available at the BEA. State level GDP is available on an annual frequency, only. We convert this information to the quarterly frequency by employing the Denton-Cholette transformation with a constant (Denton, 1971; Cholette, 1984).[7]

We deflate nominal values, more precisely nominal wages of teenagers and nominal minimum wages using GDP deflators, to get real values.

In a robustness check, we use information on state level house prices. These are

[4]Due to data availability issues with respect to weights for labor force variables, we folllow Micheli (2019) and use final basic weights for the years from 1991 to 1997 and labor force weights for 1998 and afterward, which reproduces officially published numbers by the BLS quite accurately.

[5]We again use final basic weights for the time period from 1991 to 1997.

[6]Wage information in the CPS is only available for the outgoing rotation group.

[7]Micheli (2019) shows that the correlation between minimum wages and real minimum wages is unaffected by the method used to transform annual GDP deflators to a higher frequency.

available at the Federal Housing Finance Agency (FHFA). We use seasonally adjusted nominal house price indexes based on purchase-only indexes, which are available starting in 1991. We again use state level GDP deflators to get indexes for real house prices.

For each state, we regress seasonally unadjusted variables, more precisely the teen employment share, teen working hours as well as hourly and minimum wages on quarterly dummys to remove seasonality. Summary statistics for all the variables used in the analysis are reported in Table 1. The average state level unemployment rate in the time period from 1991 to 2017 was 5.6 percent. About 39 percent of the teenagers in a state were working. They worked about 24 hours per week and earned 7.3 US-Dollar per hour in nominal terms, which has been well above the average minimum wage of 6.0 US-Dollar.

3 Methodology

The significant correlation between real minimum wages and labor market outcomes for teenagers should not be interpreted causally (Micheli, 2019) as both, real minimum wages and labor market outcomes, are affected by the stance of the business cycle. Real minimum wages gradually decline over time with the inverse of the inflation rate. Additionally to that, the government regularly adjusts nominal minimum wages to prevent real minimum wages from ceasing to be binding, which has also been argued to depend on the stance of the economy (Reich, 2009).

This paper aims at drawing causal inference, which requires independence of the policy shock from all other variables under consideration. Other fields of economics face very similar challenges and assess structural vector autoregresison to be the best method to identify shocks and estimate their effects on the economy in such a setup.

Most prominently, vector autoregression is heavily used in the analysis of monetary policy (Leeper et al., 1996; Christiano et al., 1999). Here, the proxy for the stance of monetary policy, most commonly an interest rate or a monetary aggregate, is explicitly adjusted depending on the business cycle. Identifying changes in the policy variable as exogenous shocks is therefore not a valid strategy.

The analysis of fiscal policy also increasingly relies on vector autoregression (Blanchard and Perotti, 2002; Mertens and Ravn, 2010). Blanchard and Perotti (2002) argue that vector autoregression is even better suited for the analysis of fiscal than of monetary policy, for two reasons. First, the purpose of fiscal policy is not predominantly the stabilization of the economy, such that there are fiscal shocks in the first place. Second, implementation lags of fiscal policy are substantially longer, which increases the credibility of the identification strategy.

Both arguments are also valid for minimum wage policy. Even though real minimum wages co-move with the business cycle, they are driven by a variety of factors, which should be exogenous to our model. Implementation lags for minimum wage policies are also non-negligible. Given the quarterly frequency of our data in combination with sticky prices, it is reasonable to assume that real minimum wages are unaffected by contemporaneous shocks to other variables in the model.

This paper therefore employs structural vector autoregression to identify minimum wage shocks and estimate their effects on labor market outcomes for teenagers. We are interested in the average effect of minimum wages, we therefore estimate a panel vector autoregressive model, which can be written as

$$\begin{pmatrix} y_{1,t} \\ y_{2,t} \\ \vdots \\ y_{N,t} \end{pmatrix} = \begin{pmatrix} \mu_1 \\ \mu_2 \\ \vdots \\ \mu_N \end{pmatrix} + \begin{pmatrix} A_1^1 & 0 & \cdots & 0 \\ 0 & A_2^1 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & A_N^1 \end{pmatrix} \begin{pmatrix} y_{1,t-1} \\ y_{2,t-1} \\ \vdots \\ y_{N,t-1} \end{pmatrix} + \cdots + \begin{pmatrix} A_1^P & 0 & \cdots & 0 \\ 0 & A_2^P & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & A_N^P \end{pmatrix} \begin{pmatrix} y_{1,t-P} \\ y_{2,t-P} \\ \vdots \\ y_{N,t-P} \end{pmatrix} + \begin{pmatrix} \epsilon_{1,t} \\ \epsilon_{2,t} \\ \vdots \\ \epsilon_{N,t} \end{pmatrix} . \quad (1)$$

$y_{i,t}$ represents the $k \times 1$ vectors of endogenous variables. $i \in \{1..N\}$ and t indicate the state and the time period. μ_i collects the $k \times 1$ vectors of constants. The matrices A_i^p capture the effects of past realizations of endogenous variables in the respective state on current outcomes. $p \in \{1..P\}$ indicates the lag length. Past realizations of endogenous variables do not affect realizations in another states.

We employ the mean group estimator of Pesaran and Smith (1995). In contrast to a simple fixed-effect estimator, this estimator is consistent if lagged coefficients of endogenous variables differ across states. Coefficients are assumed to vary randomly across states.

We employ a Choleski-decomposition to identify shocks to the endogenous variables. In the baseline specification, we assume the ordering: real minimum wage, unemployment rate, real teenage wages, teen employment, teen working hours. This assumes that real minimum wages are contemporaneously unaffected by shocks to other variables. Real minimum wage shocks, however, affect all other variables in the same period.

The intuition for ranking real minimum wages first is straightforward. Real minimum

wages might change due to the government adjusting nominal minimum wages or due to changes in the price level. Nominal minimum wages should be orthogonal to contemporaneous shocks in other variables due time lags in the legislative process. Sticky prices imply that the price level adjusts to shocks with a lag. Real minimum wages might therefore be assumed to be unaffected by contemporaneous shocks to other variables.[8]

We estimate the panel VAR and calculate impulse responses and corresponding error bands employing the bootstrap-after-bootstrap (Kilian, 1998).[9]

4 Estimation Results

This section presents the impulse response analysis. Impulse responses represent the bootstrapped mean response of the respective variable after 2000 bootstraps. Shaded areas indicate the one and two standard error confidence bands.

Figure 1 presents impulse responses after a one standard deviation shock to real minimum wages employing the baseline ordering real minimum wage, unemployment rate, real teen wage, teen employment, teen working hours. Real minimum wages increase after a positive real minimum wage shock. The effect is highly persistent, real minimum wages remain elevated for a prolonged period of time. Real wages of teenagers also increase, but less than one for one as not all teenagers earn the minimum wage. The wage effect is strongest after about one year.

Employment and working hours of teenagers, on the other hand, decrease after a positive real minimum wage shock. The response of these two quantities is more sluggish than the wage response. It peaks after about two years. The decrease in the teen employment share peaks at about 0.9 percentage points. Working hours reduce by about 0.4 percent. The unemployment rate increases after a real minimum wage shock.

We proceed by testing for the robustness of this result. First, we investigate robustness with respect to the variable ordering. So far, we assumed that real minimum wages are unaffected by contemporaneous shocks due to sticky prices and time lags due to the legislative process. Figure 2 presents impulse responses assuming that minimum wage shocks do not affect other variables contemporaneously but are affected by contemporaneous shocks to all variables. With the exception of the imposed orthogonality of all other

[8]We examine the sensitivity of the estimated responses to a minimum wage shock by varying the assumption of exogeneity of real minimum wages. Changing the ordering of the variables is a standard procedure to check for the robustness of the results.

[9]Instead of bootstrapping the estimation bias like Kilian (1998), we follow Bruder and Wolf (2018) and approximate the bias up to first order according to Pope (1990). Impulse responses are based on 2000 bootstrap replications.

variables to a real minimum wage shock in the initial period, impulse responses are very similar to the baseline. Real teen wages and the general unemployment rate increase, employment and working hours of teenagers decrease after a minimum wage shock.

Clemens and Wither (2019) argue that house prices are an important proxy of the local business cycle. We therefore include real house prices in our panel VAR. Real house prices decrease after a shock to real minimum wages (Figure 3).[10] Even though the effect is statistically significant, it seems quantitatively negligible. The responses of all other variables, real minimum wages, the unemployment rate as well as teen real wages, employment, and working hours are unaffected by the inclusion of house prices. Allowing for minimum wages to be contemporaneously affected by shocks to all the other variables also does not change the results (Figure A.3 in the Appendix).

We proceed by increasing the lag length of our estimated panel VAR. Previously, we assumed that endogenous variables were affected by lagged observations of up to two quarters. Figure 4 presents impulse responses when including four lags of the endogenous variables. Impulse responses are, however, hardly affected by the increase in the lag length. Unemployment and teen wages increase after a minimum wage shock, working hours and employment of teenagers decrease. Changing the variable ordering does, again, not affect the results (Figure A.4 in the Appendix).

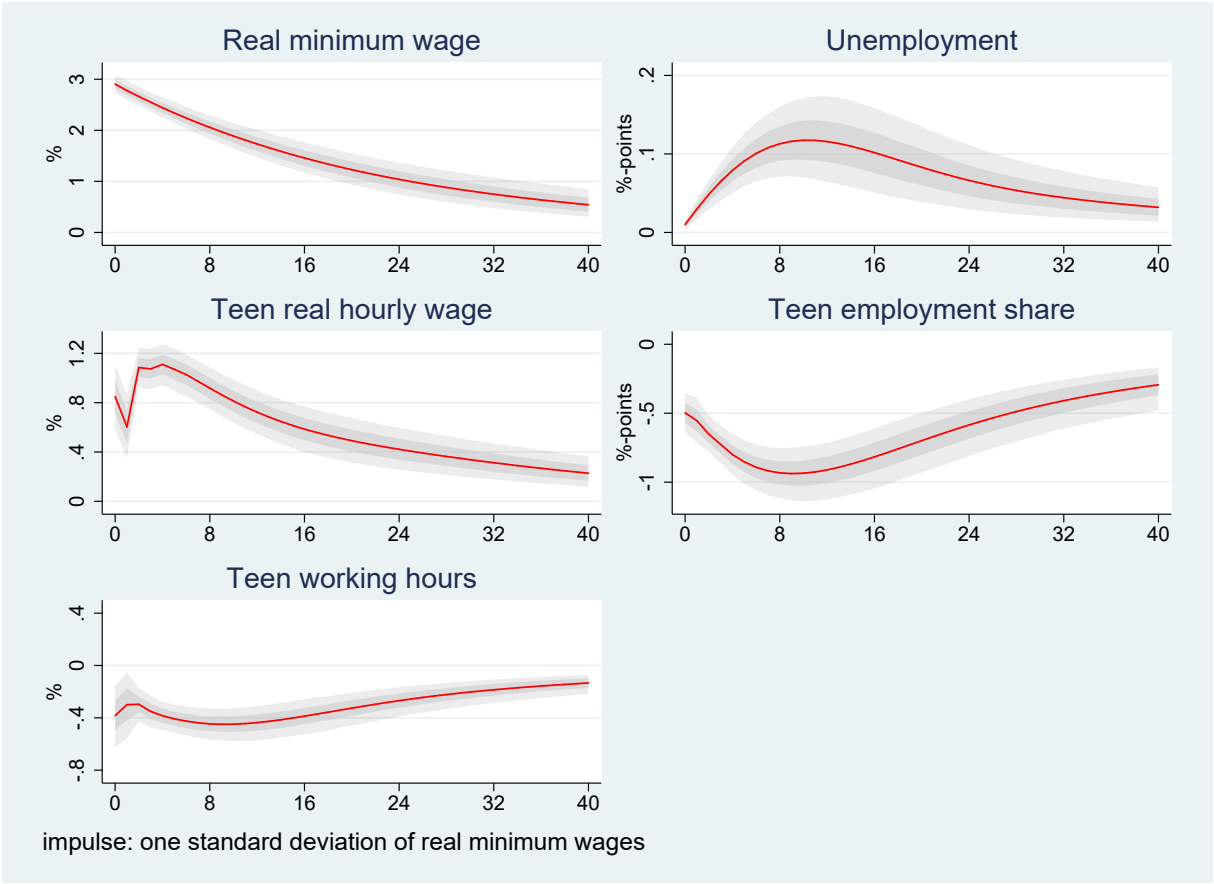
5 Concluding Remarks

This paper employs vector autoregression to estimate the effect of real minimum wage shocks on labor market outcomes. Structural vector autoregression disentangles endogenous variation in real minimum wages from exogenous shocks.

We estimate average minimum wage effects in a panel of US states in the time period from 1991 to 2017. Real minimum wage shocks increase real hourly wages of teenagers. Teen employment and teen working hours, on the other hand, decease after a minimum wage shock.

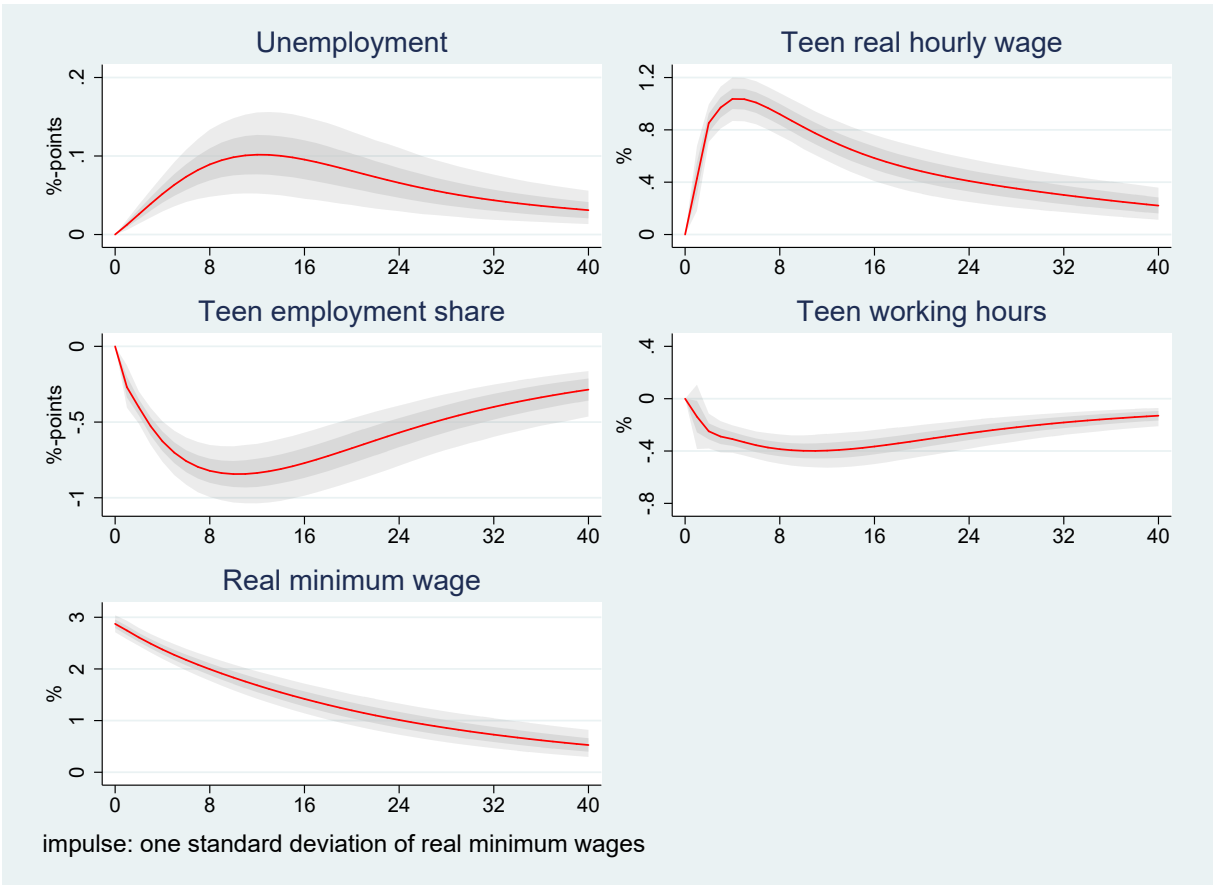
[10] Figures A.1 and A.2 show impulse responses when excluding endogenous variables that indicate the stance of the business cycle.

Figure 1: Impulse responses to a real minimum wage shock, baseline model



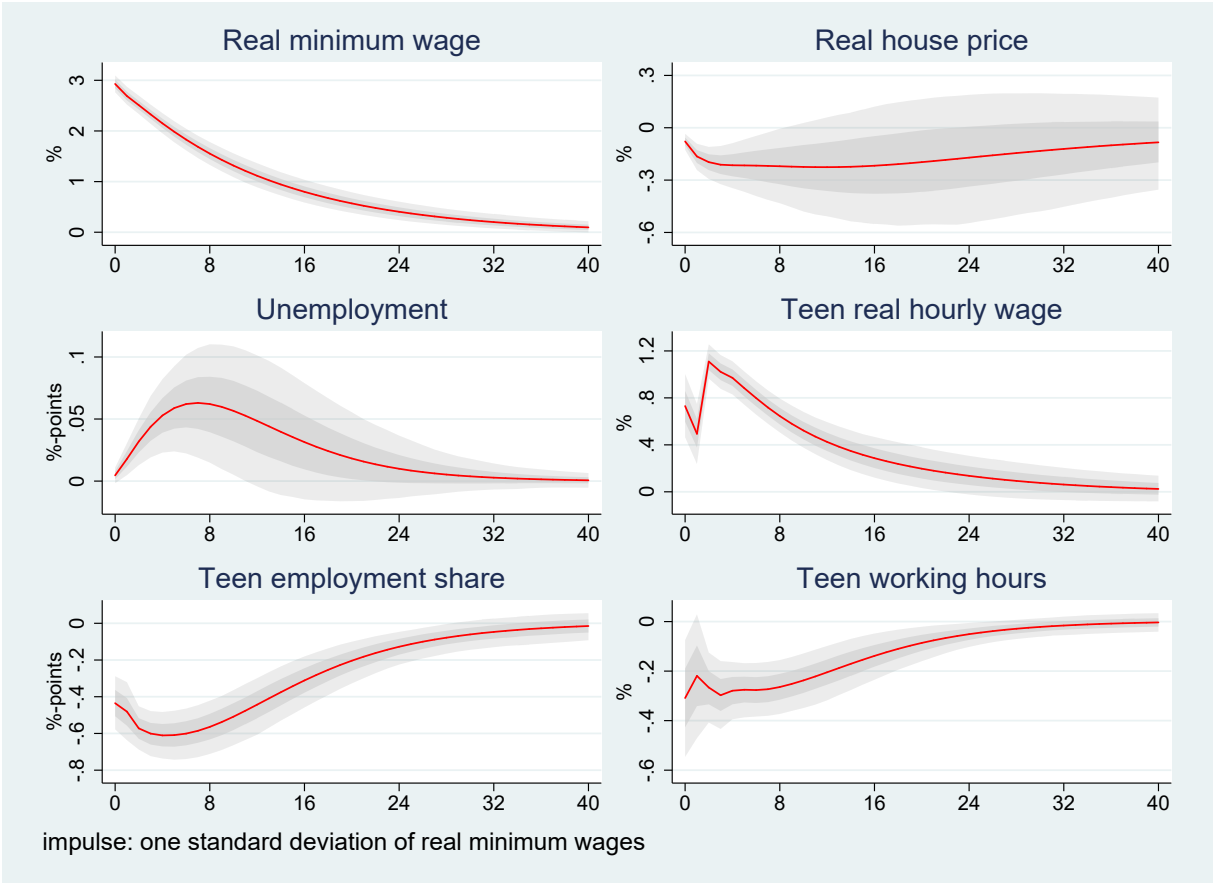
Notes: Impulse responses are bootstrapped mean responses based on 2,000 replications. Shaded areas indicate one and two standard error conficence bands. We include two lags of the endogenous variables.

Figure 2: Impulse responses to a real minimum wage shock, baseline model with alternative variable ordering



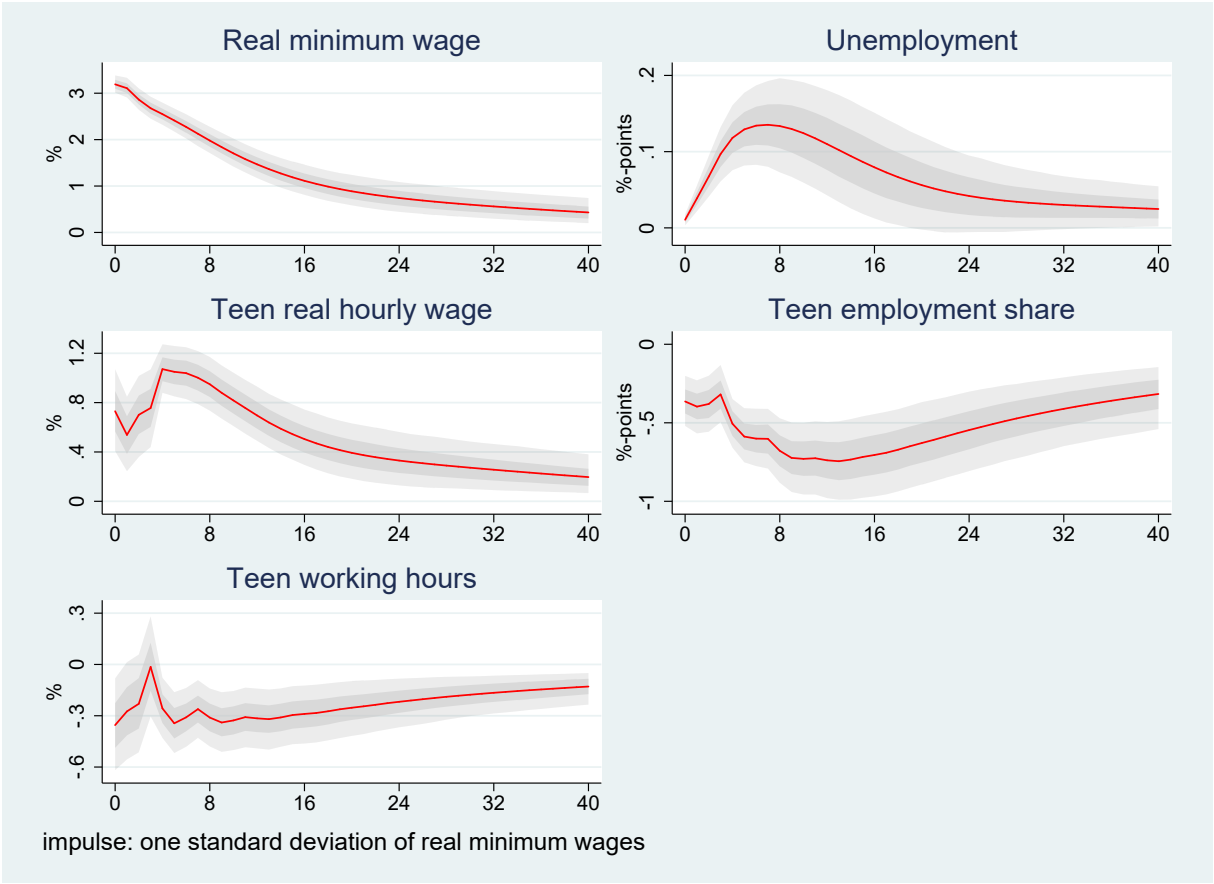
Notes: Impulse responses are bootstrapped mean responses based on 2,000 replications. Shaded areas indicate one and two standard error conficence bands. We include two lags of the endogenous variables.

Figure 3: Impulse responses to a real minimum wage shock, model with house prices



Notes: Impulse responses are bootstrapped mean responses based on 2,000 replications. Shaded areas indicate one and two standard error conficence bands. We include two lags of the endogenous variables.

Figure 4: Impulse responses to a real minimum wage shock, model with four lags



Notes: Impulse responses are bootstrapped mean responses based on 2,000 replications. Shaded areas indicate one and two standard error conficence bands. We include four lags of the endogenous variables.

Table 1: Descriptive statistics, sample period 1991-2017

Original data	Mean	Std dev	Observations
Nominal house price index[a]	174.8446	58.9566	5,508
Unemployment rate[a]	0.0562	0.0188	5,508
Nominal minimum wage	6.0085	1.4583	5,508
Nominal wage of teenagers	7.2989	1.6651	5,508
Teen employment share	0.3925	0.1172	5,508
Last week's working hours of teenagers	24.0761	3.1514	5,508
GDP deflator	84.9366	14.4695	1,377
Input for VAR			
log(Real house price)[a,b]	5.2880	0.2184	5,508
Unemployment rate[a]	0.0562	0.0188	5,508
log(Real minimum wage)[a,b]	1.9428	0.1161	5,508
log(Real wage of teenagers)[a,b]	2.1394	0.1182	5,508
Teen employment share[a]	0.3925	0.1135	5,508
log(Last week's working hours of teenagers)[a]	3.1753	0.1095	5,508

The base year for GDP deflators is 2012 (2012=100). The base period for house prices is the first quarter of 1991 (1991Q1=100). [a] Data is seasonally adjusted. [b] GDP deflators are converted to the quarterly frequency using the Denton-Cholette method with a constant.

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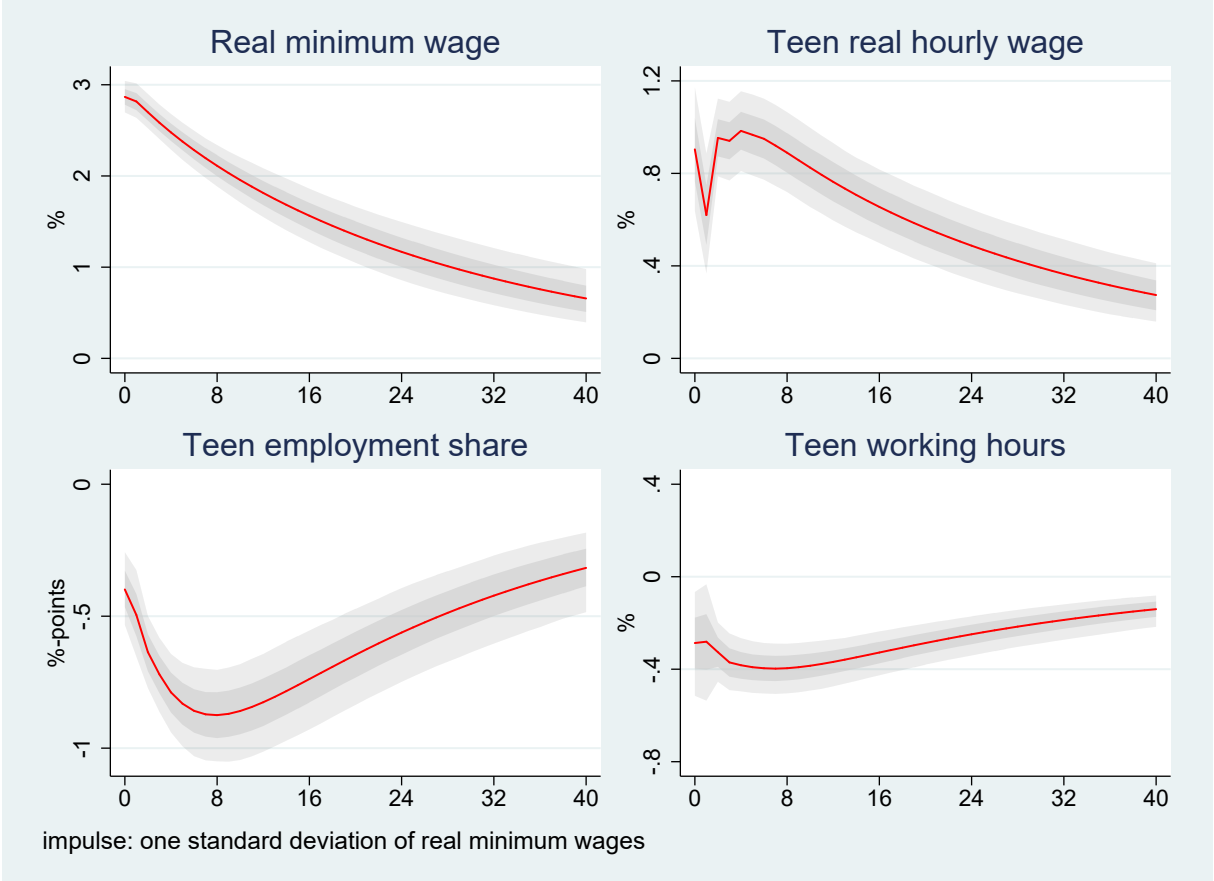
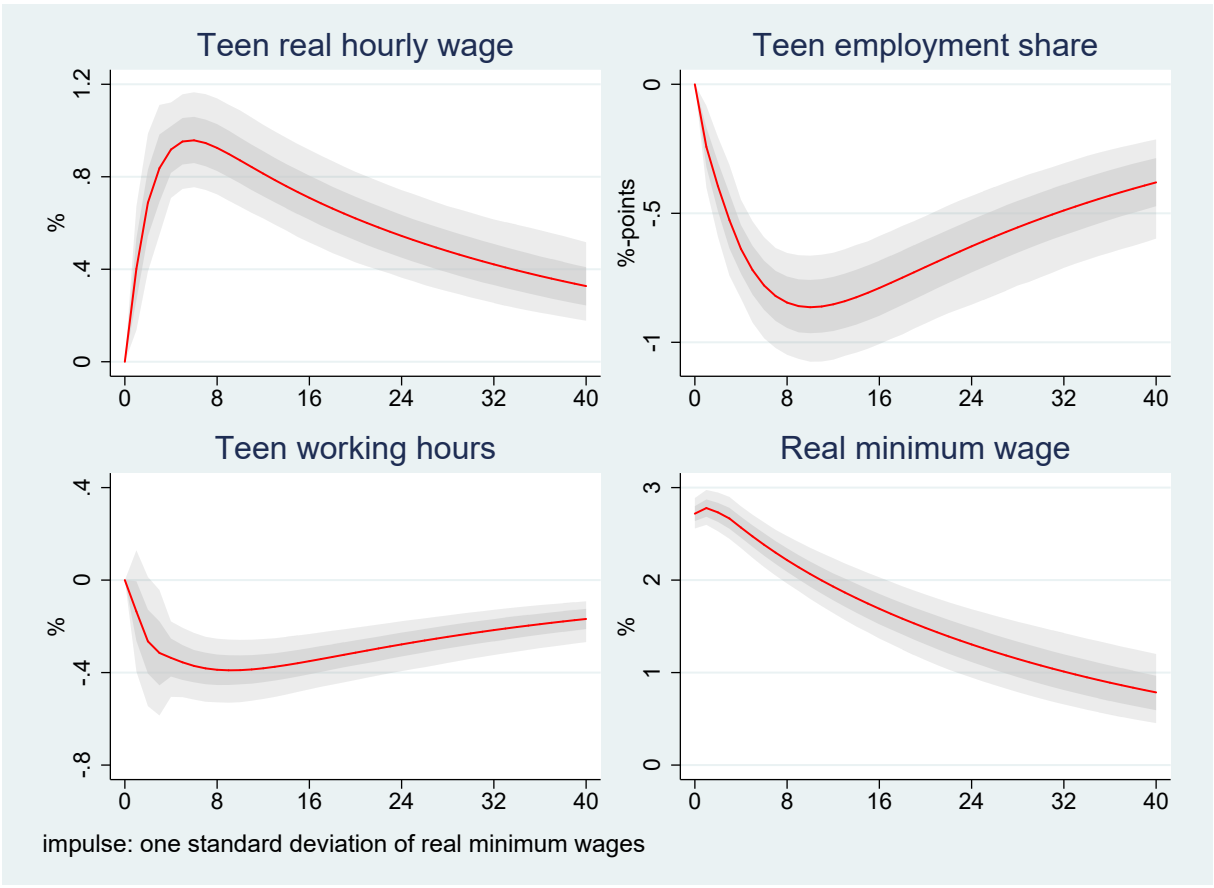
Appendix

Figure A.1: Impulse responses to a real minimum wage shock, four variable model



Notes: Impulse responses are bootstrapped mean responses based on 2,000 replications. Shaded areas indicate one and two standard error conficence bands. We include two lags of the endogenous variables.

Figure A.2: Impulse responses to a real minimum wage shock, four variable model with alternative variable ordering

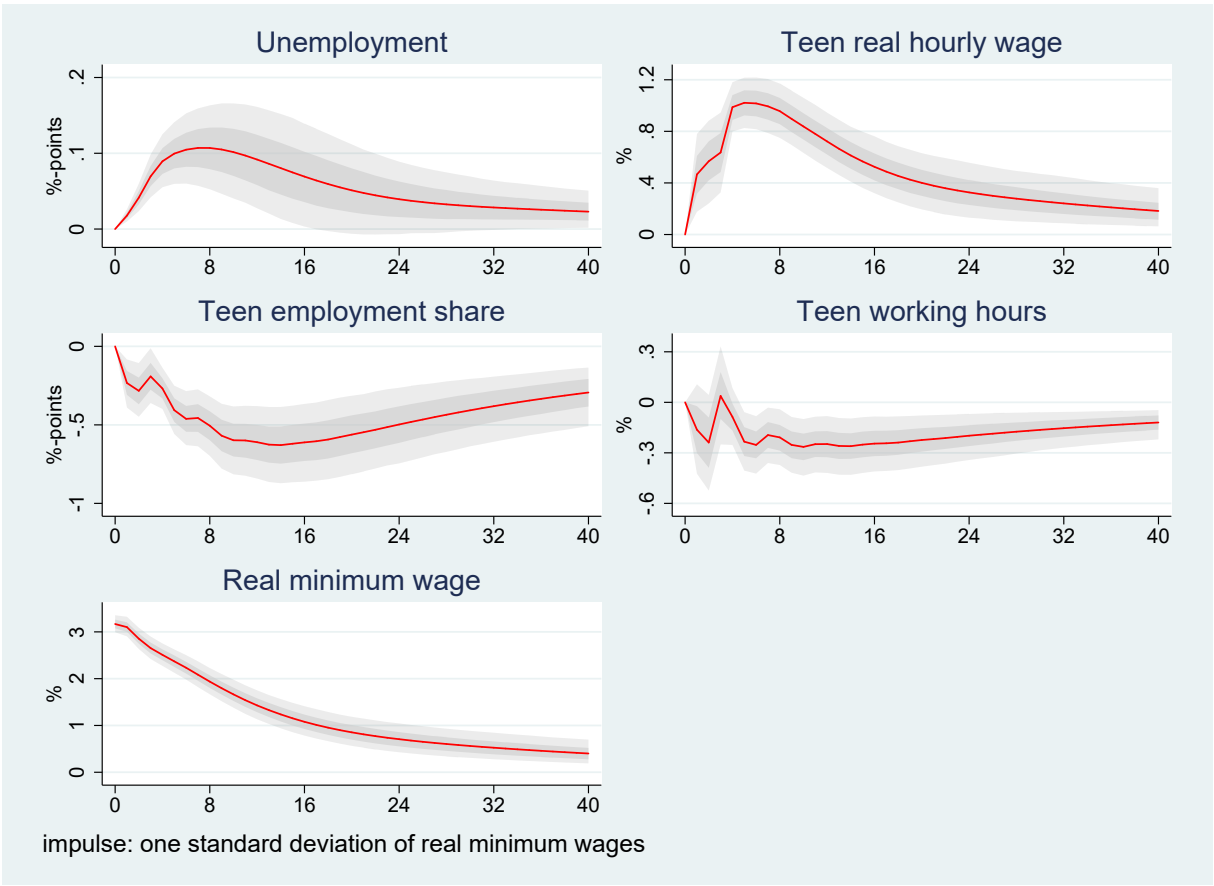


Notes: Impulse responses are bootstrapped mean responses based on 2,000 replications. Shaded areas indicate one and two standard error confidence bands. We include two lags of the endogenous variables.

Figure A.3: Impulse responses to a real minimum wage shock, model with house prices and alternative variable ordering

Notes: Impulse responses are bootstrapped mean responses based on 2,000 replications. Shaded areas indicate one and two standard error conficence bands. We include two lags of the endogenous variables.

Figure A.4: Impulse responses to a real minimum wage shock, model with four lags and alternative variable ordering



Notes: Impulse responses are bootstrapped mean responses based on 2,000 replications. Shaded areas indicate one and two standard error conficence bands. We include four lags of the endogenous variables.