New Evidence on the Effect of Right-to-Work Laws on Productivity and Population Growth

Michael J. Hicks, Michael LaFaive, and Srikant Devaraj

In his study of right-to-work (RTW) laws, Richard Vedder (2010) outlined the classical-liberal argument regarding workplace liberty and offered evidence of the effects of RTW legislation on employment and output in individual states. He found that RTW laws have a positive impact on both jobs and output as firms and workers move to states with greater economic freedom.

This article extends Vedder's work by examining the impact of RTW laws on productivity and population growth. We begin with a review of the literature on both issues. Second, we reprise the exposition of labor demand theory offered by Hicks and LaFaive (2013), directly tying their work to estimates of total factor productivity (TFP), the Solow residual, and labor productivity across RTW and non-RTW states. Third, we re-evaluate earlier estimates of the effect of RTW laws on population growth offered by Hicks (2012) and Hicks and LaFaive (2013). In doing so, we incorporate an identification

---

Cato Journal, Vol. 36, No. 1 (Winter 2016).

Michael J. Hicks is the George and Frances Ball Distinguished Professor of Economics and Director of the Center for Business and Economic Research at Ball State University. Michael LaFaive is the Director of the Morey Fiscal Policy Initiative at the Mackinac Center for Public Policy. Srikant Devaraj is Research Assistant Professor at the Center for Business and Economic Research at Ball State University.

strategy introduced by Hicks (2012) designed to adjust for population growth unrelated to RTW legislation.

The Impact of Right-to-Work Legislation: A Review of the Literature

The National Labor Relations Act of 1935 (the Wagner Act) did not permit states to restrict union contracts from mandating universal union membership within a union-represented establishment. In 1947, the Taft-Hartley Act allowed states to opt out of this requirement and allowed employees to avoid union membership and payment of union dues. The affirming vote of states to permit this union opt-out has become known as RTW legislation.

Some state legislatures actually voted for RTW laws prior to passage of the Taft-Hartley Act. The states that first passed RTW laws were heavily concentrated in the South, Southwest, and Great Plains. Those regions were not heavily industrialized at the time and did not possess large transportation sectors. Furthermore, there was considerable cultural opposition in the South toward the labor movement (Black and Black 1989). Since the Taft-Hartley Act, 25 states have passed RTW legislation, with Indiana doing so twice. The two most recent adopters are in the heavily unionized manufacturing states of Indiana and Michigan.

A large body of analysis has been performed regarding the impact of RTW legislation. The role of RTW legislation on unionization levels and rates has a long empirical history (Dickens and Leonard 1985, Freeman 1985, Farber 1987, Lazear 1988, Reder 1988, Jarley and Fiorito 1990, Moore 1998) and generally concludes that RTW laws reduce private-sector union participation, although some later works (e.g., Koeller 1994) find no impact.

Newman (1983) focused on RTW laws in the South from the 1940s through 1970s and found that RTW legislation was a significant contributor to population growth as labor-intensive manufacturing firms moved to RTW states.

Holmes (1998) extended Newman's work by using RTW as an identification tool to siphon out the impact of other business-friendly policies on firm location at the county level. His study was especially important in that it included a broad range of business-friendly policies in a carefully executed study of counties in different states but with contiguous borders. Holmes (1998) reports a very

large increase in manufacturing employment in places with business-friendly policies and no unusual geographic complications. For example, he notes that while Louisiana and Mississippi are both RTW states, their border shows stark differences in manufacturing location because Louisiana has a long history of unfriendly policies toward business.

More recently, Stevans (2009) introduced an endogeneity correction in the adoption of a RTW law. Since it is possible that local factors (such as strong unions) prevent the passage of RTW laws, any test of RTW versus non-RTW states is not a natural experiment. Stevans found that after applying an econometric correction for the endogeneity problem, there were no wage or employment effects of RTW legislation. Vedder, Denhart, and Robe (2011) conducted a study of RTW using a pooled OLS (ordinary least squares) model from 1977 through 2007. They found a roughly 1 percent increase in the growth rate of per capita personal income for states passing RTW legislation. The strength of their work is its parameterization of several contributing factors and the length of time analyzed, but they do not correct for the endogeneity problem.

Hicks (2012) estimated the impact of RTW laws on manufacturing employment, manufacturing incomes, and the share of manufacturing income in states from 1929 through 2005. He examined the actual effect of RTW legislation using an identification strategy that isolated old Southern states and 1947 manufacturing employment to account for political factors affecting the passage of RTW laws. Hicks reported no impacts on manufacturing employment, share, or incomes from the full sample. However, there were statistically significant contributions of RTW laws to manufacturing income growth in the vast majority of states that had adopted legislation since 1950. Criticism of the empirical design of the study prompted a follow-up article (Hicks and LaFaive 2013) that looked at shorter time periods. The new study found that prior to 1970, RTW legislation had only a small effect on population, income, and employment. However, later periods (1971–90 and 1991–2011) saw a large and statistically significant influence of RTW.

Vedder (2010) extends the RTW literature by identifying two likely effects of RTW legislation—namely, higher population growth and levels, and higher labor productivity. His work offers its greatest contribution in explaining the transmission of policy to the action of individuals and firms. Vedder (2010: 178) suggests that his empirical

work "is likely not the last word," and it is in that spirit we proceed to refine his empirical framework.

Economic Theory and Right-to-Work Legislation

Minimal formal modeling of the impact of RTW legislation exists in the economic literature. The work outlined above is either empirical or offers a descriptive theory of effects. Reed (2003) provides a review of the complexity of economic theory surrounding RTW laws and develops several arguments. The first of these is that the presence of RTW laws may permit nonunion workers to free ride, eroding the strength of unions to bargain and thereby reducing the wage premium for workers. Second, the increased requirement for effective unions under an RTW environment may motivate unions to demonstrate their effectiveness by securing higher wage and benefit gains. These two arguments, both of which are plausible, may occur simultaneously.

The impact of RTW laws on firm location decisions is of interest both as a research and policy question. The effects of RTW legislation during different periods of regional growth offer some evidence of the overall effect of RTW. Among the questions that can be asked of RTW are whether or not unionization leads to differences in firm productivity, and whether wages and benefits vary across regions with different levels of unionization. Moreover, insofar as wages and benefits are not the primary cost differential between union and nonunionized firms, other matters may play a bigger role in firm location decisions. For example, negotiating with unions may be costly, and much of the cost-increasing effects of unions are embedded in work rules and decreased flexibility in hiring and firing, not pay. Earlier researchers have offered a formal model of a production function (Hicks and LaFaive 2013), which we reprise here.

We model a simple production technology $\theta(N)$ that is solely dependent on labor, N. As described above, suppose that the level of unionization affects productivity, then $\theta(N[u])$, but the direction of the effect is unclear so $d\theta(N[u])/du \gtreqless 0$. The wage effect of unionization $w(u)$ is such that RTW could increase, decrease, or leave wages unchanged ($dw[u]/du \gtreqless 0$). From this, we construct a familiar labor demand function:

$$(1)\quad \pi = p\theta(N[u]) - w(u)\hat{N},$$

where profit, π, for a firm is comprised of the multiplicative product of the price, p, and a labor-only production function $\theta(N)$. From this is subtracted the wage rate, w, times employed labor units $\hat{N}$. The first-order condition with respect to unionization is

$$(2) \quad \frac{\partial \pi}{\partial u} = p\theta'(N[u])N'(u) - w'[u]\hat{N}.$$

If we assume that $\theta'(N[u]) > 0$, then Hicks and LaFaive's (2013) model yields some straightforward results: if $\partial\theta(N[u])/\partial u \geq 0$ and $\partial(w[u])/\partial u \leq 0$, then $\partial\pi/\partial u \geq 0$. More simply, profits could be higher with unions if labor productivity benefits from unionization. However, in the opposite case, if $\partial\theta(N[u])/\partial u \leq 0$ and $\partial(w[u])/\partial u \geq 0$, then $\partial\pi/\partial u \leq 0$. These alternative findings imply that unionization may either increase or decrease firm profitability depending on the impact of unions on the productivity of labor.

Reed (2003) explains the uncertainty surrounding the direction of the impact of unionization that makes formal modeling unclear. He argues that productivity and wage effects of unions vary by industry and time. So, the conditions outlined above provide strict relationships, which may vary either through aggregation or across time. Thus, in the preceding model, the effect of RTW legislation transmits to the aggregate economy through an uncertain pathway. This uncertainty leaves the effect of RTW legislation largely an empirical question to be explored in a labor productivity model and reliant on careful treatment of the data.

For example, RTW legislation may well have been influenced by initial union conditions or local preferences. Strong unions in industrialized states may have blocked the legislation, while less industrialized states would be more likely to endorse RTW legislation. Moreover, heavily industrialized states may enjoy manufacturing clusters, such as automobile production, that continued to attract new firms seeking the benefits of agglomerations. This feature may lead to an observed $\partial\theta(N[u])/\partial u \geq 0$ that is unrelated to RTW legislation. Also, during periods of rapid employment growth in heavily unionized sectors, unions may have served as employee screening tools for employers and so boosted profitability. Later, as employment declined, unions may have aided in the retention of low-productivity workers thus reducing labor productivity.

Conversely, the convergence of state-level industrial structure in the past half century would tend to push increased levels of more

unionized industries (primarily manufacturing and transportation because mining, a heavily unionized industry, is not particularly mobile) in states that had historically low levels of manufacturing. In other words, states became more similar over the last half century, and this necessarily meant more manufacturing in the South. This result could have occurred without any consideration of RTW legislation. Moreover, it is not clear that in the absence of weakened union influence the optimal firm decision would be to hire more workers. Consequently, what is most helpful in understanding the empirics is in the derivation of TFP and the Solow residual in RTW versus non-RTW states, which accounts for the growth in productivity not accounted for by the growth of inputs. It is to that matter we now turn our attention.

Productivity Effects of Right-to-Work Laws

In this section, we estimate total factor productivity in the context of RTW legislation. Vedder (2010) argues that higher output elasticity of RTW states will boost aggregate output, an observation that is confirmed by his empirics. However, what is critical is the determination of the transmission mechanism of this growth and its decomposition across RTW and non-RTW states.

We begin with a Cobb-Douglas production function. Constructing a time series from the *Annual Survey of Manufacturers*, we estimate this model at the state level for manufacturing firms from 2004–11 (Hicks 2013). This is a relatively straightforward model, where we seek to extract the TFP across the dimension of RTW. Summary statistics are reported in Table 1.

TABLE 1
Capital and Labor Levels and Expenditures

	Mean	Median	Std. Dev.
Capital Stock ($1,000s)	20,562,598	13,407,505	22,112,637
Capital Expenditure ($1,000s)	2,884,433	2,143,272	3,089,931
Employment	251,765	177,486	249,326
Payroll ($1,000s)	11,824,359	8,550,733	12,245,945
Output ($1,000s)	102,000,000	75,053,127	110,000,000

Source: U.S. Census Bureau (2004–11).

These data have a limited time period, beginning with annual surveys in 2004. However, this suits our purpose since we will approach the problem of evaluating the relative influence of RTW laws across two samples during a period in which no RTW laws were changed. Indiana passed RTW legislation in 2012 and Michigan in 2013, so we limit our analysis to 2011. Oklahoma passed RTW legislation in 2001; thus it is likely a full movement to equilibrium would not have occurred. We address this in the results.

Our model is the familiar Cobb-Douglas production function: $Y_{i,t} = AK^{\alpha}_{i,t}N^{\beta}_{i,t}$, from which we wish to recover empirical estimates of TFP, *A*. We also compute the Solow residual across samples of RTW and non-RTW states. TFP is the growth in output attributable to technological change in the capital and labor basis model. The Solow residual is an expansion upon the TFP estimate since it accounts for changes output not explained by the growth of inputs. In this sense, it is the combined growth in the changes in marginal product across inputs and the total technological change across time. TFP is derived from an estimation of the Cobb-Douglas production function, while the Solow residual is derived from growth accounting. Our calculation of the Solow residual is drawn from Hulten (2001) and takes the form: $\mathrm{R} = \frac{dY}{Y} - s_k \frac{dK}{K} - s_n \frac{dN}{N}$ where *s* is the share of each input. The results from our Cobb-Douglas model are reported in Table 2.

These results are distinctly similar to the canonical estimates of the Cobb-Douglas production function as constant returns to scale across aggregate sectors. At interest across these samples are the estimates of TFP. In RTW states, our estimates of TFP are 2.022, while for non-RTW states the estimate is 1.16.[1] Moreover, when we combine the sample and include an RTW variable, we find it is positive and statistically significant, and includes the value of other coefficients, suggesting that RTW does matter. These results hold when we omit Oklahoma from the analysis due to its 2001 adoption of RTW legislation.

[1]A Wald test rejects the equality of these coefficients: t-statistic = −8.44, for H0: $\beta_{\mathrm{RTW}} = \beta_{\text{non-RTW}}$.

TABLE 2
Cobb-Douglas Estimates

	All RTW States	All Non-RTW States	Full Sample	Full Sample w/RTW
Total Factor Productivity	2.022***	1.166***	1.439***	1.371***
	(6.61)	(5.60)	(9.77)	(9.45)
Capital	0.401***	0.386***	0.403***	0.393***
	(5.24)	(6.86)	(10.79)	(10.73)
Labor	0.557***	0.632***	0.598***	0.609***
	(6.55)	(10.23)	(14.92)	(15.50)
RTW Dummy	—	—	—	0.126***
				(4.23)
Adj-R^2	0.90	0.96	0.94	0.94

Notes: N = 370, OLS, estimates. *** denotes statistically significant at the 0.01 level, ** at the 0.05 level, * at the 0.10 level. Each estimate has been treated with White's (1980) heteroskedasticity corrections.

Together these results strongly suggest that the presence of RTW legislation increased total factor productivity of manufacturing firms from 2004–11. However, the estimate of total factor productivity, *A*, has a critical weakness in that it provides an estimate across the average input mix. The Solow residual addresses that weakness by providing a single technology estimate while accounting for changes in input share of capital and labor. Table 3 reports these results.

In both the derived TFP from our Cobb-Douglas production function, and in our growth accounting of the Solow residual, we find

TABLE 3
Solow Residual, TFP, and Output Growth
U.S. Manufacturing, 2004–11

	R (Solow Residual)	TFP	$d(\log[Y])$
RTW	3.99	2.022	0.006
Non-RTW	2.58	1.166	20.004

much higher levels of productivity growth in RTW states than in non-RTW states. Consistent with received theory, output declines are occurring in non-RTW states. This is consistent with an interpretation of $\partial\theta(N[u])/\partial u \leq 0$ from the derivative of the labor demand function. This is also consistent with the findings from Vedder (2010).

This model has some inherent weaknesses, not least of which is an estimation across the business cycle, which included significant changes to manufacturing (see Hicks 2013 for a summary). To address this problem, we launch a second empirical strategy to test productivity.

We use data on manufacturing firms from the 2007 Survey of Business Owners (SBO) collected by the U.S. Census Bureau from a random sample of businesses in the United States. The data used in our analysis are based on the Public Use Microdata Sample (PUMS) released by the U.S. Census Bureau in August 2012. The sample includes all businesses from the U.S. nonagricultural sector that were in existence during 2007, filed tax returns with the Internal Revenue Service, and had revenues of more than $1,000. The Census Bureau identified these firms using IRS Form 1040, Schedule C; Form 1065, U.S. Return of Partnership Income; Form 1120, U.S. Corporate Income Tax Return; Form 941, Employer's Quarterly Federal Tax Return; and Form 944, Employer's Annual Federal Tax Return. Summary statistics appear in Table 4.

To test these data, we posit a very simple model of firm productivity:

$$(3) \quad \log\left(\frac{Ri}{Ni}\right) = \alpha + \beta_1 RTW_i + \beta_2 \log(w_i) + \beta_3 T_i + \boldsymbol{\theta S} + \alpha_i + e,$$

where the receipts per employee are a function of a fixed intercept, location in an RTW state, average wages per employee in the firm, w, tenure T, a vector of firm size categories, $\mathbf{S}$, and a dummy variable for each state (Alabama is the omitted state). Results, with state-clustered standard errors, appear in Table 5.

These results point to a direct impact of location in an RTW state on productivity, as measured by firm-level output per worker, for a random sample of almost 50,000 manufacturing firms in 2007. The effect is similar to the Cobb-Douglas and Solow residual results, statistically significant, and supportive of results reported by Vedder (2010).

Our exploration of industry- and firm-level productivity suggests that the effect of unionization, through the absence of RTW legislation, is negative and significant, and also affects firms' capital structures across labor markets, as evidenced by the estimates of total

TABLE 4
Productivity and Right-to-Work Laws

	Mean	Median	Std. Dev.
Receipts per Employee ($1,000s)	206.12	135.71	435.55
Right-to-Work States	0.36	0	0.48
Pay per Employee ($1,000s)	36.70	34	24.07
Established in			
1980–89	0.209	0	0.407
1990–99	0.189	0	0.391
2000–02	0.054	0	0.225
2003	0.019	0	0.137
2004	0.022	0	0.147
2005	0.018	0	0.134
2006	0.017	0	0.129
2007	0.010	0	0.101
Employment Size			
5–9	0.134	0	0.341
10–19	0.165	0	0.371
20–49	0.205	0	0.404
50–99	0.148	0	0.355
100–249	0.112	0	0.315
250–499	0.027	0	0.163
500–999	0.008	0	0.089
1,000+	0.003	0	0.053

Source: U.S. Census Bureau (2007).

factor productivity from the Cobb-Douglas production function and the Solow residual. In order to more fully explore this, we turn our attention to population growth in RTW states.

Modeling the Impact of Right-to-Work Laws

In examining the role of RTW laws in fostering migration, Vedder (2010) acknowledged that factors other than RTW legislation influence migration patterns. The problem is that there is little expectation that RTW laws devolve upon states in a random fashion. Thus we adapt the endogeneity treatment from Hicks and LaFaive (2013) to address this concern.

TABLE 5
Productivity Estimation Results

Variable	Coefficient
α	1.96
	(61.41)
RTW	0.0748***
	(32.95)
Wages	0.8561***
	(98.09)
Tenure Category	Yes
Size Category	Yes
State Fixed Effects	Yes
N	49,814
R^2	0.42

Notes: *** denotes statistically significant at the 0.01 level, ** at the 0.05 level, * at the 0.10 level; t-statistics in parentheses, for standard errors clustered by state.

Hicks and LaFaive (2013) observed that places that were relatively poor in the middle of the 20th century also possessed a latent anti-union sentiment, which led to early passage of RTW legislation. The ensuing half century has seen many of these places grow faster than the nation as a whole, for reasons as diverse as expanded political freedom for minority groups to the widespread adoption of air conditioning. Consequentially, a model that treats the introduction of RTW legislation as a random event would bias any estimate of its impact. For that reason, we must suspect endogeneity within the RTW legislation and measures of economic performance such as population growth.

To correct for this problem, we employ an identification strategy for the adoption of an RTW law, with an eye toward isolating RTW and other unobserved variables that may affect our economic variables of interest. Here we posit that adoption of an RTW law would be influenced by the importance of manufacturing within a state at the time the 1947 Taft-Hartley Act was adopted and the political environment surrounding unions at that time. To represent these

variables, we use manufacturing income in 1947 and a binary variable representing the old Southern states (i.e., those states that seceded from the union). The identifying equation for RTW is:

$$(4)\quad E(R_{i,t}|M_i,S_i) = \alpha + \beta_1(M) + \beta_1(S) + u_{i,t},$$

where $dM/dt = 0$, and $ds/dt = 0$. The resulting estimate $\hat{R}_{i,t}$ is conditioned on two variables that do not vary with time. This equation offers two consequences regarding the endogeneity and concomitant policy concerns above. We believe the endogeneity concern is addressed through the identification of factors that would contribute to a decision to adopt RTW legislation in states. The time invariant nature of the regressors in this first-stage estimate introduces a first-stage, fixed-effects estimate of $\hat{R}_{i,t}$, using a technique introduced by Fernandez-Val and Vella (2011).

This approach captures any time invariant heterogeneity from which concomitant policy variables would have their greatest source. To correct for time-varying heterogeneity (unequal variances), we employ a feasible generalized least squares (FGLS) estimate, because each of the subestimates are for short periods that potentially suffer from small sample–related problems, as well as from period-specific heterogeneity (Wooldridge 2002). These two steps provide a safeguard against the incidental variable concern.

For our estimation, we examine the conterminous 48 states and the District of Columbia from 1947 through 2011. Summary statistics appear in Table 6.

TABLE 6
Summary Statistics

	Mean	Median	Std. Dev.
Population	4,195,693	2,787,000	4,747,510
Right to Work	0.297	0	0.457
Right-to-Work Adjacency	0.316	0.25	0.335
Real Personal Income	173,000,000	103,000,000	215,000,000
Total Employment	2,287,311	1,539,370	2,459,790
Real Wages	23,015	1,556	26,475

Sources: Bureau of Economic Analysis (2015); Hicks and LaFaive (2013).

We construct a very basic treatment model to estimate the impact of RTW legislation:

$$(5)\quad log\left(\frac{dP_{i,t}}{dt}\right) = \alpha + \beta(\widehat{R_{i,t}}) + \beta\tilde{W}(\widehat{R_{j,t}}) + \delta\tilde{W}Y_{j,t} + \theta Y_{i,t-n} + \epsilon_{i,t},$$

where the dependent variable P is population in state i, in year t. Population growth is estimated as a function of a common intercept, α a presence variable for RTW legislation, in state i, in year t, and the weighted average of that variable in contiguous states, weighted with a first-order contiguity matrix, $\tilde{W}$. This formulation is designed to account for cross-border effects of RTW legislation in adjacent states.

These two elements are corrected with the expected value of RTW from the endogeneity equation (4) above, which is designed to identify the adoption of an RTW legislation. The regression includes a first order spatial contiguity element to correct for spatial autocorrelation ($\delta\tilde{W}Y_{j,t}$), a temporal autoregressive element ($\theta\gamma_{i,t-n}$) with optimal lag lengths selected through an informational criterion recommended by Bozdogan (2000). We include an error term, $\epsilon_{i,t}$, iid, $\rightarrow (0, \sigma^2)$. All variables employed in the analysis pass individual and common unit root tests and so are assumed stationary.

There are some econometric considerations in the estimation process. The FGLS are estimated with White's (1980) heteroskedasticity invariate, variance-covariance matrix. The estimate of $E(R_{i,t})$ does not appear to suffer from weak instrumentation concerns, with and F-statistic of 511.5, and both instrumental variables enjoying statistical significance far better than 0.01 percent. We offer an alternative specification to deal with spatial autocorrelation, employing a method proposed by Pesaran (2006). We report and interpret both results, which we call Model 1 and Model 2, respectively.

We estimate the relationship between RTW legislation and population economic variables from 1947 to the present over three distinct time periods: from 1947 through 1970, 1970 through 1990, and 1990 through 2011. The purpose of this approach is to evaluate both the impact of RTW on population and whether or not effects varied across time periods. The full time period estimates are reported in Table 7.

Table 8 reports the selected results (RTW coefficient only) from two different specifications (Model 1 and Model 2) across the three different time periods and the Wald test results from the comparison of growth rates between time periods. Our analysis assumes that

TABLE 7
State Population Growth Rate, 1947–2013

	Model 1	Model 2
Intercept	0.0058***	0.001
	(6.84)	(−1.47)
Right to Work	0.009***	0.0007***
	(4.52)	(2.71)
Adjacent Right to Work	−0.01074***	−0.002
	(−3.59)	(−0.74)
Spatial Autocorrelation	0.59***	—
	(2.23)	
AR(1)	0.56***	0.457225***
	(15.25)	(4.77)
Adjusted R-squared	0.53	0.48
F-statistic	928.2	994.3
Durbin-Watson stat	1.74	1.82

Notes: N = 2,303; *** denotes statistically significance at the 0.01 level, ** at the 0.05 level, * at the 0.10 level. All estimates in pooled OLS.

growth rates for population are measures of overall economic well-being and that RTW legislation affects them through a labor demand function. This labor demand function yields conflicting theoretical possibilities as to the impact of unions, which has been the challenge to existing research in this area for some time (Reed 2003). Results above suggest that RTW would be productivity enhancing and so promote population growth. We also assume that the results above permit us to interpret the RTW legislation dummy variable as clean, in the sense that it does not capture other policy variables that are not perfectly coincident. While the estimation process leads to this assumption in our interpretations, the relaxation of this assumption simply alters the interpretation from a strict RTW effect, compared to that of a combined suite of policies of the type offered by Holmes (1998).

These results indicate that RTW legislation has a positive and statistically significant influence on population growth during the length of the observed period (the first column of results). The effect is not discernable from 1947–70 but is in the later periods. Furthermore,

TABLE 8
STATE POPULATION GROWTH RATE, RTW COEFFICIENTS, AND COEFFICIENT RESTRICTION TESTS

Model 1	RTW Coefficient	Wald Test H0 = 1947–2013 value	H0 = 1947–70 value	H0 = 1971–90 value	H0 = 1990–2013 value
1947–70	0.000252	—	n/a	—	—
1971–90	0.15**	2.83***	2.95***	n/a	0.93
1991–2013	0.01***	2.49***	2.65***	−33.2***	n/a

Model 1	RTW Coefficient	Wald Test H0 = 1947–2013 value	H0 = 1947–70 value	H0 = 1971–90 value	H0 = 1990–2013 value
1947–70	−0.0016	—	n/a	—	—
1971–90	0.013†	1.53†	1.81*	n/a	0.29
1991–2013	0.011**	2.17**	2.65***	−0.36	n/a

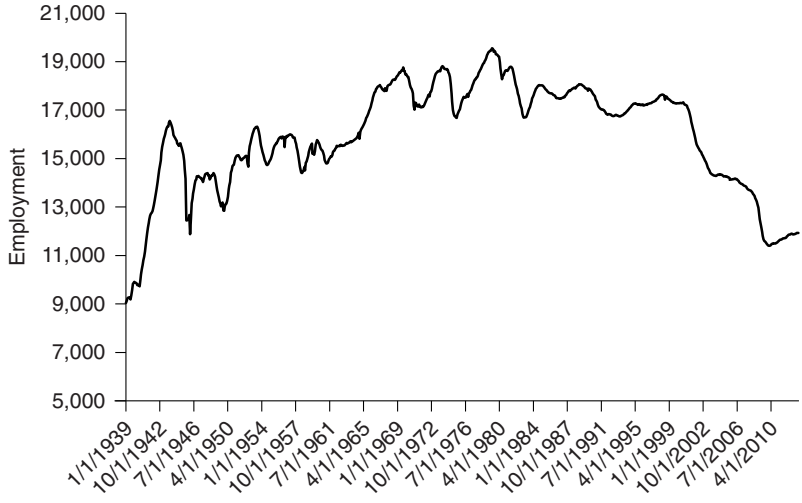
NOTES: *** denotes statistically significant at the 0.01 level, ** at the 0.05 level, * at the 0.10 level, and † at the 0.15 level.

these impacts are relatively large, with growth rates boosted just over 1 percent for population. We believe these results are insensitive to alternative specifications that address the concomitant variable problem (see Hicks and LaFaive 2013 for a fuller treatment of this issue). These findings are suggestive of Vedder, Denhart, and Robe (2011), and especially Vedder (2010).

The estimates in each of these categories tell a similar story. From 1947 through 1970, the presence of RTW legislation played no role in population growth. A Wald test confirmed that for population growth, the 1947–70 period was lower than either the later period (1971–90) or the overall time. Moreover, RTW laws in adjacent states had no measurable effect during this period. Whatever the cause, it is clear that RTW legislation did not affect population growth during the more than two decades after Taft-Hartley passed, a time of brisk increases in manufacturing employment (Figure 1).

The period of nearly static employment growth in the most heavily unionized sectors, from 1971–90, experienced a very different effect of RTW, having a strong impact on population growth of 1.5 percent. In all three cases, a Wald coefficient test found statistically different coefficient values for this period when compared to values in the earlier period (1947–70).

FIGURE 1
Monthly U.S. Manufacturing Employment



By the final period, from 1991–2013, the effect of RTW on these three measures had lessened from the 1971–90 period but remained both statistically significant in each case and important in terms of the size of the impact (all roughly 0.8 percent higher growth in states with an RTW law). The adjacent RTW variable was neither economically nor statistically significant in any of our estimates.

Our research suggests that in the early days following Taft-Hartley, RTW legislation had no meaningful impact on aggregate economic growth measures in states in which it had passed. During the beginning of the manufacturing employment stagnation (1971–90), that changed, with RTW laws exerting a significant impact on growth of all three measures. In the period 1991–2013, the impacts of RTW on growth slowed modestly, but remained large enough that they should command economic policy attention.

Conclusion

Richard Vedder (2010) offered an important addition to the literature on RTW legislation with his description of the influence individual choice plays in both population growth and labor productivity in states where RTW legislation has passed. This article has focused on the theory and empirics of the matter, extending both the argument from Vedder into a labor demand function, and the empirics of industry and firm productivity and population growth.

We estimate a Cobb-Douglas production function for manufacturing industries at the state level and find that total factor productivity in non-RTW states was about 57 percent of the level in RTW states. Our derivation of the Solow residual suggests that non-RTW manufacturing productivity was roughly 64 percent of the RTW states. Furthermore, our firm-level analysis from the 2007 Survey of Business Owners found that RTW states achieved higher productivity (sales per employee) than firms in non-RTW states. These results extend Vedder's (2010) examination of productivity of RTW laws across three different estimation strategies.

Our second empirical strategy examined the impact of RTW legislation on population growth from 1947 to 2013. We employ an identification strategy offered by Hicks (2012) that includes 1947 manufacturing employment and the geography of the old South to isolate union disposition among voters. Our findings suggest that from 1947–70, RTW legislation had no effect on aggregate measures of economic activity between states. However, that outcome changed

for the 1971–90 and 1991–2013 periods, when the presence of an RTW law boosted state population growth by 1.1 percent to 1.5 percent—results that support Vedder's (2010) work. Thus, our study extends the literature by carefully and more fully examining the effect of RTW legislation in promoting both population growth and productivity growth.

References

Black, E., and Black, M. (1989) *Politics and Society in the South*. Cambridge, Mass.: Harvard University Press.

Bozdogan, H. (2000) "Akaike's Information Criterion and Recent Developments in Information Complexity." *Journal of Mathematical Psychology* 44 (1): 62–91.

Bureau of Economic Analysis (2015) "Regional Economic Accounts." Washington: U.S. Department of Commerce.

Dickens, W., and Leonard, J. S. (1985) "Accounting for the Decline in Union Membership, 1950–1980." *Industrial and Labor Relations Review* 38 (3): 323–34.

Farber, H. S. (1987) "The Recent Decline of Unionization in the United States." *Science* 238 (13 November): 915–20.

Fernandez-Val, I., and Vella, F. (2011) "Bias Corrections for Two-Step Fixed Effects Panel Data Estimators." *Journal of Econometrics* 163 (2): 144–62.

Freeman, R. B. (1985) "Why Are Unions Faring Poorly in NLRB Representation Elections?" In T. A. Kochan (ed.) *Challenges and Choices Facing American Unions*, 45–64. Cambridge, Mass.: MIT Press.

Hicks, M. J. (2012) "Right-to-Work Legislation and the Manufacturing Sector." Center for Business and Economic Research, Ball State University.

———— (2013) "Manufacturing Productivity through the Great Recession: What Does it Mean for the Future?" Center for Business and Economic Research, Ball State University.

Hicks, M. J., and LaFaive, M. (2013) "Economic Growth and Right-to-Work Laws." Mackinac Center for Public Policy.

Holmes, T. J. (1998) "The Effect of State Policies on the Location of Industry: Evidence from State Borders." *Journal of Political Economy* 106 (4): 667–704.

Hulten, C. (2001) "Total Factor Productivity: A Short Biography." In C. R. Hulten, E. R. Dean, and M. Harper (eds.) *New Developments in Productivity Analysis*, 1–54. Chicago: University of Chicago Press.

Jarley, P., and Fiorito, J. (1990) "Associate Membership: Unionism or Consumerism?" *Industrial and Labor Relations Review* 43 (2): 209–24.

Koeller, C. T. (1994) "Union Activity and the Decline in American Trade Union Membership." *Journal of Labor Research* 15 (1): 19–32.

Lazear, E. P. (1988) "Employment at Will, Job Security, and Work Incentives." In *Proceedings of the Conference on Employment, Unemployment, and Hours of Work*, Science Center Berlin, September 17–19, 1986. London: Allen and Unwin.

Moore, W. J. (1998) "The Determinants and Effects of Right-to-Work Laws: A Review of the Recent Literature." *Journal of Labor Research* 19 (3): 445–69.

Newman, R. J. (1983) "Industry Migration and Growth in the South." *Review of Economics and Statistics* 65 (1): 76–86.

Pesaran, M. H. (2006) "Estimation and Inference in Large Heterogeneous Panels with a Multifactor Error Structure." *Econometrica* 74 (4): 967–1012.

Reder, M. W. (1988) "The Rise and Fall of Unions: the Public Sector and the Private." *Journal of Economic Perspectives* 2 (2): 89–110.

Reed, W. R. (2003) "How Right-to-Work Laws Affect Wages." *Journal of Labor Research* 24 (4): 1–18.

Stevans, L. K. (2009) "The Effect of Endogenous Right-to-Work Laws on Business and Economic Conditions in the United States: A Multivariate Approach." *Review of Law and Economics* 5 (1): 595–614.

U.S. Census Bureau (2004–11) *Annual Survey of Manufacturers*. Washington: U.S. Census Bureau.

_____ (2007) "Survey of Business Owners." Washington: U.S. Census Bureau.

Vedder, R. (2010) "Right-to-Work Laws: Liberty, Prosperity, and Quality of Life." *Cato Journal* 30 (1): 171–80.

Vedder, R.; Denhart, M.; and Robe, J. (2011) "Right to Work and Indiana's Economic Future." Indiana Chamber of Commerce. Available at http://share.indianachamber.com/media/docs/IndianaRightToWork-1-27-11.pdf.

White, H. (1980) "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity." *Econometrica* 48 (4): 817–38.

Wooldridge, J. M. (2002) *Econometric Analysis of Cross-Section and Panel Data*. Cambridge, Mass.: MIT Press.