The Impact of the Manufacturing and Agriculture Credit in Wisconsin

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Abstract

In 2011 Wisconsin adopted the Manufacturing and Agriculture Credit (MAC), which provides credits which largely offset the taxes faced by businesses in those sectors in the state. While manufacturing employment has grown since the MAC took effect in 2013, how much of these gains were due to the credit is under debate. To isolate the policy effect, I focus on counties on either side of the Wisconsin border. After accounting for time and group effects, I find that since 2013 manufacturing employment has grown on average 1.9 percentage points (at an annual rate) faster in Wisconsin relative to counties just across the border. Quantitatively, I find that every 1 percentage point cut in the effective manufacturing tax rate was associated with a nearly 0.9 percentage point increase in the manufacturing employment growth rate. I also find significant spill-overs to the broader economy. Non-manufacturing employment has grown on average 0.7 percentage points per year faster on the Wisconsin side of the border since 2013, with each percentage point cut in the manufacturing tax rate associated with a 0.4 percentage point increase in non-manufacturing employment growth with a one year lag. I estimate that the cumulative impact of the MAC was that by September 2016 manufacturing employment in Wisconsin border counties was 6.6% higher and total employment 2.5% higher than they would have been in the absence of the tax credit. Applying these border-county estimates to the whole state suggests that since its introduction the MAC accounted for a total gain of over 20,000 manufacturing jobs (a 4.6% increase) and over 42,000 total jobs (a 1.8% increase) in Wisconsin.

*The establishment of the Center for Research on the Wisconsin Economy is pending campus approval.

1 Introduction

1.1 Overview

In an effort to retain and expand production and employment in two sectors of traditional strength, in 2011 the Wisconsin State Legislature adopted the Manufacturing and Agriculture Credit (MAC). Phased in from 2013-2016, the MAC now nearly eliminates the tax liability for manufacturing and agricultural business activity, which are crucial sectors in the Wisconsin economy. In September 2016, together these sectors accounted for over 490,000 jobs (20% of private employment) with an annual output of $61.4 billion (over 22% of private output) in Wisconsin. Since the time of its introduction, the MAC has been controversial because of uncertainty about its cost, distribution of benefits, and impact on employment.[1] While all of these issues are important in evaluating the policy, I focus on the impact of the MAC on manufacturing and overall employment. Using local labor market data for counties on either side of the Wisconsin border, I find that the MAC has had a large and significant impact on both manufacturing employment and total employment.

As with all policy evaluations, in order to measure the impact of the MAC we need to construct a counterfactual. That is, we need to estimate what outcomes would have prevailed in Wisconsin if the MAC had not been introduced. Previous discussion of the MAC has focused on outcomes at the state level, comparing employment outcomes in Wisconsin with its own past, national averages, or neighboring states.[2] However, there are two main problems with the simply comparing the performance of Wisconsin to other states or the nation as a whole since the introduction of the MAC. First, to measure the effects of policies we need to compare not just differences after the policy change, but rather whether the differences which predated the policy have changed since its introduction. In other words, we need to analyze the difference in differences. For example, one state may have had persistently higher employment growth than Wisconsin both before and after the policy change, but the policy may have narrowed the gap. Nonetheless, consistent with previous analysis such as [16], I show below that analyzing the state-level difference in differences does not find significant impact of the policy.

Second, and more importantly, the previous analysis made strong assumptions about the counterfactuals. For example, comparing outcomes in Wisconsin to its neighboring states treats those border states as counterfactuals. That is, the analysis presumes that if the MAC had not taken effect, employment in Wisconsin would mirror its neighboring states. However there are many additional factors which differ among the states which confound the measurement of the policy impact. (Comparing outcomes in Wisconsin to national averages includes many more potential confounding factors, and so may exacerbate the problem.) For example, the economies of Minnesota and Illinois are largely driven by their main metro areas, while Wisconsin's employment and population are more dispersed. In particular, roughly 67% of Minnesota employment is in the Minneapolis-St. Paul metro area (and this share has been increasing), while roughly 29% of Wisconsin's employment is in the Milwaukee metro area (and this share has been declining). Thus changes in urban structure, growth, policy,

[1] See for example the discussion in Gallagher [7] and recently in Bauer [2].

[2] See for example reports by Neumann [13], Wisconsin Budget Project [16] (which does consider a difference in differences), and Wisconsin Manufacturers and Commerce [17].

or governance may lead to differential effects between Wisconsin and Minnesota which are unrelated to the MAC. Other important factors which differ across states include industry and sectoral concentrations, demographics and labor force dynamics, and natural resource concentrations.

To better isolate policy effects and construct counterfactuals, I focus on local labor markets by considering counties on either side of the Wisconsin border. By doing so, I follow much of the recent literature on policy evaluation. Focusing on a localized area allows me to a construct a cleaner counterfactual and thus to better measure the impact of the policy. Many of the demographic, regional, and industry factors are common on either side of the border, which better isolates differences in state-level policy. In my empirical analysis, I further allow for time and border-group specific fixed effects, which in practice means that I compare outcomes date-by-date between a Wisconsin border county and its matched county (or counties) across the border.

Focusing on border counties also helps with the identification of the policy impact, as for these counties the state-level policy change is plausibly exogenous. But the introduction of the MAC in Wisconsin was clearly not exogenous at the state level, but rather reflected (at least in part) a conscious response to economic conditions and the state's competitive position. The same factors driving the policy change also affect economic outcomes like employment, so estimates obtained from measuring ex-post employment growth at the state level do not correctly identify the policy impact, as they are biased by these unobserved or omitted variables.

After accounting for time and group effects, I find that since 2013 manufacturing employment has grown on average 1.9 percentage points (at an annual rate) faster in Wisconsin relative to counties just across the border. However these initial results pool the impact of all statewide differences between Wisconsin and neighboring states, not just the MAC. In particular, there have been related business tax changes (mostly increases) in Illinois and Michigan during the sample, as well as additional policy changes among the states which are harder to quantify. For example, during the sample period (2001-2016) both Michigan and Wisconsin became right to work states, which as Holmes [10] showed may have impacted manufacturing employment beyond the tax changes. Moreover the MAC was only one part of an overall attempt to change the business climate in Wisconsin, which also included changes in unionization, personal taxes, and regulation.

To better focus on the impact of the tax changes such as the MAC, I then condition on changes in the effective tax rate on manufacturing businesses in each county. Quantitatively, I find that every 1 percentage point cut in the effective manufacturing tax rate was associated with a 0.8-0.9 percentage point increase in the manufacturing employment growth rate. I also find significant spill-overs to non-manufacturing employment, which has grown on average 0.7 percentage points per year faster on the Wisconsin side of the border since 2013. Each percentage point cut in the manufacturing tax rate was associated with a 0.4 percentage point increase in non-manufacturing employment growth with a one year lag.

Combining and aggregating my results, I estimate that the cumulative impact of the MAC was that by September 2016 manufacturing employment in Wisconsin border counties was 6.6% higher and total employment 2.5% higher than it would have been in the absence of the tax credit. I then apply these estimates to the rest of the state, accounting for differences between interior and border counties. My results suggest that since its introduction the

MAC accounted for a total gain of over 20,000 manufacturing jobs (a 4.6% increase) and over 42,000 total jobs (a 1.8% increase) in Wisconsin.

1.2 Related Literature

This paper builds on the literature in economics which uses a difference-in-differences approach for policy evaluation, including the seminal work of Ashenfelter [1] and Card and Krueger [3]. In particular, I follow a number of papers which have used border counties to measure the impact of policy. For example Holmes [10] used border counties to analyze right-to-work laws, which he viewed as an indicator of broader pro-business policy, finding a large positive impact manufacturing activity. Similar border county data has been used by Dube, Lester, and Reich [4] to analyze minimum wages, and by Hagedorn, Manovskii, and Mitman [9] to analyze the extension of unemployment benefits, among others.

I follow most closely the recent paper by Ljungqvist and Smolyansky [11] who analyze the impact of changes in state corporate income taxes, and my baseline empirical specification largely mirrors theirs. They study a long sample with many states, and find that increases in state corporate taxes lead to reductions in employment and income. Overall, they find that cuts in state corporate taxes do not have a significant impact, but those cuts which happen in recessions do have significant positive impact. Relative to their paper, I focus on a narrower sample of Wisconsin and its border states and concentrate on taxes on the manufacturing sector. I find a larger impact from this more targeted tax policy.

Apart from these papers, there is a more extensive literature analyzing the impact of state taxes on growth. This literature mostly focuses on state-level aggregates across panels of states, and has generally found mixed evidence.[3] However papers that are more narrowly focused often find significant effects of taxes. For example, Goff, Lebedinsky, and Lille (2012) study matched pairs of states, finding growth-enhancing effects of lower tax burdens in general and lower individual income-tax rates in particular. In addition, Moretti and Wilson (2017) focus on the location decisions of star scientists, finding a substantial negative impact of higher personal and business taxes. In addition, there is a separate literature examining the impact of targeted business tax credits. These studies have generally found that such credits are effective, and may lead to a sizable impact on economic activity.[4]

1.3 Outline of the Paper

In the next section, I discuss the MAC and the data I use in more detail, and provide some suggestive preliminary evidence of the policy impact. Section 3 then provides the main empirical results on the impact of the MAC on manufacturing and non-manufacturing employment and discusses their implications. Then in Section 4, I apply the estimates to the whole state, accounting for differences between border and interior counties. Section 5 concludes.

[3] See Gale, Krupkin, and Rueben [6] for a recent discussion and references for the literature on the impact of state taxes on growth.

[4] See Weiner [14] for a review of the literature on business tax credits.

2 The MAC and the Data

2.1 The Manufacturing and Agriculture Credit

As part of the 2011 biennial budget, the Wisconsin State Legislature adopted the Manufacturing and Agriculture Credit (MAC). As Gallagher [7] noted, proponents of the legislation like then-State Senator Glenn Grothman viewed the MAC as providing a, "competitive advantage in attracting manufacturers. 'This improves the tax climate big time for manufacturers – and manufacturers bring money into the state,' Grothman said. 'If we have a strong manufacturing climate, we will automatically have a strong retail climate and a strong service sector.' " On the other hand, opponents viewed it as, "giving away hundreds of millions of dollars to CEOs and big corporations." and "mindless lunacy." Similar arguments have continued throughout the implementation of the MAC (see Ferral [5] for a recent example).

In this paper I estimate the impact of the MAC on employment, both in manufacturing and more broadly. Of course, there are many other factors which are important in the evaluation of the MAC, such as its cost, distributional impact, and efficiency. A separate issue is whether other policies, such as general corporate tax reduction affecting a broader employment base, could achieve similar goals. While I do not address such issues, I do find that the MAC had a significant impact on employment in the state, which is a key component in evaluating the benefits of the policy.

In more detail, the MAC provides a credit on manufacturing and agricultural production activities on properties in Wisconsin to offset at least part of the state tax burden. The credit is a percentage of eligible qualified production activities income, meaning that it does not cover income from investments or royalties. The credit is available to both traditional corporations that pay corporate (or franchise) taxes, as well as to pass-through entities whose income is reported as personal income by the business owners, and thus pay personal income taxes. The credit is calculated by multiplying eligible qualified production activities income by one of the following percentages:

For taxable years beginning after December 31, 2012, and before January 1, 2014, 1.875%.
For taxable years beginning after December 31, 2013, and before January 1, 2015, 3.75%.
For taxable years beginning after December 31, 2014, and before January 1, 2016, 5.025%.
For taxable years beginning after December 31, 2015, 7.5%.

Thus since the MAC was fully phased in at the start of 2016, manufacturing corporations have faced an effective tax rate of 0.4% (relative to the 7.9% corporate rate) while pass-throughs faced an effective rate of at most 0.15% (relative to the top personal rate of 7.65%). The credit is nonrefundable, so any amount not used to offset the current Wisconsin income or franchise tax liability may be carried forward for 15 years.

To measure employment, I use data from the Quarterly Census of Employment and Wages (QCEW) on employment in manufacturing and all private industries. The QCEW covers all establishments which report to the Unemployment Insurance (UI) programs of the United States, representing about 97% of all wage and salary civilian employment in the country. Released quarterly, the QCEW provides monthly data on employment by state and county (as well as MSA) which is not seasonally adjusted. I focus on manufacturing employment because there is only limited data on agricultural employment by county (annual

data over only part of the sample). I measure employment gains as the year-over-year percentage increase (log difference) in employment, which removes much of the seasonality. (My empirical work below also includes time effects, which capture much of the residual seasonality.) The data sample runs from January 2001-September 2016, so the annual growth rates run from January 2002-September 2016.

I focus on the impact of the MAC by measuring the impact of changes in the effective corporate tax rate on manufacturing businesses. Wisconsin kept its corporate income tax rate constant throughout the sample, so changes in its effective tax rate were due to the MAC. However some of Wisconsin's neighboring states changed their corporate tax rates during the sample period. In particular, Illinois increased its corporate rate from 7.3% to 9.5% in 2011 and then lowered it to 7.75% in 2015, while Michigan increased its corporate rate from 1.9% to 4.95% in 2008, with a further increase to 6% in 2012. Consistent with the year-over-year percentage changes in employment, my empirical work uses year over-year differences in effective corporate tax rates on manufacturing.

2.2 Border Counties

As described above, statewide comparisons mix different factors which make it difficult to isolate the impact of the policy.[5] There are important differences in the makeup of the different state labor markets (such as the concentration of manufacturing) and trends affecting the states (such as the growing concentration of employment in Minneapolis but the relative decline of Milwaukee) which confound measurement of the impact of the MAC. Therefore I follow much of the recent literature and analyze border counties. The demographics, urban and sectoral concentrations, and regional impacts are much more similar across bordering counties than across border states. I follow Ljungqvist and Smolyansky [11] who argue that, "by comparing economic outcomes in groups of neighboring counties straddling a state border, we can eliminate (or at least reduce) the biasing effects of unobserved local variation in economic conditions that might correlate with the tax change."

A map of the counties of Wisconsin and its neighboring states is shown in Figure 2.1. I now focus on differences across these borders. My sample includes 21 border counties in Wisconsin (Buffalo, Burnett, Crawford, Douglas, Florence, Forest, Grant Green, Iron, Kenosha, La Crosse, Lafayette, Marinette, Pepin, Pierce, Polk, Rock, St. Croix, Vernon, Vilas, and Walworth), each of which are matched with their paired county (or counties if the borders of multiple overlap) in Minnesota (Carlton, Chisago, Goodhue, Houston, Pine, St. Louis, Wabasha, Washington, and Winona), Iowa (Allamakee, Clayton, and Dubuque), Illinois (Boone, Jo Daviess, Lake, McHenry, Stephenson, and Winnebago), and Michigan (Dickinson, Gogebic, Iron, and Menominee). Thus the sample includes a total of 43 counties in 21 groups. Appendix A describes the sample selection and border groups in more detail.

In the next section I provide the main empirical results, but first I provide some simple comparisons which suggest that the MAC had a large effect in the border counties, as my later results bear out. In particular, Figure 2.2 shows annual (year-over-year) growth rates of manufacturing employment from January 2002-September 2016 pooled across the border counties of Wisconsin, as well as pooled data for the counties in Minnesota, Illinois, Iowa,

[5]For completeness, in Section 4.2 below I provide the corresponding direct statewide comparison.

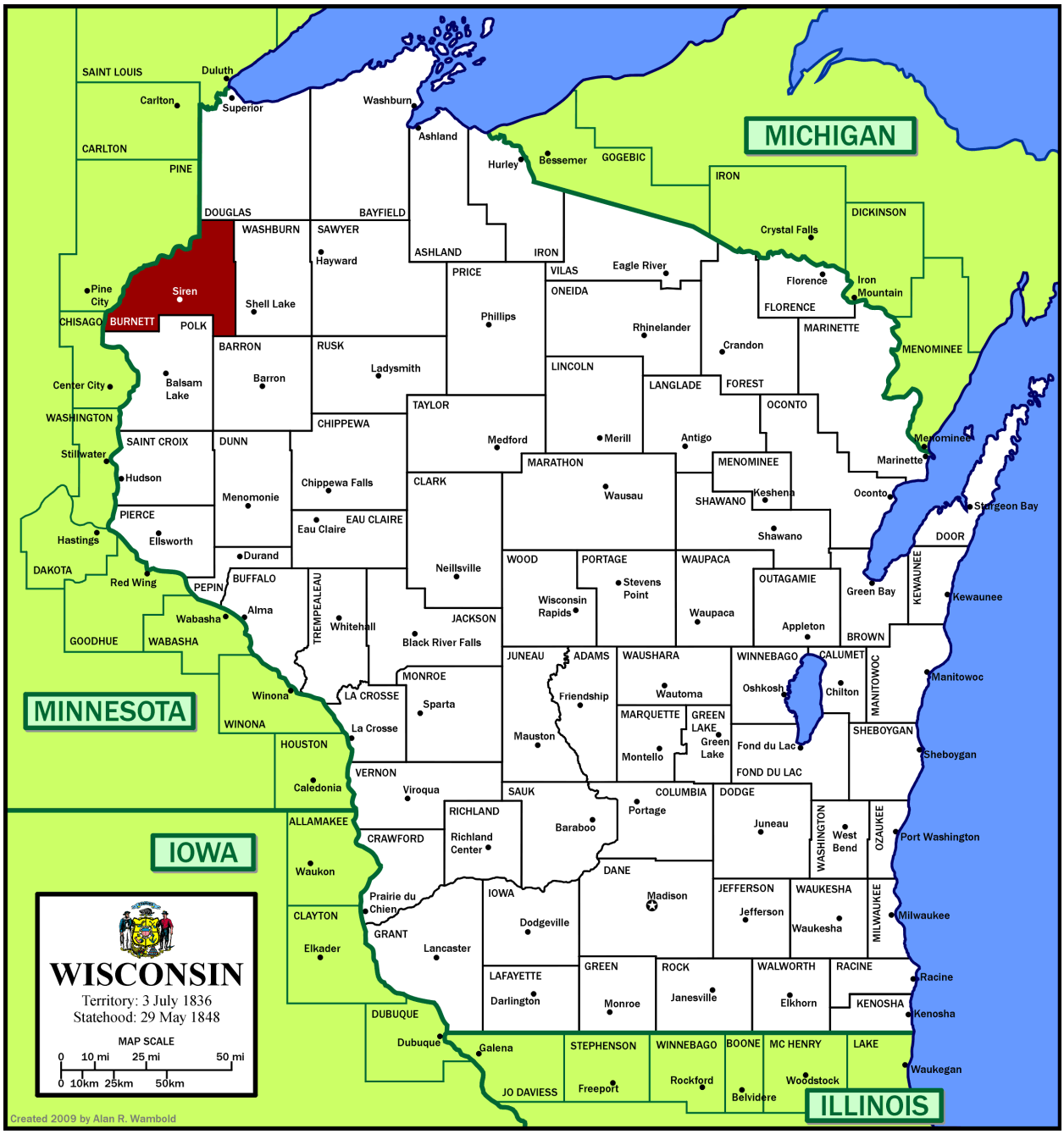

Figure 2.1: County map of Wisconsin and its bordering states of Minnesota, Iowa, Illinois, and Michigan.

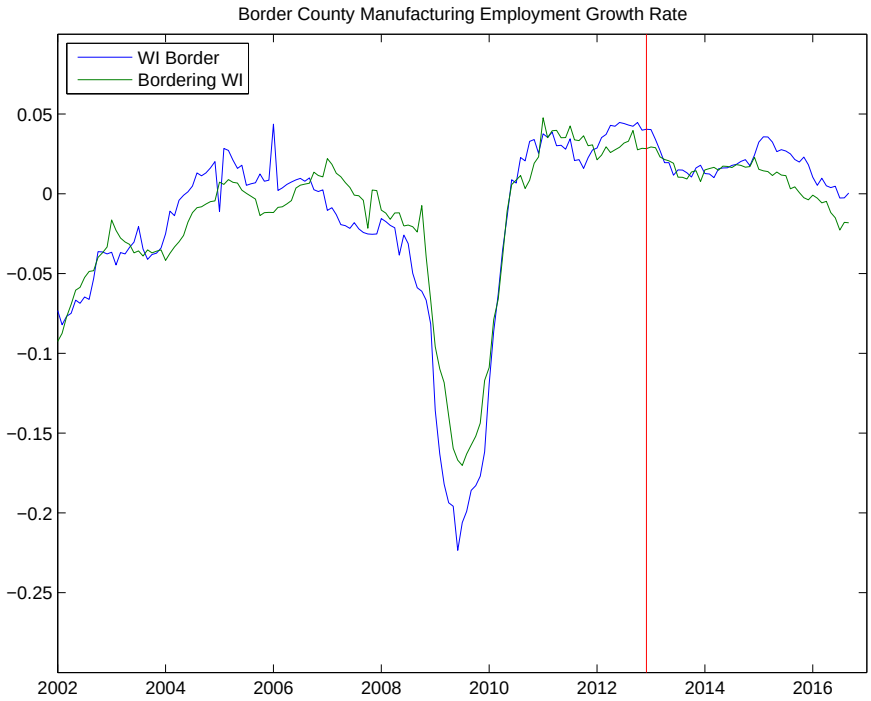

Figure 2.2: Annual growth rates of manufacturing employment in border counties of Wisconsin (blue line), and pooled data for counties in Minnesota, Illinois, Iowa, and Michigan which border Wisconsin (green line).

	2002-2012	2013-2016	Difference
Wisconsin	-2.39	1.78	4.17
MN-IA-IL-MI	-2.01	0.90	2.91
Difference	-0.38	0.87	1.26 (p=0.29)

Table 2.1: Difference in differences for manufacturing employment growth in border counties.

and Michigan that border Wisconsin. While Wisconsin had lagged behind earlier in the sample, we see a notable divergence between the growth rates over the last few years, with manufacturing employment increasing more rapidly in Wisconsin border counties than across the border. Table 2.1 gives the corresponding difference in differences results, showing the average growth rates over the pre-MAC period of 2002-2012, along with the period from 2013-2016 when the MAC was in effect. Manufacturing employment fell in the first period and recovered in the second period on both sides of the border, but both fell faster and increased faster in Wisconsin. In particular, the acceleration in manufacturing employment growth after 2013 was much larger in the border counties of Wisconsin, increasing by an average 1.3 percentage points per year faster than counties across the border. While large in magnitude, this difference is not statistically significant, as manufacturing employment growth is relatively volatile in the border counties. My later empirical results disaggregate the border counties and include fixed effects which help control the variation, and the results there are similar to these simple comparisons.

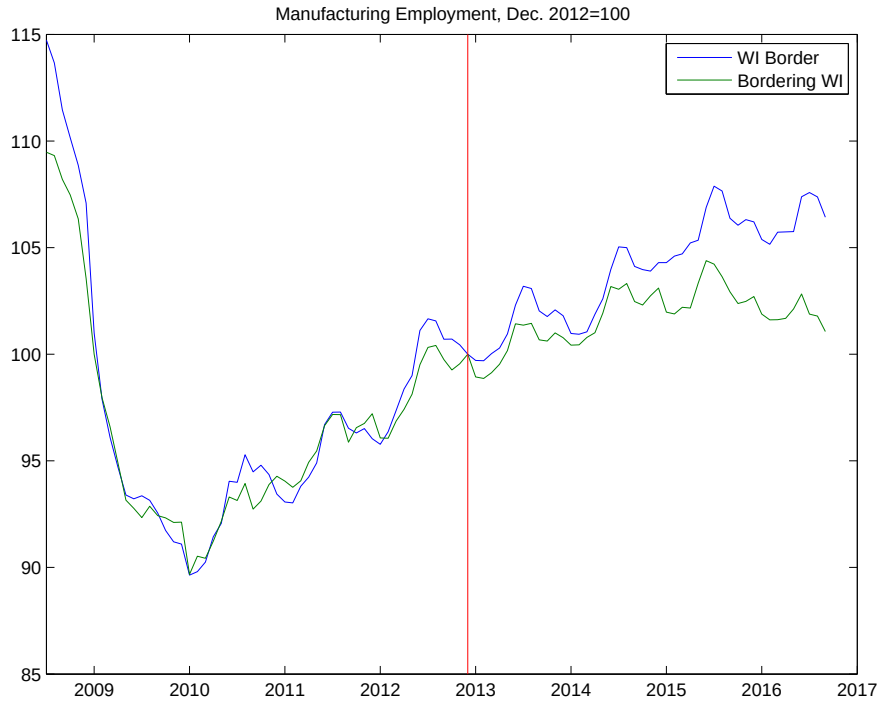

Figure 2.3: Manufacturing employment in border counties of Wisconsin (blue line), and pooled data for counties in Minnesota, Illinois, Iowa, and Michigan which border Wisconsin (green line). Data for December 2012 is indexed to 100.

This divergence in manufacturing employment is even more apparent in the employment levels, which effectively cumulate the growth rates, as shown in Figure 2.3. There I plot the level of employment pooled across the border counties for the last eight years, with the data for December 2012 (the last month prior to the MAC taking effect) indexed to 100. Manufacturing employment fell more dramatically in the Wisconsin counties in the 2008 recession, which is apparent from the fact that Wisconsin starts from a higher level at the left of the figure. From 2009 through the end of 2012 the two series closely track each other, but they begin to diverge starting around 2013. By the end of the sample in September 2016, manufacturing employment had increased by 4.6% more in Wisconsin border counties than in counties across the border.

	2002-2012	2013-2016	Difference
Wisconsin	0.64	2.12	1.48
MN-IA-IL-MI	0.43	1.04	0.61
Difference	0.21	1.08	0.87 (p=0.04)

Table 2.2: Difference in differences for non-manufacturing employment growth in border counties.

Looking at non-manufacturing employment growth in the border counties suggests that the MAC may also have had positive impacts on the broader economy as well. In particular

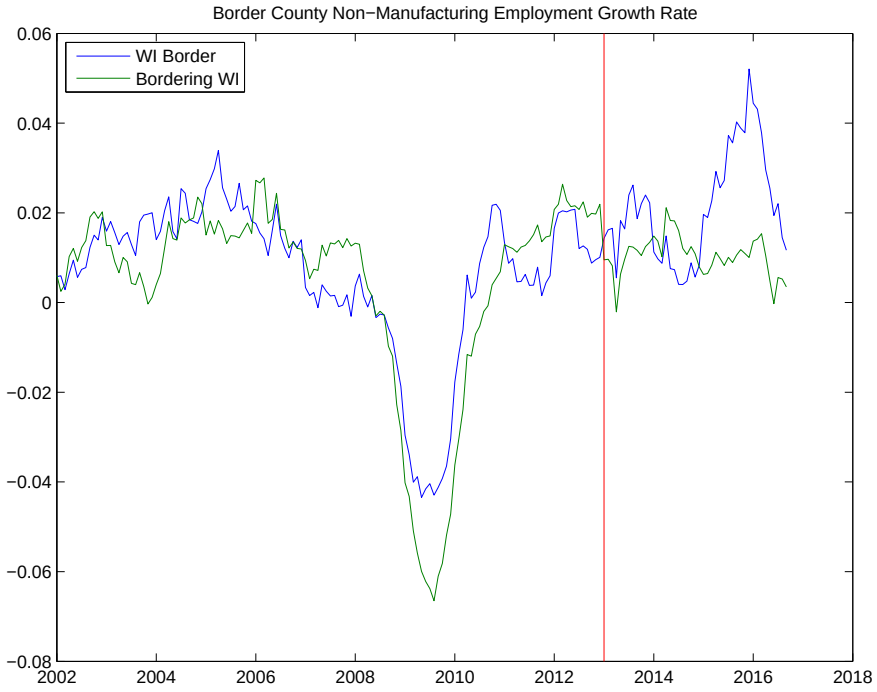

Figure 2.4: Annual growth rates of non-manufacturing employment in border counties of Wisconsin (blue line), and pooled data for counties in Minnesota, Illinois, Iowa, and Michigan which border Wisconsin (green line).

Figure 2.4 plots the annual growth rates of non-manufacturing employment (total private employment minus manufacturing employment) for the border counties in the same sample period. There we see that non-manufacturing employment growth was notably higher in the Wisconsin border counties after the introduction of the MAC in 2013. This observation is also apparent in the difference in differences in Table 2.2. There we see that since 2013 the acceleration in non-manufacturing employment has been on average nearly 0.9 percentage points greater in Wisconsin border counties than across the border, and moreover that this difference is statistically significant ($p = 0.04$).

3 Empirical Results

While the results in the previous section suggest that the MAC may have had effects on employment, pooling the data across the border counties failed to take advantage of the unique spatial nature of the data. We were not directly analyzing the changes which occurred across a border, but instead averaging changes over the whole border. In addition, we made no attempts to control for any common differences across time or space affecting the counties, or to gauge how much of the observed changes were due to the MAC. In this section I present the main empirical results which remedy these shortcomings and allow me to obtain sharper results.

3.1 Empirical Specification

My empirical models follow Ljungqvist and Smolyansky [11] by using a difference-in-differences specification of the general form:

$$Y_{c,s,t} = \alpha_{g,t} + \delta X_{s,t} + \varepsilon_{c,s,t}.$$

For each variable (c, s, t) index counties, states, and dates respectively, while g indexes the contiguous counties on either side of a state border.[6] $Y_{c,s,t}$ is the employment variable of interest, either manufacturing or non-manufacturing, expressed as an annual growth rate as discussed above. $X_{s,t}$ is the independent variable of interest, typically the year-over-year change in the effective corporate tax rate on manufacturing in the state. However I first consider a dummy indicator variable for Wisconsin starting in 2013, to parallel the simple difference in differences results above and measure whether there was a significant difference in employment growth following the introduction of the MAC. Clearly this dummy pools all sources of state-level differences beyond tax rates. In addition, because the MAC was introduced with an announced phase-in schedule, and there may also be delays in response, I also analyze specifications including a lead and lag of the tax changes.

The terms $\alpha_{g,t}$ are border-county-group/year fixed effects, which are crucial. Ljungqvist and Smolyansky [11] emphasize that including these effects, "ensures that the effect of tax changes on treated counties is always measured relative to bordering control counties that do not experience a tax change. In this sense, $\alpha_{g,t}$ absorbs any confounding local economic shocks that are otherwise unobservable and so aids a causal interpretation of our results." By looking at year-over-year changes, the specification removes unobserved county- and state-specific fixed effects in the corresponding levels equation. Also unlike a levels specification with fixed effects, this specification allows me to accommodate the repeated treatments (continued changes in tax rates) and reversals (tax increase followed by cuts) which are observed in the sample.[7]

3.2 Results

The main results are shown in Table 3.1, which lists the parameter estimates (δ) for the regressions of manufacturing employment growth on different independent variables ($X_{s,t}$) of interest. Each regression also includes the whole suite of border-county-group/year fixed effects ($\alpha_{g,t}$) whose estimates I do not report. Also reported in the table are the standard errors for the estimates which are clustered by state, the implied p-values, and the adjusted R^2 from each regression. For each regression there are $43 \times 177 = 7611$ county-month observations.

The result in the first line takes as its independent variable a post-MAC dummy, an indicator which is one from 2013 onward in Wisconsin and zero at other dates and in other

[6] In coding the group variable g, I treat a Wisconsin border counties as the base, and assign the same index to each county in the other states that share a border with the Wisconsin county. Thus g runs from 1 to 21 and a non-Wisconsin county can have multiple g values. Appendix A lists the groups.

[7] Because they look at a longer nationwide panel, Ljungqvist and Smolyansky [11] also include (changes in) some demographic controls in their regressions. For my shorter sample focused on Wisconsin, these are less important.

Independent variable	Coefficient	Std. Error	p-value	Adj. R^2
Post-MAC dummy (percent)	1.879	0.606	<0.01	0.244
Change in manufacturing tax	-0.859	0.229	<0.01	0.244
Change in manufacturing tax: lead	-0.142	0.410	0.73	0.243
Change in manufacturing tax: current	-0.819	0.281	<0.01	
Change in manufacturing tax: lag	0.040	0.616	0.95	

Table 3.1: Regression results for manufacturing employment growth in border counties. Each regression includes date and border-pair specific fixed effects. Reported are the coefficient estimates, standard errors which are clustered by state, and p-values, along with the adjusted R^2 from the regression. There are $43 \times 177 = 7611$ county-month observations.

states. Thus this is a generalization of the simple pooled difference-in-differences from Table 2.1 above, which now includes the fixed effect controls. The estimate is significant both economically and statistically, showing that since 2013 manufacturing employment has grown on average 1.9 percentage points faster in Wisconsin border counties than in counties just across the border. This is larger than the pooled county results, suggesting that the pooling masked some of the differences across the border and highlighting the importance focusing on local labor markets.

While this initial result is suggestive of the impact of the MAC, it includes all possible differences between Wisconsin and the other states since 2013. As discussed above, both Michigan and Illinois raised their corporate tax rates in the years just before the MAC took effect, which may have dampened employment in those states. Further, the MAC was only one part of an overall attempt to change the business climate in Wisconsin, which included changes in unionization, personal taxes, regulation, and becoming a right-to-work state in 2015. Thus, as in Holmes's [10] right to work analysis, this is more of a "pro-business" indicator capturing the entire impact of changes in the business climate.

To better gauge the quantitative impact of the MAC, I then regress the manufacturing growth rates on changes in the effective manufacturing tax rate (as well as the fixed effects). As the second row of in the table shows, this yields a quantitatively and statistically significant estimate of -0.86. That is, I find that for each percentage point reduction in the tax rate on manufacturing, the manufacturing employment growth rate increases by 0.86 percentage points. Thus manufacturers in border counties were sensitive to changes in taxes, responding to the lower tax burden by expanding employment. This is the main estimate that I use in later calculations.

I next look into whether there were anticipatory or delayed effects of the tax changes. This is potentially important, as the MAC was passed about a year and a half before it took effect, and had an announced phase-in schedule. On the other hand, it may take time for manufacturers to ramp up employment or there may be add-on delayed effects from an initial change in taxes. Thus instead of just including the contemporaneous changes in tax rate, I add a one year lead and one year lag to the regression equation.[8] As the bottom rows of the table show, there are no detectable dynamics in the response of manufacturing

[8]Since the tax rates are constant over the year, adding high frequency leads or lags would make no difference.

Independent variable	Coefficient	Std. Error	p-value	Adj. R^2
Post-MAC dummy (percent)	0.690	0.401	0.09	0.221
Change in manufacturing tax: current	-0.092	0.129	0.47	0.216
Change in manufacturing tax: current	0.097	0.193	0.62	0.220
Change in manufacturing tax: lag	-0.421	0.097	<0.01	

Table 3.2: Regression results for non-manufacturing employment growth in border counties. Each regression includes date and border-pair specific fixed effects. Reported are the coefficient estimates, standard errors which are clustered by state, and p-values, along with the adjusted R^2 from the regression. There are $43 \times 177 = 7611$ county-month observations.

employment to tax changes, as the estimate on the current change is essentially unaffected while the lead and lag estimates are small and insignificant.

Next I turn to analyzing whether the MAC had spill-overs to other sectors, as the results in Section 2.2 suggested. Table 3.2 lists the parameter estimates for regressions which are similar to those in Table 3.1, but now for non-manufacturing employment growth. The first line again lists the results for the post-MAC dummy, and I find that on average non-manufacturing employment has grown 0.7 percentage points per year faster on the Wisconsin side of the border since 2013. This is similar to, but slightly lower than, the result in the pooled data difference in differences in Table 2.2, and is significant at the 10% level. Next I turn to the spill-over impact of the changes in manufacturing taxes. The second row of the table shows that the impact of a current reduction in manufacturing taxes on non-manufacturing employment is small and not significant. However the bottom rows of the table allow for dynamics, and show that the manufacturing tax changes seem to have an effect with a one-year lag. The current year effect is small and insignificant, while the lagged effect is large and statistically significant. In particular, the bottom row of the table shows that a 1 percentage point cut in effective manufacturing taxes leads to an increase of non-manufacturing employment growth of 0.4 percentage points one year later.

Overall my results suggest the MAC led to more rapid manufacturing employment growth since it took effect in 2013. Moreover, as manufacturing employment grew, the other sectors of the economy followed with expansion as well.

3.3 Implications of the Results

To measure the cumulative impact of the MAC, I calculate what my results suggest would have happened to employment in its absence. That is, I construct an artificial tax change series which eliminates the tax changes due to the MAC (keeping the changes in other states), and feed this through the regression equation to obtain the counterfactual employment growth rates. Starting from the actual employment levels in December 2012, I cumulate the counterfactual growth rates to construct the counterfactual employment level.

The results are shown in Figure 3.1, which plots employment pooled across the border counties, along with the estimated counterfactual level, with the data for December 2012 indexed to 100. My estimates suggest that in the absence of the MAC, manufacturing employment would have remained roughly constant since 2013, declining by a cumulative 0.2% over that span. On the other hand, actual manufacturing employment in the Wisconsin bor-

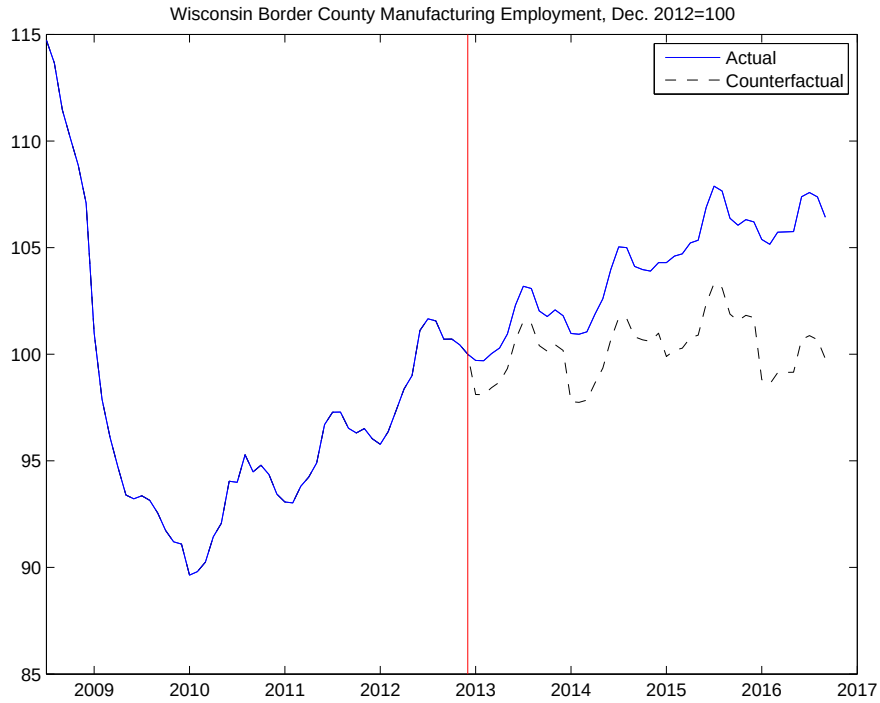

Figure 3.1: Manufacturing employment in border counties of Wisconsin, with the actual data (blue line), and estimated level in the absence of the MAC (dashed line). Data for December 2012 indexed to 100.

der counties grew by 6.4%. This suggests that the MAC accounted for more than the entire observed increase in manufacturing employment, so that by September 2016 manufacturing employment in the Wisconsin border counties was 6.6% higher than it would have been if the tax credit had not been introduced.

To measure the overall impact of the MAC on employment, I conduct a similar exercise for non-manufacturing employment. Figure 3.2 plots the estimated cumulative percentage increases in manufacturing, non-manufacturing, and total employment due to the policy. My regressions suggest that in January 2013 when the MAC took effect, it caused a slight fall in non-manufacturing employment due to the negative contemporaneous estimate (which is insignificant, but I include it nonetheless). But after the small initial reduction, non-manufacturing employment grew as the manufacturing gains spilled over to other sectors. Adding up the gains over time, I find a cumulative increase of 1.5% in non-manufacturing employment in the border counties by the end of the sample. Adding together the counterfactual manufacturing and non-manufacturing series yields the counterfactual time series for total employment. Figure 3.2 shows that by September 2016 total employment in the border counties increased by 2.5% over the level that would have prevailed absent the policy.

4 Statewide Implications

While the cross-border comparisons are useful to measure the impact of the policy on the border counties, the results do not necessarily transfer directly to the rest of the state.

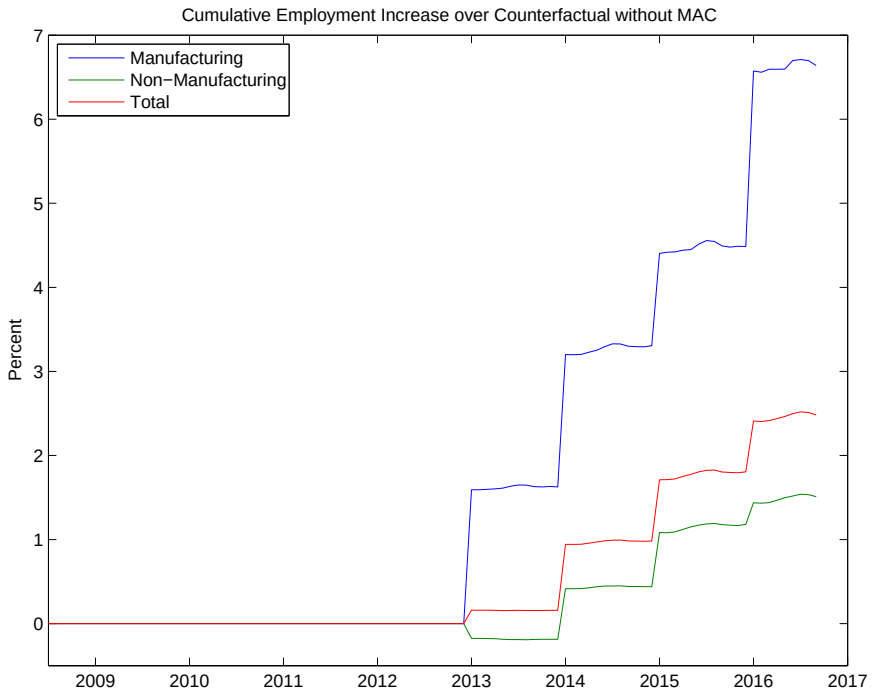

Figure 3.2: Cumulative increase in employment in border counties of Wisconsin, calculated as the percentage increase in the actual data compared to the estimated level in the absence of the MAC. Shown are manufacturing employment (blue line), non-manufacturing employment (green line) and total employment (red line).

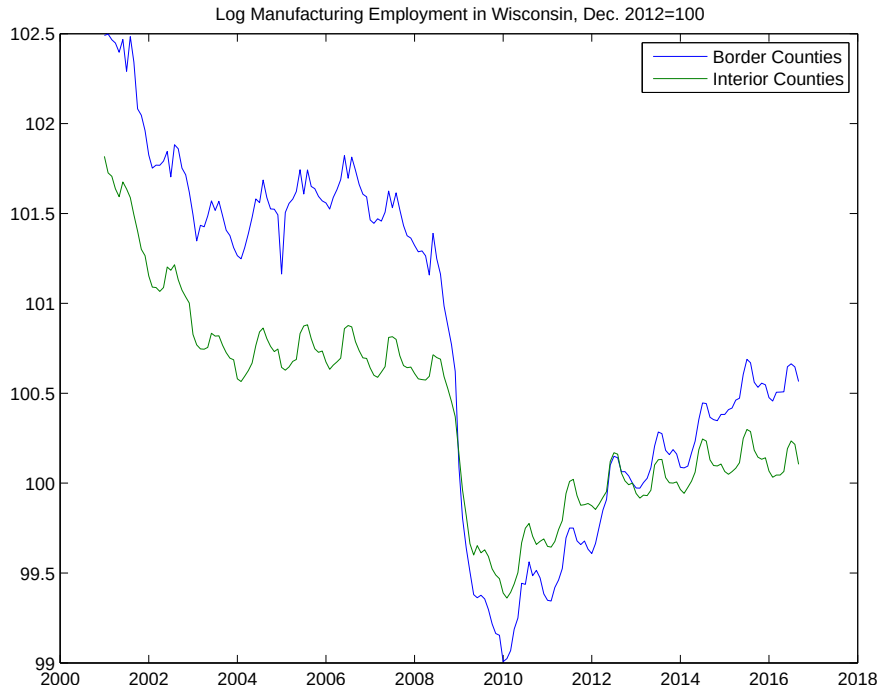

Figure 4.1: Log manufacturing employment in Wisconsin border counties (blue line) and interior counties (green line). Data for December 2012 indexed to 100.

My results suggest that the MAC accounted for more than the observed 6.4% cumulative increase in manufacturing employment and more than a quarter of the 8.9% increase in total employment in the border counties since the credit went into effect. To apply these results from the border counties to the rest of Wisconsin requires some care however, as the border counties are not necessarily representative of the rest of the state. This is clear from the statewide data, where manufacturing employment has increased by 2% and total employment by 5.3% since December 2012, both of which are lower than in the border counties. My regression results do allow for time and border-pair specific effects which absorb some of the idiosyncratic features of the border counties, but do not fully capture differences between border and interior counties. In this section I adapt the border county estimates to the whole state, using the historical relationships between employment in border and interior counties. These results suggest a smaller, but still sizeable, impact of the MAC on employment statewide.

4.1 Applying the Border County Results

I consider three simple ways of applying my results from the border counties to the interior, and thus measuring the total statewide impact of the policy. The first approach is to apply the border results directly, assuming that my empirical results have identified the true state-level effect. Thus the cumulative impact of the MAC on employment would be the same for the whole state, resulting in a 6.6% gain in manufacturing employment and a 2.5% gain in total employment. These results are quite strong, as they suggest manufacturing employment

Dependent var.	Independent var.	Coefficient	Std. Error	p-value	Adj. R^2
Interior manuf.	Constant	5.519	0.131	<0.01	0.945
	Border manuf.	0.668	0.012	<0.01	
Interior non-manuf.	Constant	5.172	0.121	<0.01	0.968
	Border non-manuf.	0.732	0.010	<0.01	

Table 4.1: Regression results for manufacturing and non-manufacturing employment in Wisconsin interior counties. Each regression is specified in log levels. Reported are the coefficient estimates, standard errors, and p-values, along with the adjusted R^2 from the regression. Each regression has 189 monthly observations.

would have declined sharply in the absence of the policy. Moreover, they don't account for difference between border and interior counties.

A second approach is to suppose that the MAC accounted for the same proportional share of the employment gain in the interior as in the border. Since the MAC accounted for all the manufacturing employment gains on the border and 28% of the total employment gains, we would then estimate that it accounted for the entire 2% gain in manufacturing employment and a 1.5% (28% of 5.3%) gain in total employment statewide. This approach accounts for the differences between the border and interior, but does not use any data other than the total gains.

The third approach, which I take as the benchmark, uses the historical relationship between employment in the border and interior counties. In practice this approach delivers an estimate in between the other two. Figure 4.1 shows the levels of manufacturing employment in the border and interior counties (in log terms, with December 2012 scaled to 100). There we see that manufacturing employment was more volatile in the border counties over the sample, declining more in the first half of the sample through the Great Recession and then increasing more rapidly afterward. Non-manufacturing employment was similarly more volatile in the border than the interior throughout.

Therefore to project from the border to the interior, I estimate the relationship between employment, both manufacturing and non-manufacturing, in border and interior counties. The regression specifications are simply:

$$\log Y_{i,t} = \beta_0 + \beta_1 \log Y_{b,t} + \varepsilon_t,$$

where $Y_{i,t}$ is the pooled employment levels in the interior counties and $Y_{b,t}$ the pooled employment levels for the border counties. I run separate regressions for manufacturing and non-manufacturing employment, whose results are shown in Table 4.1. These results suggest that a 1% change in employment, either manufacturing or non-manufacturing, in the border counties is associated with roughly a 0.7% change in employment in the interior counties.

I use these regressions, along with my previous results on the border counties, to estimate the statewide impact of the MAC. In particular, I substitute the counterfactual border time series for manufacturing and non-manufacturing employment in the absence of the MAC into the regressions, which results in counterfactuals for the interior counties. Adding the border and interior results together then provides an estimate of the total statewide impact of the MAC.

Figure 4.2: Manufacturing employment in Wisconsin, with the actual data (blue line), and estimated level in the absence of the MAC (dashed line).

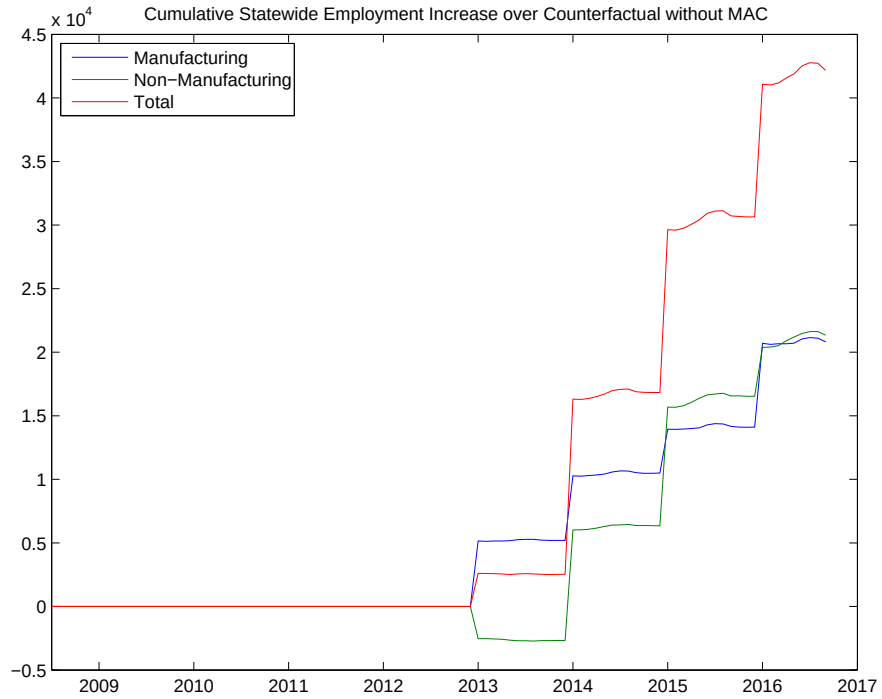

Figure 4.3: Cumulative increase in employment in Wisconsin, calculated as increase in the actual data compared to the estimated level in the absence of the MAC. Shown are manufacturing (blue line), non-manufacturing (green line) and total (red line) employment.

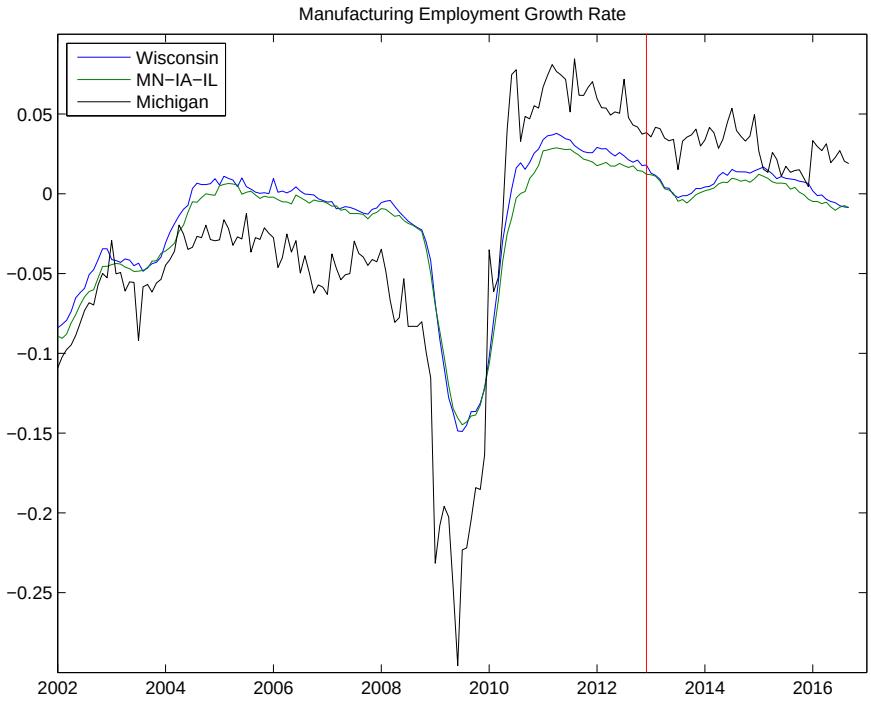

Figure 4.4: Annual growth rates of manufacturing employment in Wisconsin (blue line), pooled data for Minnesota, Iowa, and Illinois (green line), and Michigan (black line).

The results are shown in Figures 4.2 and 4.3, which parallel the border county results in Figures 3.1 and 3.2, but now plot the results for the whole state in employment levels. In particular, Figure 4.2 plots the level of manufacturing employment in Wisconsin along with the estimated counterfactual in the absence of the MAC. The estimated 6.6% increase in manufacturing employment from the border counties implied a 4.3% increase in the interior, and thus a 4.6% increase statewide. This suggests that manufacturing employment would have fallen in the absence of the MAC, and I estimate that by September 2016 the MAC accounted for a cumulative increase of 20,819 manufacturing jobs statewide.

Figure 4.3 plots the estimated cumulative statewide increase in manufacturing, non-manufacturing, and total employment due to the MAC. There we see that the employment gains in the manufacturing and non-manufacturing sectors were roughly equal. The estimated percentage gains in the non-manufacturing sector were substantially smaller, but non-manufacturing employment is roughly 4 times as large as manufacturing employment, resulting in a commensurate increase in total jobs. In total, I estimate that by September 2016 the MAC accounted for a gain of 42,161 jobs statewide, a 1.8% increase in private employment.

4.2 Direct Statewide Comparisons

A natural first step in evaluating the potential impact of the manufacturing and agriculture credit is to look at state level outcomes, and compare results in Wisconsin to the its neighboring states or to national averages. While I have discussed the drawbacks of this analysis

	2002-2012	2013-2016	Difference
Wisconsin	-1.91	0.59	2.50
Minnesota-Iowa-Illinois	-2.42	0.22	2.64
Difference	0.51	0.37	-0.14 (p=0.89)

Table 4.2: Difference in differences for manufacturing employment at the state level.

above, I provide it here for comparison with the previous analysis such as [16]. Looking directly at state-level aggregates, I do not find significant differences between Wisconsin and its bordering states.

Figure 4.4 mimics Figure 2.2 above, but now focusing on border states rather than border counties. The figure shows the annual growth rate in manufacturing employment in Wisconsin, along with the growth rate of pooled data for Minnesota, Iowa, and Illinois. The figure separately plots statewide manufacturing employment growth in Michigan, whose Upper Peninsula border counties we used above. The figure shows that manufacturing employment growth was typically slightly higher in Wisconsin than in Minnesota, Iowa, and Illinois, and this relationship does not seem to have changed much since 2013.

The figure also shows that statewide manufacturing employment in Michigan had vastly different dynamics than in the other states, with persistently large employment losses from 2002-2010, followed by a larger recovery in growth rates. Thus at the state level Michigan does not seem to be a relevant comparison for the effects of policy in Wisconsin. While the counties in the Upper Peninsula of Michigan are relatively similar to their bordering Wisconsin counties, the entire states have different dynamics. This again suggests the potential problems with statewide comparisons, which are lessened by considering local labor markets.

The figure suggests that at the state level there is no evident impact of the MAC. This is further illustrated by the simple difference in differences results in Table 4.2. There I show the average growth rates over the pre-MAC period of 2002-2012, along with the period from 2013-2016 when the MAC was in effect. In both Wisconsin and its neighboring states, manufacturing employment fell on average in the first period and grew after 2013. Also in both periods employment growth was slightly higher in Wisconsin. But looking at the difference in differences, we see that growth accelerated slightly more, 0.1% per year on average, in the border states than Wisconsin. However as the table shows, this very small difference is not statistically significant, with a p value of nearly 0.9.

5 Conclusion

The strong policy effects that I find by analyzing the border counties are not evident in statewide comparisons. As described above, this suggests that important differences across the states, such as urban concentration and growth, industry and sectoral concentrations, and demographics and labor force dynamics confound the policy effect in the state-level data. In fact, losses of manufacturing jobs were concentrated counties in the Milwaukee metro area (particularly Milwaukee and Waukesha counties), while the gains–some quite substantial–were spread more evenly across the state. Moreover, the introduction of the

MAC in Wisconsin was not exogenous, but rather reflected (at least in part) a conscious response to economic conditions and the state's competitive position. The same factors driving the policy change also affect economic conditions, so measuring ex-post results at the state level do not identify the policy impact.

By focusing on the local labor markets on either side of the Wisconsin border, I estimate that the Manufacturing and Agriculture Credit had a significant impact on manufacturing and total employment in the state. While other questions about the policy may remain, my results suggest that it has generated substantial job growth in Wisconsin.

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A Definition of the Border Groups

In defining the border groups, I treat a Wisconsin border county as the base, and assign the same group to each county in the other states that shares a significant border with the Wisconsin county. I try to match border counties in pairs, assigning each county to the one whose border it most closely overlaps. I ignore small overlaps, where the shared portion of the border accounts for less than a quarter of the total border length. In addition, I drop Trempealeau County, WI which has a small border with Minnesota, but its county seat and most of the mass of the county is well interior. The following table reports my border county grouping.

	WI	MN	
1	Douglas	Carlton	St Louis
2	Burnett	Pine	
3	Polk	Chisago	
4	St. Croix	Washington	
5	Pierce	Goodhue	
6	Pepin	Wabasha	
7	Buffalo	Wabasha	Winona
8	La Crosse	Houston	Winona
9	Vernon	Houston	
	WI	IA	
10	Crawford	Allamakee	
11	Grant	Clayton	Dubuque
	WI	IL	
12	Lafayette	Jo Daviess	
13	Green	Stephenson	
14	Rock	Winnebago	Boone
15	Walworth	McHenry	
16	Kenosha	Lake	
	WI	MI	
17	Iron	Gogebic	
18	Vilas	Gogebic	
19	Forest	Iron	
20	Florence	Iron	Dickinson
21	Marinette	Dickinson	Menominee