# JOB CREATION TAX CREDITS, FISCAL FORESIGHT, AND JOB GROWTH: EVIDENCE FROM U.S. STATES

Robert S. Chirinko and Daniel J. Wilson*

April 2016

* **Acknowledgements:** We would like to acknowledge the excellent research assistance provided by Katherine Kuang, Charles Notzon, Tom O'Conner, and the comments and suggestions from seminar/conference participants at the American Economic Association, CESifo, Econometric Society, Einaudi Institute of Economics and Finance, European Central Bank, Federal Reserve Bank of San Francisco, Federal Reserve System Committee on Regional Analysis, Goethe University, Institute for Advanced Studies (Vienna), International Institute for Public Finance, Italian Ministry of Economy and Finance, IZA, National Tax Association, North American Regional Science Association, Oxford University, Southern Economic Association, Universities of La Sapienza, Tor Vergata, and Urbino, University of Dublin, University of Illinois at Chicago, University of Lugano, and the Upjohn Foundation, especially our formal discussants, Tim Bartik, Elliott Dubin, Leo Feler, Yolanda Kodrzycki, Tuomas Kosnen, and Sarah Zubairy. Comments from Olivier Blanchard and Adam Shapiro have also been appreciated. Financial support from the Federal Reserve Bank of San Francisco and the Upjohn Foundation is gratefully acknowledged. All errors and omissions remain the sole responsibility of the authors, and the conclusions do not necessarily reflect the views of the organizations with which they are associated.

Robert S. Chirinko
Department of Finance
2333 University Hall
University of Illinois at Chicago
601 South Morgan (MC 168)
Chicago, Illinois 60607-7121
PH: 312 355 1262
FX: 312 413 7948
EM: Chirinko@uic.edu

Corresponding Author
Daniel J. Wilson
Federal Reserve Bank of San Francisco
Mail Stop 1130
101 Market Street
San Francisco, CA 94105
PH: 415 974 3423
FX: 415 974 2168
EM: Daniel.Wilson@sf.frb.org

# JOB CREATION TAX CREDITS, FISCAL FORESIGHT, AND JOB GROWTH: EVIDENCE FROM U.S. STATES


## ABSTRACT

This paper studies the effects of job creation tax credits (JCTCs) enacted by U.S. states between 1990 and 2007 to gain insights about fiscal foresight (alterations of current behavior by forward-looking agents in anticipation of future policy changes). Nearly half of the states adopted JCTCs during this period, and their experiences provide a rich source of information for assessing the quantitative importance of fiscal foresight. We investigate whether JCTCs affect employment growth before, at, and after the time they go into effect. A theoretical model identifies three key conditions necessary for fiscal foresight, captures the effects of the rolling base feature of JCTCs, and generates several empirical predictions.

We evaluate these predictions in a difference-in-difference regression framework applied to monthly panel data on employment, the JCTC effective and legislative dates, and various controls. Failing to account for the distorting effects of fiscal foresight can result in upwardly biased estimates of the impact of the JCTC fiscal policy by as much as 37%. We also find that the cumulative effect of the JCTCs is positive, but it takes several years for the full effect to be realized. The cost per job created is approximately $17,000, which is low relative to cost estimates of recent federal fiscal programs.



**Keywords:** Fiscal foresight, job creation tax credits, state business tax incentives, implementation lags, fiscal policy

**JEL codes:** E62 (fiscal policy), E24 (employment), H25 (business taxes), H71 (state and local taxation, subsidies, and revenue)

# JOB CREATION TAX CREDITS, FISCAL FORESIGHT, AND JOB GROWTH: EVIDENCE FROM U.S. STATES

## TABLE OF CONTENTS

# JOB CREATION TAX CREDITS, FISCAL FORESIGHT, AND JOB GROWTH: EVIDENCE FROM U.S. STATES

> There is a great deal of evidence that fiscal policy works well, almost everywhere, perhaps especially well when the interest rate is at its effective lower bound.
>
> Stanley Fischer (2015)

> … I would prefer more targeted measures…., such as a tax credit for employers who hire the long-term unemployed or direct employment.
>
> Alan Krueger (2015)

Recent years have seen a resurgence in interest by policymakers and economists alike in the use of fiscal policy as a tool for promoting both short-run and long-run economic growth. The Economic Stimulus Act of 2008 and the American Recovery and Reinvestment Act of 2009 are indicative of this renewed interest, and they presage more frequent reliance on fiscal policy as a policy tool in the years ahead. As indicated by the above quotation, one of the key lessons learned over the past 20 years by Board of Governors Vice Chair Fischer is that "fiscal policy works well."

But how well? Assessing the quantitative impacts of fiscal policies is made difficult by "fiscal foresight," alterations of current behavior by forward-looking agents in anticipation of future policy changes. In particular, lags between when a fiscal policy is signed into law and when it goes into effect encourage fiscal foresight and create anticipation effects that bias inferences. The quantitative importance of anticipation effects is a key policy question and has been the subject of much previous research and debate. Several recent empirical studies of fiscal multipliers distinguish between anticipated and unanticipated changes in aggregate fiscal policy. Auerbach and Gale (2009); Leduc and Wilson (2013); Leeper, Richter, and Walker (2012); Mertens and Ravn (2010, 2012); and Ramey (2011), among others, report significant differences between anticipated and unanticipated shocks in terms of their co-movements with macroeconomic activity, pointing to the importance of fiscal foresight.[1] The evidence in Hsieh (2003, p. 397) provides a nuanced view with anticipated income changes affecting consumption "when the income changes are large, regular, and easy to predict" but not when the income changes are small and irregular. The simulations of Yang (2005) confirm the importance of fiscal foresight in a perfect foresight model. By contrast, the VAR analyses of Blanchard and Perotti (2002) and Perotti (2012) and the single-equation analysis of Poterba (1988) find no evidence of fiscal foresight in advance of fiscal shocks and pre-announced tax changes, respectively.

All of the above studies are based on aggregate data.[2] Estimating anticipation effects with aggregate data faces some difficulties. Observed movements in macroeconomic outcomes during periods between the passage of fiscal legislation and its implementation are due both to overall economic conditions and to any anticipation effects. Disentangling these two components in aggregate time series data requires strong assumptions and substantial variation in the data.

We turn to the substantial variation in state-level panel data to shed light on the existence and quantitative importance of fiscal foresight for firms. We focus on a particular fiscal policy, job creation tax credits (JCTCs). Nearly half of U.S. states have enacted permanent, broad-based JCTCs over the past twenty years.[3] Figure 1 shows the policy diffusion process over time for

---

[1] Coglianese, Davis, Kilian, and Stock (2015) document the importance of anticipatory purchase of gasoline with respect to gasoline taxes.

[2] Despite its clear policy importance, the literature on fiscal foresight using panel or microeconomic data is surprisingly sparse. A related literature has looked at the consumer spending response of households to the receipt of pre-announced tax rebates (see Johnson, Parker, and Souleles (2006), Parker, Souleles, Johnson, and McClelland (2013), and Shapiro and Slemrod (2009)). These studies exploit quasi-random variation across households in the timing of rebate receipt to estimate their spending response to the rebate receipt. However, they are unable to estimate announcement/anticipation effects because the rebate legislation is the same for all households.

[3] Here and throughout the paper we focus on JCTCs that are "broad" in the sense that they apply to employers in a wide range of industries, in all parts of the state and without substantial non-employment-based requirements. Neumark and Grijalva (2013) document that many states additionally have narrow hiring credits targeted at particular industries (such as biotechnology, information technology, or motion pictures), particular areas of the state ("enterprise zones"), or particular actions (such as headquarters relocation, facilities expansion, or research and development). We also focus on JCTCs that are "permanent" in the sense that their legislation did not set an expiration date. This latter restriction rules out temporary JCTCs that are sometimes passed as short-run stimulus measures. These temporary JCTCs

these state JCTCs (based on the legislative enactment dates that we compiled for this paper). To our knowledge, the first JCTC was enacted in 1987 by Nebraska. Since then, these tax credits have proliferated, with an additional 21 states adopting a JCTC by the end of 2007. Figure 2 shows the geographical distribution of these credits. The plurality of JCTC states are in the eastern United States, but there are also many in the Midwest and South.

Three important aspects of state JCTCs give rise to a powerful empirical context for identifying the effects of fiscal foresight. First, we do not have to disentangle the effects of fiscal policy from monetary policy in our state panel dataset. Second, states adopting JCTCs differ in whether their credit goes into effect immediately or with a delay (and in the length of the delay). The variation in this dimension allows us to estimate the effects of fiscal foresight because such foresight is reduced, if not eliminated, when there is no implementation delay. Based on states' legislative records, we are able to measure the existence and length of each JCTC implementation delay period by identifying two key dates:

- the "signing" date on which the legislation is signed into law by the state's governor and
- the "qualifying" date on or after which net new hires by an in-state employer can qualify for the credit.[4]

The relation between signing and qualifying dates defines two JCTC regimes that may exhibit different employment responses. We present a partial equilibrium theoretical model to show how a firm's optimal labor demand varies over time in each of the two regimes. When the qualifying date occurs after the signing date, employers anticipate the forthcoming decline in the effective wage. Hence, they have an incentive to initially decrease employment during the implementation period (the period between the signing and qualifying dates) and then to compensate for this decrease by raising employment sharply at the qualifying date. We refer to this potential negative effect as an Anticipatory Dip, and the subsequent positive effect as a Compensating Rebound. Each is a specific result of fiscal foresight. States whose JCTCs have an implementation period are classified as delayed-JCTC states. Alternatively, the qualifying

are likely to be endogenous with respect to current and expected employment growth. For similar reasons, we consider only JCTCs passed prior to the Great Recession, which began in December 2007.

[4] This timing convention is used frequently in the fiscal foresight literature (Mertens and Ravn, 2012, p. 146). These and other terms are discussed in detail in Section III.A and Appendices A and B.

date may occur at or before the signing date. We classify these states as immediate-JCTC states and expect that the response of employment at the qualifying date will be less than for delayed-JCTC states; this difference measures the Compensating Rebound.

The third important aspect of state JCTCs is that the economic outcome they are intended to stimulate, employment growth, is measured with substantial accuracy (by the BLS) and at a high frequency (monthly). This allows us to precisely estimate the dynamic response of state employment growth around JCTC adoptions for each of the two regimes. Specifically, for delayed-JCTC states, we estimate average employment growth before, at, and after the qualifying date, while for immediate-JCTC states, we estimate average employment growth at and after the qualifying date. We can thus estimate the presence and magnitudes of the Anticipatory Dip and Compensating Rebound.

Moreover, we are also able to evaluate the cumulative impact of JCTCs on local job growth (which we label CUM), which is important for both state and federal policymakers considering such policies. Federal JCTCs have been much debated in recent years in the U.S. and abroad.[5] For instance, Bartik and Bishop (2009) argue that a "well-designed temporary federal job creation tax credit should be an integral part of the effort to boost job growth." In 2010, a limited JCTC was part of the Hiring Incentives to Restore Employment (HIRE) Act. A second JCTC was part of President Obama's 2011 proposed American Jobs Act that would have offered a tax credit of $4,000 for hiring long-term unemployed workers, but the legislation was not passed by Congress. Per the above quotation from Krueger (2015), JCTCs continue to be discussed well into the current economic expansion.

Our paper provides quantitative evidence on the importance of Anticipatory Dips (ADs), Compensating Rebounds (CRs) and the cumulative impacts (CUMs) of JCTCs. The paper proceeds as follows. Section I presents two initial empirical explorations. We examine employment growth before and after the month in which firms qualify for the JCTC. We document that employment growth rises when firms become eligible for JCTCs and that, consistent with fiscal foresight, the increase is larger for delayed-JCTC-states. We also present two synthetic control case studies – one for an immediate-JCTC state and one for a delayed-

[5] See Cahuc, Carcillo and Le Barbanchon (2016) for a study of the recently enacted JCTC in France.

JCTC state – to illustrate the potential role of policy implementation delays in generating ADs and CRs.

Section II constructs a partial equilibrium theoretical framework for understanding the effects of a JCTC on labor costs and analyzes the intertemporal decisions faced by a firm. Our analysis identifies three key conditions necessary for an AD and CR and generates several empirical predictions. Moreover, the theoretical framework provides guidance for correctly measuring the magnitude of the pecuniary incentive provided by JCTCs.

Section III describes the unique dataset that we have hand-collected on permanent, broad-based state JCTCs signed into law in the United States since 1990. Twenty-one JCTCs are identified, seven for delayed-JCTC states where the signing date is before the qualifying date, and the complementary class of 14 immediate-JCTC states. The latter serves as a control group critical for quantifying the CRs. Further details are provided in Appendix A (Glossary) and Appendix B (containing details about our JCTC dataset). Section III also discusses empirical preliminaries and specification issues. We examine the factors leading to JCTC adoption and conclude that reverse causation (employment growth leading to JCTC adoption) is unlikely to be a concern. The statistical properties of the monthly employment data are examined, and we find that the growth rate of employment is stationary. Based on these empirical results, we specify an estimating equation that delivers consistent estimates of the response of employment growth to JCTCs. Lastly, we use the inverse probability weighting (IPW) estimator, a matching type estimator that controls for possible selection effects that might bias our estimates.

Section IV presents our main empirical results, as well as several robustness checks and extensions. Our baseline estimates of the effects of delayed JCTCs and immediate JCTCs are obtained from difference-in-difference regression model using panel data for the 48 contiguous U.S. states. We document the importance of fiscal foresight, both in terms of an AD before and then a CR after the qualifying date for delayed-JCTC states. Employment growth responds sluggishly to JCTCs. We use our estimates and JCTC data to compute a cost per job created and the associated fiscal multiplier.

Section V concludes.

# I. SOME INITIAL EMPIRICAL EXPLORATIONS

Before proceeding to a detailed econometric analysis of JCTCs, we first present some initial non-parametric graphical evidence on the importance of fiscal foresight. We undertake a simple event study exercise and then offer two synthetic control case studies that illustrate the potential role of policy implementation delays in affecting the dynamics of economic activity around the time of policy enactments.

*I.A. Simple Event Study*

We compare employment growth averaged over N months before and after a JCTC event. A JCTC event is defined as the first month in which both new employment can qualify for the credit and the credit legislation has been enacted into law. The event window is defined by N, which is either 1, 6, 12, or 36 months. The scatterplots in Figure 3 show employment growth before (on the horizontal axis) and after (on the vertical axis) these events for all 21 JCTC states in our sample sorted into two regimes. Delayed-JCTC states – where the credit becomes effective one or more months after it is enacted into law – are colored orange/grey; immediate-JCTC states – where the credit becomes effective immediately upon enactment – are colored black. The solid line in each scatterplot is a 45 degree line. If there is an increase in state employment growth at and after the event date, the data point for that state will lie above the 45 degree line.

Figure 3 documents that employment growth tends to be higher after a JCTC becomes effective. This pattern appears to weaken somewhat as the event window is lengthened from 1 month to 36 months. The scatterplots also show that the response to the JCTC is larger for delayed-JCTC states than immediate-JCTC states, suggesting the empirical importance of CRs and possibly ADs.

*I.B. Synthetic Control Case Studies*

Next, we present synthetic control case studies for two selected states, one that is an immediate-JCTC state (Maryland) and one that is a delayed-JCTC state (Idaho). These two states are selected because they illustrate the potential impact of policy delay – i.e., fiscal foresight – on the dynamics of economic activity (employment) around policy enactments. The synthetic control method (Abadie, Diamond, and Hainmueller, 2010) involves tracing the evolution of some outcome measure over time for a treated unit compared with the evolution of a weighted-average of the outcome measure for a number of untreated control units. The weights are chosen to minimize the pre-treatment distance between the treated unit and the synthetic control unit in terms of the outcome variable and/or other variables. In our case, we construct synthetic controls for Maryland and Idaho, minimizing the distance in terms of pre-treatment employment growth, as well as the conditioning variables used in the difference-in-difference regression framework later in the paper. (See the note to Figure 4 for further details about the construction of the synthetic controls.)

Figure 4a presents the case study of Maryland, an immediate-JCTC state. It plots log private-sector employment in Maryland and in its synthetic control from 12 months prior to 12 months after Maryland signed into law its JCTC in May 1996. The law went into effect immediately, meaning that firms adding jobs starting in May 1996 could qualify for the tax credit. Employment in Maryland and its synthetic control are quite close before this event, with the exception of one outlier month in January 1996. (There was a both a temporary federal government shutdown and a historically severe Mid-Atlantic snowstorm in January 1996, both of which likely had a large negative effect on employment in that month.) Immediately after May 1996, Maryland's employment begins to exceed that for the synthetic control, and the difference grows over time, suggesting that some firms react to the credit promptly, while others react with a lag.

Figure 4b contains similar graphical evidence for Idaho, a delayed-JCTC state. Before the signing date of April 2001, employment in Idaho closely matches employment from its synthetic control. After April 2001, Idaho employment drops relative to its synthetic control, as firms cut back on employment in anticipation of the tax credit nine months in the future. That drop is arrested in January 2002, the month in which firms qualify for the tax credit. After the tax credit becomes effective, it takes nine months for Idaho's employment to return to that of its synthetic control. These patterns document the responsiveness of employment to JCTCs and the quantitative importance of fiscal foresight.

The simple event study uses no controls, while the case studies use controls formed for each state. A more complete analysis will pool the data and use all of the variation in a difference-in-difference regression framework. Before we begin this more complete empirical analysis, we develop and study a theoretical model in the next section.

# II. THEORETICAL FRAMEWORK

This section presents a dynamic model of the firm that provides guidance about the patterns of policy-response coefficients we should expect from a forward-looking firm facing a permanent JCTC. We begin by defining the firm's cash flows and the constraints that it faces. The first-order conditions (FOCs) characterizing optimal behavior are examined. These determine the steady-state values for three real variables – labor, output, and sales, as well as the transition behavior in the face of a policy stimulus. The adoption of a JCTC is then analyzed in three models of increasing generality in terms of the responses of the real variables away from the steady-state. We focus on the delayed-JCTC regime (which contains an implementation period between signing and qualifying months), highlight several empirical implications, measure the magnitude of the pecuniary incentive provided by JCTCs, and identify the three key conditions necessary for the emergence of Anticipatory Dips (ADs) and Compensating Rebounds (CRs).

*II.A. Optimization Problem*

Cash flow in period t is composed of four elements. First, revenues ($REV_t$) accrue to the firm from sales ($S_t$) in a market where the firm may have market power ($P_t = P[S_t], P'[S_t] \leq 0$). The demand curve is linear with slope ($-\beta/2$) and a constant term equal to ($1+\beta$). The linearity assumption is made for convenience; the parametric restriction as a simple device for assuring that, in the steady-state (SS), the firm faces an elastic demand curve for any value of $\beta$,

$$REV\left[S_t\right] \equiv P_t * S_t = \alpha * S_t - (\beta/2) * S_t^2, \tag{1a}$$

$$\alpha \equiv 1+\beta, \tag{1b}$$

$$\left|\frac{dS_t}{dP_t}\frac{P_t}{S_t}\right|_{SS} = (1+2/\beta) > 1 \qquad 0 < \beta < \infty, \tag{1c}$$

where we assume in equation (1c) that the steady-state value of $S_t$ equals one (an assumption verified in sub-section II.C).

Second, labor is the only factor of production, and production cost ($COST_t$) is the product of an exogenous wage (w) and labor input ($L_t$),

$$COST\left[L_t\right] \equiv w * L_t\ . \tag{2}$$

Third, the firm smooths production intertemporally by adjusting the end-of-the-period inventory stock ($I_t$). The firm has an exogenous target inventory-to-sales ratio ($\zeta$). Deviations from this target result in the following quadratic cost,

$$f[I_{t-1}, S_t] \equiv (\mu / 2) * \left( I_{t-1} - \zeta * S_t \right)^2 \qquad \mu \geq 0 . \tag{3}$$

Such a cost is standard in the inventory literature (cf., Ramey and West, 1999, equation 3.1) and represents inventory holding and stockout costs. If $f[.]$ is linear, $\zeta = 0$, and $(\mu / 2)$ equals the cost of borrowed funds, then equation (3) would represent the carrying cost of inventory.

Fourth, the firm receives a job creation tax credit equal to the product of the legislated tax credit rate ($\tau_t$), the wage rate, and the level of credit-qualifying employment. For the state credits in our sample, credit-qualifying employment is current employment, $L_t$, minus employment in the previous period, $L_{t-1}$ (or averaged over several previous periods such as the past 12 months). Because the previous period is not a fixed interval at a point in time but rather a window that moves forward in time with employment, this type of credit is known as a "rolling base" credit. The rolling base feature of these credits has important implications on the incentives from and the cost of tax credit programs. These implications are examined in sub-section II.E below. Here we assume a rolling base and the tax credit received by the firm is defined as follows,

$$g[L_t, L_{t-1} : \tau_t] \equiv \tau_t * w * \left( L_t - BASE_t \right), \tag{4a}$$

$$BASE_t \equiv L_{t-1} . \tag{4b}$$

The tax credit rate is noted explicitly in equation (4a) as a conditioning variable given its central role in the subsequent analysis.

In maximizing cash flow qua profits over the planning period, the firm faces production function, inventory accumulation, and isoperimetric constraints. The production function depends only on labor,[6]

$$Q_t = L_t^{(1/\delta)} \qquad \delta > 1, \tag{5}$$

where the returns to labor are decreasing and $\delta > 1$. The latter property is required for satisfying

[6] This formulation of the production function is consistent with a constant returns-to-scale production function with labor and a fixed factor as arguments, where the latter is normalized to one and fixed during the length of the period over which we evaluate the impact of the JCTC.

the second-order conditions (cf. fn. 9) and the uniqueness of the steady-state (cf. fn. 10). The end-of-period inventory stock is accumulated according to the following recursive equation,

$$I_t = Q_t - S_t + I_{t-1}. \tag{6}$$

Equation (6) will be appended to the optimization problem with a time-varying shadow price, $\theta_t$. The final constraint concerns the inventory stock at the end of the planning period. The firm begins the planning period with an inventory stock, $I_0$. If left unconstrained, the firm will end the planning period at time T with the inventory stock completely depleted, and some of its profit will be illusory. To avoid this extreme inventory drawdown that would distort profits and employment decisions, we require that $I_T = I_0$, which, after repeated substitution with equation (6), is equivalent to the following isoperimetric constraint,

$$I_T - I_0 = 0 = \sum_{t=1}^{T}\left(Q_t - S_t\right). \tag{7}$$

Note that this is a weaker constraint than the special case of assuming the firm starts with zero inventory because, in this special case, the firm will optimally deplete the inventory stock completely by period T and $I_T = I_0 = 0$. The constraint in equation (7) will be appended to the optimization problem with a time-invariant shadow price, $\phi$. This constant shadow price of output plays a critical role in the intertemporal allocation of labor, output, and sales for a firm facing a delayed JCTC and in the emergence of ADs and CRs.

Combining the four relations defining cash flow ($CF_t$), discounting $CF_t$ by a constant discount factor ($R^t$ depending on a constant discount rate $\rho$), assuming that cash flows accrue at the end of the period, substituting $L_t$ for $Q_t$ with equation (5), and appending the two constraints, we write the dynamic optimization problem as follows,

$$\Pi_0 = \underset{\{L_t, S_t, I_t\}}{\text{Max}} \sum_{t=1}^{T} R^t \left\{ CF\left[L_t, S_t, I_{t-1}, L_{t-1} : \tau_t\right] + \theta_t\left(I_t - L_t^{(1/\delta)} + S_t - I_{t-1}\right) + \phi \sum_{t=1}^{T}\left(L_t^{(1/\delta)} - S_t\right) \right\}, \tag{8a}$$

$$R^t \equiv \left(1+\rho\right)^{-t} \qquad \rho > 0, \tag{8b}$$

$$CF\left[L_t, S_t, I_{t-1}, L_{t-1} : \tau_t\right] \equiv \left(REV\left[S_t\right] - COST\left[L_t\right] - f[I_{t-1}, S_t] + g[L_t, L_{t-1} : \tau_t]\right). \tag{8c}$$

*II.B. First Order Conditions*

The firm maximizes discounted cash flows by appropriate choices of labor, sales, and the inventory stock. Given the inventory accumulation constraint, the latter variable is predetermined by the choices of labor and sales, and it could be eliminated from equation (8) with equation (6). We include $I_t$ explicitly in equation (8) to facilitate the interpretation of the first-order conditions. We begin with the perturbation of equation (8) with respect to $I_t$,

$$I_t: \; -R*\mu\left(I_t - \zeta * S_{t+1}\right) + \theta_t - R*\theta_{t+1} = 0, \tag{9a}$$

→

$$\theta_t = \sum_{s=0}^{T} R^{t-s-1} \; \mu\left(I_{t+s} - \zeta * S_{t+s+1}\right). \tag{9b}$$

Equation (9a) is a first-order difference equation in $\theta_t$.[7] It can be solved by recursive substitution for $\theta_{t+s}$ and by imposing the terminal condition that that $\theta_T$ equals zero (discussed below). This solution is presented in equation (9b) and defines $\theta_t$ as the shadow price of adding a unit of inventory in period t and keeping that unit in inventory until period T. If in period t, the inventory stock exceeds its target level $\left(\left(I_{t+s} - \zeta * S_{t+s+1} > 0\right), \forall s = 0, T\right)$, an addition to inventory aggravates the imbalance, is costly to the firm, and $\theta_t > 0$.[8] These incremental costs are increasing in $\mu$ and are discounted by R. If in period t, the inventory stock is below its target level, then the additional unit is beneficial to the firm, the incremental cost is negative, and $\theta_t < 0$. In the steady-state, the inventory stock equals its target level, the inventory imbalance is zero, and $\theta_t = 0$.

The key decisions made by the firm concern labor and sales. The first-order condition for labor is as follows,

---

[7] If the cash flow term defined in equation (8c) had also included an inventory carrying cost ($c * I_{t-1}$), this additional cost term would have merely redefined $\theta_t$. Inventory carrying costs would enter equation (9a) as $-R*c$ and, in this case, equation (9b) would contain an additive constant multiplied by the discount factor.

[8] We assume that the inventory imbalance is reduced monotonically to zero. Given the quadratic specification, inventory imbalances of either sign are penalized, and it would be unnecessarily costly for the firm to overshoot the steady-state value.

$$L_t: \ w*\left(1-\tau_t+\tau_{t+1}*R\right)+\theta_t*\left(L_t^{((1-\delta)/\delta)}/\delta\right)=\phi*\left(L_t^{((1-\delta)/\delta)}/\delta\right), \qquad (10a)$$

→

$$MPL\left[L_t\right]=w_t^{EFF}/\left(\phi-\theta_t\right) \qquad w_t^{EFF}\equiv w*\left(1-\tau_t+\tau_{t+1}*R\right), \quad MPL\left[L_t\right]\equiv\left(1/\delta\right)*L_t^{((1-\delta)/\delta)} \qquad (10b)$$

→

$$L_t=\left(\frac{\phi-\theta_t}{\delta*w_t^{EFF}}\right)^{(\delta/(\delta-1))}, \qquad (10c)$$

$$Q_t=\left(\frac{\phi-\theta_t}{\delta*w_t^{EFF}}\right)^{(1/(\delta-1))}. \qquad (10d)$$

The two terms on the left side of equation (10a) define the total cost from hiring an incremental worker (and hence producing an incremental unit of output). The first term reflects labor costs represented by the effective wage rate, $w_t^{EFF}$ , which is equal to the sum of the cost of hiring labor ( $w$ ) less the tax credit received in period t ( $-w*\tau_t$ ) and, owing to the rolling base feature of the tax credit (discussed in more detail in sub-section II.E), plus the tax credit that will not be received in period t+1 ( $w*\tau_{t+1}*R$ ). Taken together, these latter two terms form the effective tax credit rate that differs markedly from the legislated tax credit rate, $\tau$. The second term is the cost of adding to an inventory imbalance. If $\theta_t$ is positive due to a positive inventory imbalance, incremental output from a new hire increases the imbalance and is costly to the firm. These incremental costs are equal to the benefit from an additional hire, represented by the term on the right side of equation (10a). This term is the constant shadow price of output, $\phi$, multiplied by the marginal product of labor.

These relations are rearranged into a more concise expression in equation (10b), which shows that labor is optimally chosen such that its marginal product equals labor's effective wage rate "deflated" by the true price of output, which is its shadow price net of any cost due to an inventory imbalance. Equation (10c) is a rearrangement of equation (10b) and relates $L_t$ to the production function parameter, shadow prices, and the effective wage rate. Equation (10d) is the corresponding expression for $Q_t$.

The second key choice by the firm concerns sales determined by the following first-order condition,

$$S_t: \quad (\alpha - \beta * S_t) + \mu * \zeta (I_{t-1} - \zeta * S_t) + \theta_t = \phi, \tag{11a}$$

$\rightarrow$

$$S_t = \frac{\alpha + \mu * \zeta * I_{t-1} + \theta_t - \phi}{\beta + \mu * \zeta^2} \ . \tag{11b}$$

Equation (11a) is a perturbation of equation (8) that impacts cash flow in three ways. The first term in equation (11a) is the marginal revenue, which decreases in the level of sales because of the downward-sloping demand curve. The second term reflects the cash flow from a change in the target and depends on the sign of the inventory imbalance. An increase in sales (and hence the target level of inventory) reduces a positive imbalance and adds to cash flow. The impact is negative when the inventory imbalance is negative. Note that this effect disappears if the target level is zero ($\zeta = 0$). The third term is the shadow price of inventory imbalances. The shadow price's impact on an incremental sale is opposite to its impact on labor because $Q_t$ (dependent on $L_t$) and $S_t$ have opposite but numerically identical effects on the inventory stock. If this cost is positive due to a positive inventory imbalance, an incremental sale reduces the imbalance and increases cash flow. These three terms define the total cash flow from an incremental sale and, under profit-maximization, equal the constant shadow price of output, $\phi$. Equation (11b) is a rearrangement of equation (11a) that relates $S_t$ to demand curve parameters, the predetermined inventory stock, and shadow prices.

Lastly, perturbations of the shadow prices yield the per-period inventory accumulation constraint and the planning-period isoperimetric constraint, respectively,

$$\theta_t: \quad I_t = L_t^{(1/\delta)} - S_t + I_{t-1}, \tag{12}$$

$$\phi: \quad \sum_{t=1}^{T} \left( L_t^{(1/\delta)} - S_t \right) = 0, \tag{13}$$

*II.C. Steady-State*

These first-order conditions form the basis of our analysis of the steady-state and transition associated with a delayed JCTC. In this sub-section, we analyze a steady-state defined by two characteristics: the inventory stock equaling its target value ($I_{SS} = \zeta * S_{SS}$) and sales equaling output ($S_{SS} = Q_{SS}$). The first characteristic implies that $\theta_{SS} = 0$ and that sales and output given by equations (10d) and (11b), respectively, can be written as follows,[9]

$$Q_{SS} = \left( \frac{\phi_{SS}}{\delta * w_{SS}^{EFF}} \right)^{(1/(\delta-1))} , \tag{14}$$

$$S_{SS} = \frac{\alpha - \phi_{SS}}{\beta} . \tag{15}$$

In order to analyze how variables respond to the introduction of a JCTC, we consider an initial steady state in which there is no JCTC, and hence $w_{SS}^{EFF} = w$. In order to form baseline values, we adopt the normalization that $w = (1/\delta) < 1$. The second characteristic and the normalization implies the following solution for the shadow price of output,

$$Q_{SS} = S_{SS} \rightarrow h[\phi_{SS}] = 0 \rightarrow \phi_{SS} = 1 , \tag{16a}$$

$$h[\phi_{SS}] \equiv \beta(\phi_{SS})^{(1/(\delta-1))} + \phi_{SS} - \alpha . \tag{16b}$$

The unique solution to equation (16) is $\phi_{SS} = 1$.[10] With this value for the shadow price of output, $S_{SS} = Q_{SS} = L_{SS} = 1$. The critical result here is that the optimal choice of labor in the initial steady state is 1. Therefore, the effects of introducing a JCTC can be easily computed as a deviation from unity.

*II.D. Responses To A JCTC: No Rolling Base; No Inventory Costs*

We now examine the firm's responses to the introduction of a JCTC. In order to highlight three different channels of influence, we will examine in this sub-section a special case of the model in which the JCTC does not have a rolling base and the inventory technology is

---

[9] In the steady-state, the second-order conditions can be verified. The matrix of second derivatives for L and S is as follows, $\begin{bmatrix} ((1-\delta)/\delta) * L^{((1-2\delta)/\delta)} & 0 \\ 0 & -\beta \end{bmatrix}$, which is negative definite for $\delta > 1$. Note that the first-order condition for $I_t$ vanishes in the steady-state.

[10] A value of $\phi_{SS} = 1$ is a solution to equation (16). Since $h[0] \le 0$, $\lim_{\phi_{SS} \to \infty} h[\phi_{SS}] \to +\infty$, and $h'[\phi_{SS}] > 0 \ \forall \phi_{SS} > 0$, we can verify that $\phi_{SS} = 1$ is the unique solution to $h[\phi]$ provided $\delta > 1$, $\alpha = 1 + \beta$, and $\beta \ge 0$.

costless. Sub-section II.E reintroduces the rolling base. Sub-section II.F contains a general model with the rolling base and costly inventory.

In anticipation of the empirical analysis, we divide the timeline for a firm in a delayed-JCTC state into three intervals,

BEFORE: The months between the signing date and the qualifying date.

AT: The month containing the qualifying date.

AFTER: The months after the qualifying date.[11]

The AT and AFTER intervals capture the immediate and lagged responses, respectively, to the same JCTC stimulus. We draw a distinction between them to isolate the CR and CUM effects.

We assume that the firm begins in the steady-state with no JCTC. At the beginning of the planning period, policymakers adopt a permanent JCTC with a "qualifying date" (the date at which time employment above the credit base qualifies for the credit) in the future. This situation describes delayed-JCTC states and leads to some very interesting dynamic behavior that we study in terms of its effect on employment in the BEFORE and then in the AT and AFTER intervals. There are two restrictive assumptions adopted in this sub-section. The rolling base is eliminated so that $BASE_t \equiv 0$ or a constant in equation (4b). We maintain that there is an inventory stock that allows production to be smoothed across periods, but inventory costs are absent ($\mu = 0$). The first-order conditions for labor and sales for this restricted model are as follows,

$$L_t = \left( \frac{\phi}{\delta * w_t^{EFF}} \right)^{(\delta/(\delta-1))} \qquad w_t^{EFF} \equiv w \qquad t \in \{BEFORE\}, \tag{17a}$$

$$L_t = \left( \frac{\phi}{\delta * w_t^{EFF}} \right)^{(\delta/(\delta-1))} \qquad w_t^{EFF} \equiv w * (1 - \tau_t) \qquad t \in \{AT, AFTER\}, \tag{17b}$$

$$S_t = \frac{\alpha - \phi}{\beta} \qquad t \in \{BEFORE, AT, AFTER\}. \tag{17c}$$

The introduction of the JCTC lowers $w_t^{EFF}$ in the AT and AFTER intervals. Thus, $L_t$ rises at the time of the qualifying date and stays permanently higher. These initial hiring and production plans lead to an imbalance with $S_t$, which, for the moment, remains fixed. A change

[11] By definition, the BEFORE interval is empty (zero length) for immediate-JCTC states.

in the shadow price of output restores the balance over the planning period. Per equations (17), the decline in $\phi$ (below its initial steady state value of 1) has three effects. First, it raises $S_t$ uniformly in all three intervals. Second, it lowers $L_t$ and $Q_t$ in the BEFORE interval relative to the initial steady-state. Third, it also lowers $L_t$ and $Q_t$ in the AT and AFTER intervals. However, this decrease (due to the decline in $\phi$) is more than offset by the stimulus from the lower effective wage rate. [12] The adjustment process continues until the increased level of sales matches the increased level of output over the planning period.

The above analysis generates an AD due to fiscal foresight.[13] Even though the effective wage rate in the BEFORE interval does not change, employment in that interval falls relative to its prior steady-state value. This change represents a shift in production from high-cost to low-cost periods as the firm, foreseeing the future drop in the effective wage rate, adopts an intertemporal production plan that minimizes average production costs and satisfies an endogenous sales constraint.

The AD directly leads to the CR. The level of sales following from the implementation of the JCTC is determined by the new steady-state value of the shadow price of output ($\phi$). This value will be the same whether or not an AD exists. Hence, the levels of employment and output during the AT and AFTER intervals must be larger when an AD occurs in the BEFORE interval

---

[12] This net effect depends on the properties of the term $\phi_{SS} / (\delta * w_{SS}^{EFF})$ appearing in equation (14); specifically, the elasticity of $\phi$ with respect to $w_{SS}^{EFF}$ ($\varepsilon_{\phi, w_{SS}^{EFF}}$) must be less than one. To evaluate this condition, rewrite the steady-state relation $h\left[\phi_{SS}\right]$ in terms of $w_{SS}^{EFF}$ (which does not generally appear in $h\left[\phi_{SS}\right]$ because of the normalization, $w = (1/\delta) < 1$),
$h\left[\phi_{SS}\right] = \kappa\left[\phi_{SS}[w_{SS}^{EFF}], w_{SS}^{EFF}\right] \equiv \beta\left(\phi_{SS}[w_{SS}^{EFF}] / (\delta * w_{SS}^{EFF})\right)^{(1/(\gamma-1))} + \phi_{SS}[w_{SS}^{EFF}] - \alpha \equiv \chi\left[w_{SS}^{EFF}\right]$. In any steady-state, $Q_{SS} = S_{SS}$ and hence $\chi'\left[w_{SS}^{EFF}\right] = 0$ through an adjustment in $\phi$ to the change in $w_{SS}^{EFF}$. Differentiating $\chi\left[w_{SS}^{EFF}\right]$ with respect to $w_{SS}^{EFF}$, setting the derivative equal to zero, and evaluating this derivative at the original steady-state, we obtain $\varepsilon_{\phi_{SS}, w_{SS}^{EFF}} = \left(\beta / (\beta + \delta - 1)\right) < 1$ provided $\delta > 1$.

[13] Our Anticipatory Dip differs from the well-known Ashenfelter Dip (Ashenfelter, 1978; Heckman and Smith, 1999). While both Dips involve transitory declines of employment and earnings, respectively, prior to the implementation of a policy, the channels differ. The Ashenfelter Dip is a selection phenomenon driven by low opportunity costs; Anticipatory Dips are driven by intertemporal tradeoffs.

in order to compensate for the lost output. This extra output is the CR, the "compensating rebound."

Decreasing returns to labor, a downward-sloping demand curve, and an inventory technology are each necessary for the AD and CR. If the returns to labor were increasing, then the firm would have an incentive to bunch production in the AT interval absent inventory costs in this restricted model.[14] The absence of either of the remaining two conditions would lead to a sequence of static optimization problems. If the firm faced a perfectly elastic demand curve, then all of period t's production could be sold without the penalty from declining marginal revenues. In this case, the dynamic elements in the optimization problem disappear, the firm sets period t production based only on the period t wage rate, and output and employment do not change in the BEFORE interval.

Lastly, if there is no inventory technology, then $Q_t$ must equal $S_t$ in each period, and the firm no longer has a separate sales decision.[15] In this case, the inability to change inventory prevents the firm from taking advantage of the differential production costs due to the delayed implementation of the JCTC program. Again, the dynamic optimization problem becomes a sequence of static problems, and there are no interrelations among wage rates in different periods. With a concave production technology and a negatively-sloped demand curve, the firm has the motivation to smooth sales and reallocate production but, absent an inventory technology, it does not have the means to shift production across periods. All three elements are needed to provide the firm the motivation and means to shift employment and generate ADs and CRs.

*II.E. Responses To A JCTC: No Inventory Costs*

We now relax one of the two restrictions in the above model and analyze the effects of the rolling base on the response to the delayed JCTC. The qualitative effects on employment are identical to those documented in sub-section II.D, though the quantitative effects differ. With a

---

[14] If the returns to labor were constant, the firm would be indifferent to producing in any period other than the first.

[15] If an inventory technology is not available to the firm, the inventory accumulation constraint $\left(I_t = Q_t - S_t + I_{t-1}\right)$ would be removed from the optimization problem (equation (8a)) and $S_t$ would be replaced by $Q_t$ for all t.

rolling base, the effective wage (equation (10b)) is impacted differently in the BEFORE interval and then in the AT and AFTER intervals,

$$\frac{\partial w_t^{EFF}}{\partial \tau_t} = w * R = w * \left(1/\left(1+\rho\right)\right) > 0 \qquad t \in \{BEFORE\}, \tag{18a}$$

$$\frac{\partial w_t^{EFF}}{\partial \tau_t} = -w * \left(1-R\right) = -w * \left(\rho/\left(1+\rho\right)\right) < 0 \qquad t \in \{AT, AFTER\}. \tag{18b}$$

Somewhat paradoxically, the introduction of the JCTC raises the effective wage rate in the BEFORE interval. With a delayed JCTC, the firm is not eligible to receive the tax credit in the BEFORE interval, and hence obtains no benefits. However, any hiring in the BEFORE interval raises the employment base above which subsequent employment must rise in order to qualify for the credit. Hence, employment in the BEFORE interval lowers the value of the credit in future periods.[16] Being forward-looking, the firm internalizes this cost when choosing employment in the BEFORE interval. This negative effect on profitability is measured in equation (18a) by the discounted wage rate.

In the AT and AFTER intervals, the JCTC lowers effective wages. However, the quantitative impact is dramatically reduced by the rolling base feature of the tax credit. The $\rho/\left(1+\rho\right)$ term in equation (18b) reflects that, with a rolling base, eligible incremental employment receives a tax credit today but at the expense of eliminating the tax credit on incremental employment tomorrow. This latter cost is discounted and, hence the overall stimulus from the tax credit increases with the discount rate. Since the discount rate is generally a small number, the rolling base feature drives a large wedge between the legislated and effective tax credits and affects the specification of the JCTC in the econometric equation. Assuming an expected long-run nominal return on equity of 10% and an expected long-run inflation rate of 3%, $\rho$ is 7%, and $(\rho/(1+\rho)) \approx 0.065$. Hence, after the qualifying date, the effective tax credit rate is only 6.5% of the legislated credit rate. In the extreme with no discounting ($\rho = 0$), the credit provides no stimulus at all.

[16] Altschuler (1988) identified a similar perverse effect with respect to the R&D tax credit.

*II.F. Responses To A JCTC: The General Model*

This sub-section analyzes the general model in which the JCTC is delayed and has a rolling-base and, unique to this sub-section, inventory imbalances are costly.[17] We introduce the latter effect by allowing $\mu > 0$. The first-order conditions for the general model are modified by including terms containing the cost of inventory imbalances ($\mu$ interacted with the inventory/sales target, $\zeta$) and the shadow price of adding to inventory imbalances ($\theta_t$),

$$L_t = \left( \frac{\phi - \theta_t}{\delta * w_t^{EFF}} \right)^{(\delta/(\delta-1))} \qquad w_t^{EFF} \equiv w * \left(1 + \tau_{t+1} * R\right) \qquad t \in \{BEFORE\}, \tag{19a}$$

$$L_t = \left( \frac{\phi - \theta_t}{\delta * w_t^{EFF}} \right)^{(\delta/(\delta-1))} \qquad w_t^{EFF} \equiv w * \left(1 - \tau_t + \tau_{t+1} * R\right) \qquad t \in \{AT, AFTER\}, \tag{19b}$$

$$S_t = \frac{\alpha + \mu * \zeta * I_{t-1} + \theta_t - \phi_{SS}}{\beta + \mu * \zeta^2} \qquad t \in \{BEFORE, AT, AFTER\}. \tag{19c}$$

The introduction of costly inventory changes the quantitative but not the qualitative effects of the JCTC analyzed above. With $S_t$ and $\phi$ held at their initial steady-state levels, employment initially decreases in the BEFORE interval and increases in the AT and AFTER intervals. The BEFORE response in employment results in an inventory drawdown, $\theta_t < 0$ (per equation (9b)), and incremental employment in all periods becomes more valuable by reducing the inventory imbalance. Consequently, an unambiguous implication of the general model is that inventory costs lead to a smaller fall in employment in the BEFORE interval.

The relative change in employment in the AT and AFTER intervals is subject to two contrasting effects and the net effect of the introduction of inventory costs is ambiguous. Since the inventory drawdown in the BEFORE period is lower, there is a reduced need to replenish inventory and relative employment falls. However, in the AT and AFTER intervals, there is an added incentive to hire labor and produce output to eliminate the costly inventory imbalance, and relative employment rises.

---

[17] Abel (1982) and Auerbach (1989) also use dynamic optimizing models to study anticipated tax changes. Their models give explicit consideration to adjustment costs but do not contain decision margins for inventories and sales. The present model identifies the three key conditions impinging on inventories, sales, and production necessary for the emergence of Anticipatory Dips and Compensating Rebounds.

Inventory, its shadow price, and sales respond differently in subsequent periods relative to the model in sub-section II.E. In the face of a negative inventory imbalance, an incremental sale aggravates the imbalance and becomes less valuable in a model with costly inventory. The inventory imbalance is largest in the BEFORE interval and falls over time. The decrease in the imbalance results in an increase in $\theta_t$ that stimulates sales. Rather than being constant over the planning period, sales in the general model rises over time. As in all models considered here, $\phi$ adjusts so that the inventory imbalance is eliminated by the end of the planning period at which time $\theta_T = 0$.

Figure 5 summarizes the theoretical predictions for the path of employment over the planning period and the interesting dynamics associated with a delayed JCTC. With a delayed-JCTC, employment falls after the credit is enacted (at date $t^S$) as forward-looking firms delay hiring and draw down inventories to meet current demand. This decline is amplified when the value of the tax credit is computed with a rolling base. The combined effect is illustrated by line segment AB. When the JCTC goes into effect (at qualifying date $t^Q$), employment rises sharply for several reasons: rebuilding the work force (line segment BC), responding to the lower effective wage rate (line segment CD), and replenishing inventory (line segment DE). Note that only the response indicated by line segment CD represents the "true" short-run stimulative effect of a JCTC. Gradually, employment falls as inventories return toward their steady-state levels, but it remains above the original employment level because of lower labor costs (line segment AF, which is the same length as line segment CF).

In sum, the Anticipatory Dip is represented by line segment AB and Compensating Rebound by line segments BC and DE.

*II.G. Immediate-JCTC vs. Delayed-JCTC Regimes*

The above analysis has focused on a firm facing a delayed-JCTC, which has been adopted by seven states between 1990 and 2009. For a JCTC that goes into effect immediately, as is the case in 14 states, the pattern of employment in the AT and AFTER intervals is qualitatively similar to those displayed in Figure 5. An important difference is that fiscal foresight and the associated ADs and CRs do not exist. For immediate-JCTC states, where firms qualify for the JCTC at $t^Q$, the employment increase in the AT interval will be smaller than it is for firms in the delayed-JCTC states because there is no need to compensate for deferred hiring and inventory drawdowns; that is, the CR is absent. Thus, analyzing employment responses in immediate-JCTC states provides a clean read on the true effectiveness of JCTCs (line segment CD), whereas employment responses in delayed-JCTC states with implementation lags are likely to overstate the effectiveness of tax credits (by the sum of the line segments BC and DE). These predictions are summarized in Table 1 and lead to three hypotheses about employment growth that we test:

1. Anticipatory Dips (ADs): the negative response in the BEFORE interval for delayed-JCTC states;
2. Compensating Rebounds (CRs): the positive responses in the AT intervals for both delayed-JCTC and immediate-JCTC states, with the former being larger than the latter;
3. Cumulative Effects (CUMs): the positive responses over the BEFORE, AT, and AFTER intervals, taken as a whole, for both delayed-JCTC and immediate-JCTC states.

## III. EMPIRICAL PRELIMINARIES AND SPECIFICATION ISSUES

### *III.A Employment and JCTC Data*

Our empirical work focuses on the relation between JCTCs and employment. The latter is measured by monthly, seasonally adjusted, private non-farm employment data for the period January 1990 to December 2010.[18] The earlier date is the first month in which these data are published by the Bureau of Labor Statistics. The latter date is chosen because it provides at least three years of employment data after the final JCTC in our sample.

The JCTCs are credits against a state's corporate income or franchise tax. We conducted an initial state-by-state search for JCTCs from various sources to identify an exhaustive list of permanent, broad-based JCTCs adopted and put into effect prior to December 2007, the official NBER start date of the Great Recession. We restrict our focus to JCTCs that are "permanent," in the sense that their legislation did not set an expiration date, in order to rule out temporary JCTCs that are sometimes passed as short-run stimulus measures (i.e., countercyclical fiscal policies). These temporary JCTCs are likely to be endogenous with respect to current and

[18] The employment data come from the BLS's Current Employment Statistics series. For details on the BLS, see http://www.bls.gov/bls/empsitquickguide.htm#payroll.

expected employment growth. Similarly, we exclude JCTCs passed during the Great Recession or the weak subsequent recovery to avoid potential endogeneity concerns.[19]

For each credit, we hand-collected information on the signing date, the qualifying date, the pecuniary value of the tax credit, and other relevant characteristics. For the period 1990 to 2007, we identified 21 JCTC adoptions. Details about the identification, valuation, and design of JCTCs are provided in Appendix B.

Table 2 presents summary statistics for the employment level (in thousands), employment growth rate (in percentage points), and pecuniary value of the JCTC sorted by the JCTC status of states. As shown by the median values in panel A, column 2, the median delayed-JCTC state is similar in size to the median no-JCTC state, while the median immediate-JCTC state is larger. In panel B, the median growth rate for delayed-JCTC states of 0.138% is somewhat larger than the comparable statistic of 0.110% for immediate-JCTC states. Both are somewhat below the median growth rate for no-JCTC states of 0.155%. Panel C documents that JCTCs tend to be more generous in the immediate-JCTC states. These latter two relations suggest that an evaluation of possible bias arising from the endogeneity of JCTC adoption with respect to employment growth is warranted.

Thus, before analyzing the impact of JCTCs on employment growth in Section IV, we first study the JCTC adoption decision and determine the statistical properties of the employment data. These results inform the specification of our empirical model in sub-section D.

*III.B. Understanding JCTC Adoption*

Apart from developing a better general understanding of JCTCs, analyzing the adoption decision is useful for assessing and correcting for any endogeneity of JCTC adoption with respect to recent employment growth. It is worth noting that, for several of the JCTCs in our sample, the enacting legislation includes an explicit statement of objectives. In each case, the legislation emphasizes longer-term economic development objectives and/or state competitiveness and not short-term stimulus. Here are a few examples taken from enacted legislation:

---

[19] Wilson (2012) documents the large cross-state differences in the federal stimulus provided by the 2009 American Recovery and Reinvestment Act and finds that the stimulus spending had a substantial impact on state employment. See, also, Neumark and Grijalva (2013) for a study of the impact of JCTCs during the Great Recession.

> * The Arkansas General Assembly recognizes that job creation and capital investment in Arkansas is dependent upon being competitive with other states for business locations and expansions.
>
> * The objective of the job creation tax credit is to increase the number and quality of new jobs in [Maryland] by encouraging: A. Significant expansions of existing private sector enterprises; B. Establishment of new private sector enterprises; C. Creation of family supporting jobs; and D. Revitalization of neighborhoods and commercial areas.
>
> * It is the intent of the Louisiana Legislature that: (1) The state of Louisiana provide appropriate incentives to support establishments of basic industries that hold the promise of significant development of the economy of the state of Louisiana. (2) The amount of such incentives provided in connection with a particular establishment shall...[B]e directly related to the jobs created as a result of the establishment locating in the state of Louisiana....[20]

Of course, it is still possible that shocks affecting a state's recent employment growth will influence the timing and likelihood of that state adopting a JCTC. In particular, weak employment growth might make it more likely that JCTC legislation will be enacted and, with serial correlation in employment growth, OLS estimates of the effectiveness of the JCTC may be biased downward. To assess the potential importance of such endogeneity, we estimate the following logit equation ($\Phi\{.\}$) containing lagged employment growth and controls,

$$\text{PROB}\{D_{i,t}^{\text{Signing}} = 1\} = \Phi\left\{\text{LGROWTH}_{i,t}, \text{REPUBLICAN}_{i,t}, \text{COMPETITION}_{i,t}, \text{CITR}_{i,t}, u_{i,t}\right\}, \tag{20}$$

where $D_{i,t}^{\text{Signing}}$ is an indicator variable for the signing date in state i at time t, PROB[.] is the probability that $D_{i,t}^{\text{Signing}} = 1$, $\text{LGROWTH}_{i,t}$ is employment growth defined below in eight different ways, $\text{REPUBLICAN}_{i,t}$ is an indicator variable measuring the strength of Republican influence in state government, $\text{COMPETITION}_{i,t}$ is the fraction of bordering states with JCTCs, $\text{CITR}_{i,t}$ is the corporate income tax rate, and $u_{i,t}$ is an error term containing a white-noise component and a state fixed effect. Since there may be a number of factors determining JCTC

---

[20] Oklahoma's JCTC legislation also includes this exact same language (apart from replacing "Louisiana" with "Oklahoma").

adoption not included in equation (20), we also control for a time-invariant element of state-specific factors as a robustness check. With state fixed effects, consistent estimation is possible with a logit model but not a probit model (Cameron and Trivedi, 2005, Section 23.4).

Logit estimates of equation (20) are presented in Table 3. Since assessing the role of employment growth is the primary purpose of this exercise, we measure employment growth ($LGROWTH_{i,t}$) eight different ways: employment growth in state i over four disjoint intervals defined from t-3 to t, t-6 to t-3, t-12 to t-6, and t-24 to t-12, and each of these growth rates relative to the average employment growth rate in the states bordering state *i*. Prior employment growth is not closely correlated with the JCTC adoption decision. Tests of the joint significance of employment growth rates (bottom of Table 3) have p-values that are very far from conventional significance levels. (Similar results are obtained when the employment growth rates are entered ad seriatim.) There is a marked difference in the coefficient estimates between column 1 (where state fixed effects are omitted) and the other four columns (where they are included and states without a JCTC are dropped because their dependent variable has no within-state variation). Importantly, there is no evidence indicating that employment growth influences JCTC adoptions in our sample.

For models including state fixed effects (columns 2 to 5), JCTC adoptions are influenced positively and significantly by competition from tax policies of bordering states. By contrast, there is no discernible relation between political party or own-state corporate income tax rates and JCTC adoption.

In sum, the results in Table 3 suggest that JCTCs are adopted as longer-term tax policy measures in response to a general desire to cut business taxes, promote economic development, and improve the state's competitiveness. They do not appear to be short-term, countercyclical policies responding to anemic employment. Most importantly for the validity of our estimates, there is no evidence for reverse causation from lagged employment growth to JCTC adoption. Nonetheless, as an additional safeguard against the adverse impact of endogeneity, we utilize these logit estimates for inverse probably weighting in our main empirical models, as explained in Section III.D.

*III.C. Properties of the Monthly Employment Data*

The statistical properties of the monthly employment data are important for proper specification of the econometric equation relating employment to JCTCs. We access stationarity with informal and formal tests. We first estimate models with log employment and the first-difference of log employment as the dependent variable and the same set of independent variables: current, lagged (12 months), and led (12 months) dummies for the effective date of the JCTC and various lags of the dependent variable (LDV).

For the log levels equation, the LDV coefficient (when only one LDV is included) is close to one. For additional lags of the LDV, the sum of LDV coefficients is greater than one. Thus, the log levels equation would not appear to be a suitable specification for employment.

By contrast, for the log difference equation, the LDV coefficient (when only one LDV is included) is close to zero. Additional lags of the LDV yield coefficient sums that become positive and statistically significant, but the near constancy of the $R^2$ s suggests that there is little additional explanatory power provided by extra lags. These results strongly suggest that employment is best modeled as a simple growth rate.

This initial conclusion is confirmed by a formal unit root test (Pesaran, 2007) that extends the standard augmented Dickey-Fuller test to allow for cross-sectional dependence. This test indicates that the log employment series has a unit root and confirms that employment is best modeled as a simple growth rate.

Taken together, the results presented in Section III.B and IIII.C indicate that an estimating equation with employment growth as the dependent variable and a measure of JCTCs as an independent variable will deliver consistent parameter estimates.

*III.D. Specification Of The Estimating Equation*

With these conclusions in mind, we derive a regression specification relating employment growth to JCTCs and other likely determinants of employment growth,

$$\begin{aligned}\Delta L_{i,t} / L_{i,t-1} = {} & \gamma_{Del}^{BEFORE} \sum_{j=1}^{J_i^{BEFORE}} \frac{D_{i,t+j}^{Del}}{J_i^{BEFORE}} + \gamma_{Del}^{AT} D_{i,t}^{Del} + \gamma_{Del}^{AFTER} \sum_{j=1}^{J^{AFTER}} \frac{D_{i,t-j}^{Del}}{J^{AFTER}} \\ & + \gamma_{Imm}^{AT} D_{i,t}^{Imm} + \gamma_{Imm}^{AFTER} \sum_{j=1}^{J^{After}} \frac{D_{i,t-j}^{Imm}}{J^{AFTER}} \qquad (21) \\ & + \kappa X_{i,t} + u_{i,t} ,\end{aligned}$$

$D^{Del}_{i,t}$ is an indicator variable that equals one in the qualifying month for a delayed-JCTC state and equals zero otherwise. $D^{Imm}_{i,t}$ is an indicator variable that equals one in the latter of the signing month and qualifying month for an immediate-JCTC state and equals zero otherwise. $J^{BEFORE}_{i}$ is the length of the BEFORE interval for state *i* determined by the nature of each state's JCTC legislative history and the resulting "distance" between the signing and qualifying dates; the *i* subscript indicates that the distance will vary by state. The AT interval is only one month long. $J^{AFTER}$ is the length of the AFTER interval, which is assumed to be the same for all states. We will present models with AFTER interval lengths of 12, 24, and 36 months.[21] The purpose of dividing by the interval lengths is so that the $\gamma$'s will reflect average monthly growth rate effects and can be compared across intervals of different lengths. $X_{i,t}$ represents control variables, $u_{i,t}$ is an error term that contains three components (discussed below) and $\kappa$ and the $\gamma$'s are parameters to be estimated.

As highlighted by the theoretical model, there exists multiple intervals (BEFORE, AT, AFTER) in which employment is expected to respond differently to the JCTC. The object of our analysis is to generate consistent estimates of the $\gamma$'s for each interval and across the delayed-JCTC and immediate-JCTC regimes. Equation (21) is not a first-order condition from a structural model, and the $\gamma$'s should not be interpreted as a structural parameter.[22] Rather, the $\gamma$'s are average treatment effects measuring the impact of the JCTC, by regime, on a monthly basis over an interval. Specifically, $\gamma^{BEFORE}_{Del}$ is the average effect of a JCTC in a delayed-JCTC state on monthly employment growth during the BEFORE interval; $\gamma^{AT}_{Del}$ ($\gamma^{AT}_{Imm}$) is the average effect of a JCTC in a delayed-JCTC (immediate-JCTC) state during the AT interval; and $\gamma^{AFTER}_{Del}$

[21] In the one case (Virginia) where the state repealed the JCTC, the AFTER interval is truncated if the number of months between the initial qualifying date and the withdraw date is less than the specified length of the AFTER interval (i.e., 12, 24. or 36 months).

[22] Recall from equations (17) and the surrounding text that the response of employment to the JCTC depends directly on the JCTC and indirectly on the JCTC-induced movement in $\phi$.

($\gamma^{AFTER}_{Imm}$) is the average effect of a JCTC in a delayed-JCTC (immediate-JCTC) state during the AFTER interval.

The vector $X_{i,t}$ in equation (21) represents four control variables included in the baseline model. One way to control for overall demand conditions in the state and avoid endogeneity problems is to include a measure of the state's exposure to particularly fast-growing or slow-growing industries. For example, even in absence of any employment-inducing fiscal policies, a state with a large IT industry during the late 1990s was likely to experience rapid employment growth during that period. We control for industry-driven employment changes by first predicting a state's year-over-year employment growth rate with a weighted-average across industries of the national (excluding own-state) employment growth rates (year-over-year), where the weights are the state's employment shares in each industry. Multiplying this predicted annual growth rate by the level of own-state employment in period t-12 yields a predicted level of employment in period t. This "predicted" employment variable, $L^P_{i,t}$, was introduced by Bartik (1991) and is frequently referred to as the "Bartik shift-share variable." If the state is small relative to the nation, then this variable will not be correlated with the error term. Our empirical model is stated in terms of monthly growth rates, we therefore add the monthly growth rate of this predicted employment variable, $\Delta L^P_{i,t} / L^P_{i,t-1}$, to our baseline specification.

The three other control variables were included previously in the logit model. Section III.B documented that the adoption of a JCTC is positively influenced by JCTCs in effect in bordering states. Since one of the underlying channels of influence may be the effect of bordering state JCTCs on state *i's* employment, we include $COMPETITION_{i,t}$ as an additional control variable. The $CITR_{i,t}$ was also statistically significant in the logit model. Lastly, we include $REPUBLICAN_{i,t}$ as a fourth control variable for completeness.

We model the error term in equation (21) with a conventional two-way error components structure,

$$u_{i,t} = \alpha_i + \beta_t + \varepsilon_{i,t}, \qquad (22)$$

where $\alpha_i$ is a state-specific effect (for the employment growth rate), $\beta_t$ is a time fixed effect, and $\varepsilon_{i,t}$ is a white noise error term.

Substituting equations (22) into equation (21) and inserting the four control variables, we obtain the following estimating equation,

$$\Delta L_{i,t} / L_{i,t-1} = \gamma_{Del}^{BEFORE} \sum_{j=1}^{J_i^{BEFORE}} \frac{D_{i,t+j}^{Del}}{J_i^{BEFORE}} + \gamma_{Del}^{AT} D_{i,t}^{Del} + \gamma_{Del}^{AFTER} \sum_{j=1}^{J^{AFTER}} \frac{D_{i,t-j}^{Del}}{J^{AFTER}}$$

$$+ \gamma_{Imm}^{AT} D_{i,t}^{Imm} + \gamma_{Imm}^{AFTER} \sum_{j=1}^{J^{After}} \frac{D_{i,t-j}^{Imm}}{J^{AFTER}} \qquad (23)$$

$$+ \kappa_1 \left( \Delta L_{i,t}^{P} / L_{i,t-1}^{P} \right) + \kappa_2 \, COMPETITION_{i,t}$$

$$+ \kappa_3 \, TAXRATE_{i,t} + \kappa_4 \, REPUBLICAN_{i,t} + \alpha_i + \beta_t + \varepsilon_{i,t} ,$$

where the no-JCTC states serve as the control group.

Equation (23) uses simple indicator variables to represent the effects of the JCTCs and is our baseline model. However, an indicator variable cannot account for variation across states and intervals in the value of the tax credit. As indicated by the theoretical model, there are subtle relations between the JCTC and its ultimate incentive effects that may vary by state and by interval within a state. As an extension to the baseline empirical model, we also estimate a specification which attempts to capture this variation in pecuniary incentives. Specifically, we compute the logarithmic time differences of the effective wage rates entering the first-order conditions in equations (19) for the BEFORE and AT intervals.[23] We further assume that variations in JCTCs have no effect on the gross-of-JCTC wage rate and that the non-JCTC induced changes in the wage rate are captured by time and state fixed effects.

*III.E. Inverse Probability Weighting (IPW)*

While our logit estimates suggest that selectivity with respect to employment growth is not a problem that will adversely affect our estimates, endogeneity may occur for other reasons, especially arising from omitted variables. In order to further guard against the possible distorting effects, we obtain coefficient estimates using an Inverse Probability Weighting (IPW) estimator. The IPW is a type of matching estimator and is implemented in a two-step procedure (Hirano,

[23] This stimulus term is zero for the AFTER interval. That is, the JCTC adopted in the AT interval provides no additional stimulus in the AFTER interval. Nonetheless, we allow for lagged effects of the AT interval's stimulus by including $J^{AFTER}$ lags of it in the baseline estimating equation, similar to the inclusion of $J^{AFTER}$ lags of $D_{i,t-j}^{Del}$ and $D_{i,t-j}^{Imm}$ in the indicator variable specification (equation 23).

Imbens, and Ridder, 2003). First, we use the logit model to estimate probabilities of "treatment" (i.e., the adoption of a JCTC) and non-treatment. We then estimate our main empirical model (equation (23)) using weighted least squares. The weight for each treated observation is the estimated inverse probability of treatment for that observation (given its values for the variables that go into the logit model). The weight for each non-treated observation is the estimated inverse probability of non-treatment (i.e., the inverse of one minus the probability of treatment) for that observation. Thus, the IPW is putting more weight on treated observations that are unlikely to have been treated and more weight on untreated observations likely to have been treated. This weighting moves the adjusted data closer to a randomized experiment (where all observations are equally likely to be treated).

The IPW works well when there is a close correspondence between the domains of the densities of the probability of a JCTC signing for those states that have adopted and those that have not adopted. The kernel densities of the probability of a JCTC signing presented in Figure 6 suggest that this criterion is met with the current application of the IPW. Moreover, as we shall see below, IPW and OLS (i.e., equal-weighted IPW) estimates are quite similar, sug-gesting informally that selectivity and omitted variables biases are a minimal concern in our data.

## IV. EMPIRICAL RESULTS

This section presents estimates of the impact of JCTCs on employment growth that allow us to assess the three key empirical relations summarized in Table 1:

1. The AD (Anticipatory Dip): $\gamma_{\text{Del}}^{\text{Before}} < 0$,
2. The CR (Compensating Rebound): $\gamma_{\text{Del}}^{\text{At}} > \gamma_{\text{Imm}}^{\text{At}}$,
3. The CUM (Cumulative Effects): $\text{CUM}_{\text{Del}} > 0$; $\text{CUM}_{\text{Imm}} > 0$.

Our baseline estimates are with the JCTC measured by an indicator variable and are presented in sub-section A. The robustness of these results is examined in the additional empirical results presented in sub-sections B and C.

### *IV.A. Baseline Estimates*

Table 4 contains our baseline estimates of the $\gamma$ coefficients for the three intervals for the delayed regime and the two intervals for the immediate regime, as well as their cumulative sums.

The $\gamma$s for the five intervals represent the conditional average employment growth per month (in percentage points) and are based on equation (23). The *Cumulative Effect* (CUM) sums the product of each $\gamma$ and the number of months in its interval for either the delayed or immediate regime. The length of the BEFORE interval varies by state, so we use its average length, 5.25 months, for this calculation. The length of the AFTER interval varies across the three sets of results for 12, 24, and 36 months. The standard errors are robust to heteroskedasticity and to clustering of residuals by state. State clustering allows for general serial correlation of residuals, as recommended in Bertrand, Duflo and Mullainathan (2004).

We begin with the results in the first two columns for an AFTER interval of 12 months. For the delayed regime, the coefficient in the BEFORE interval is -0.065 and statistically significantly different from zero. This coefficient means that employment growth in delayed-JCTC states during the credit implementation period is 0.065 percentage points lower than it would have been without the credit adoption. This represents about a 50% reduction relative to the median monthly employment growth in delayed-JCTC states of 0.138 (see Table 2). Since the implementation period averages 5.25 months, this reduction in growth implies an average reduction in the level of employment over the BEFORE interval of -0.341 (-0.065*5.25) percentage points. An AD is clearly identified for the delayed regime.

In the AT interval, the coefficients for the delayed and immediate regimes are 0.128 and 0.031, respectively. The coefficient for delayed states implies a doubling of employment growth in the AT month relative to median employment growth for these states. The difference in the AT coefficients between the delayed and immediate states measures the CR. For the regression in columns 1 and 2, when the AFTER interval is 12 months, this difference of 0.097, which is economically large but not quite statistically significant (with a p-value of 0.13).

By contrast, the third empirical relation noted at the beginning of this section receives no support. The CUMs are not statistically different from zero and, in the case of the delayed regime, CUM is slightly negative.

A possible explanation of CUM results is that some firms adjust slowly to the tax incentive and 12 months is too short a period to capture the ultimate responses to the JCTCs. These laggard firms, relative to those responding in the AT interval, may be more bureaucratic or face a small pool of available workers. Given the rolling base feature of JCTCs, the firm has only a modest incentive to take the credit as soon as possible. The financial incentive to hire today and take the credit vs. delaying the new hire until tomorrow is the one-period discount factor, approximately 6.5% of the legislated tax credit. This small gain has to be balanced against adjustment frictions and disruptions from accelerated hiring. Consequently, new employment may occur very gradually for some firms, and it may take several years for the full effects of the JCTC to be reflected in employment growth.

This conjecture is examined in the remaining entries in Table 4, which extends the length of the AFTER interval from 12 to 24 and 36 months in two separate regressions. Since the intervals are largely orthogonal to each other, these extensions have no noticeable effect on other coefficients, and the AD and CR are similar in these specifications. The CRs remains around 0.10 with p-values slightly above 0.10. The $\gamma$ coefficients for the AFTER interval in either the delayed or immediate regimes increase monotonically in the length of the AFTER interval.[24] Interestingly, when the AFTER interval is 36 months, the $\gamma$s for the delayed regime and immediate regime are nearly identical. The CUMs are now positive and statistically far from zero. For an AFTER interval of 36 months, the results are consistent with the three empirical implications indicated above.

The quantitative importance of ADs for JCTCs documented in Table 4 suggests that ignoring fiscal foresight can lead to incorrect inferences regarding both short-run and longer-run policy impacts when the policy is anticipated. First, it is clear that the sharp boost in employment growth that occurs in delayed-JCTC states in the month in which the credits go into effect is not an accurate assessment of the short-run effectiveness of the credit. Rather, it mostly reflects the Compensating Rebound in employment growth following on the Anticipatory Dip. The true short-run impact of these credits is better revealed by the small AT interval effect for immediate-JCTC states. Another way to see this point is to consider what inference researchers might draw if they evaluated the impact of JCTCs using the standard event study approach, ignoring fiscal foresight. In that case, they would not distinguish between delayed- and immediate-JCTC states and they would not account for any potential drop in employment growth prior to the AT interval. In other words, they would simply regress employment growth on the

[24] Recall that these coefficients represent the average impact per month, and hence are not mechanically increased with increases in the length of the AFTER interval.

JCTC indicator in the AT interval (along with controls and state and month fixed effects). We find that such a regression yields an AT effect of 0.072 (with a p-value of 0.036), more than double the size of the AT interval effect for immediate-JCTC states from Table 4. Again, this estimate would give a misleading impression of the effectiveness of JCTCs because part of this effect is due to fiscal foresight, specifically the CR for the delayed-JCTC states.

Second, ignoring fiscal foresight can also lead to incorrect inferences regarding the longer-run impact of JCTCs. Consider the estimated cumulative effect of JCTCs on employment in Table 4 when AFTER equals 36 months. We see that the cumulative effect for delayed-JCTC states would be raised by 37% (to 1.154 from 0.844) if we ignored the decrease during the BEFORE interval.[25]

*IV.B. An Alternative Measure Of The JCTC*

Measuring the JCTC with an indicator variable has the advantage that it is likely to have much less measurement error than a variable that reflects the complexities of the legislated tax code (e.g., refundability, transferability, tax credit caps) that cannot be reflected in a single figure. In such a situation, using a coarse categorical variable may lead to less biased econometric estimates. Nonetheless, the baseline results could be misleading if the effective JCTC is relatively higher for delayed-JCTC states. In this case, the larger increase we observe at the AT intervals may be due to the larger effective JCTCs, not the CR effect that seems to be documented in Table 4. The summary statistics suggest that this is not a concern, as the median credit value, as a percent of the state's average manufacturing wage, for delayed-JCTC states is 3.2%, while that for immediate-JCTC states is 5.0% (see Table 2, Panel C). Also, our theoretical model indicates that the employment growth incentives induced by JCTCs vary by regime and interval and hence one might expect different effects of JCTCs across regimes and intervals.

Thus, as an extension to the baseline empirical model, we replace the JCTC indicator variables in equation (23) with the pecuniary values of JCTCs as suggested by our theoretical model (equations (19)). For delayed-JCTC states, the model implies that the regressors are $-\tau_i/(1+\rho)$ for the BEFORE interval and $\tau_i$ for the AT and AFTER intervals ($\gamma_{Del}^{BEFORE}$ is

[25] This figure is computed as follows: 1.154 = (0.844-AD), where AD = -0.310 (= -0.059 * 5.25 months), where 5.25 months is the average length of the BEFORE interval.

multipled by -1 in Table 5). For immediate-JCTC states, the regressor is $\tau_i * (\rho / (1+\rho))$ for the AT and AFTER intervals.[26] We assume $\rho$ is a real discount rate of 7%. Note that the legislated credit rates, $\tau_i$ , and hence the incentive effects, vary by state. The results with these pecuniary measures of the JCTCs are presented in Table 5. The pattern of results is very similar to those with the indicator variable reported in Table 4: an AD and CR are evident, and the CUMs are positive when the AFTER interval is extended to 24 or 36 months. The most notable difference in the results is that, with the exception of the BEFORE interval for the delayed regime, all of the coefficients are very imprecisely estimated. As noted above, we attribute this imprecision to the measurement error in the pecuniary JCTC variable. The importance of the results in Table 5 is that our baseline results are qualitatively robust to conditioning on the value of the JCTC.

*IV.C. Additional Empirical Results*

This sub-section presents six additional empirical results that provide robustness checks and identify estimation biases.

First, our baseline results are not sensitive to the control variables. While three of the four control variables listed in (23) are statistically significant, excluding all four control variables has little effect on the estimated coefficients. The estimates are presented in Table 6, columns 3 and 4 (the first two columns in Table 6 report our baseline results).

Second, tax legislation is sometimes passed as a package involving changes in several tax instruments (Wildasin, 2007). Our baseline specification includes the corporate income tax rate as a control, and we explore the robustness of our results by adding the state (fixed) investment tax credit rate and the state research and development tax credit rate to the baseline specification. As above, the baseline results are very insensitive to the inclusion of these two additional control variables.

Third, while the estimates are not sensitive to the control variables, they are somewhat sensitive to state and time fixed effects. Table 6 presents the baseline model without state fixed effects (columns 5 and 6) or without time fixed effects (columns 7 and 8). The results are bifurcated. The estimated $\gamma$s in the AFTER intervals change markedly: they are negative in

---

[26] For the purposes of exposition, we present here the first-order Taylor approximations of the logarithmic differences rather than the full (messier) expressions of the logarithmic differences. We compute the regressors using the full expressions.

column 6 and positive and much larger in columns 7 and 8. In all three cases, the CUMs are much different than the comparable baseline results. However, for the BEFORE and AT intervals, the estimated $\gamma$s are fairly stable and confirm the presence of an AD and CR.

Fourth, timing is very important in our study. We have been able to identify the precise months for the JCTC signing and qualifying months and have used this information to guide our empirical work. It is possible, however, that firms anticipate the signing of JCTC legislation and reduce employment accordingly.[27] In this case, both our AD estimate and our CR estimate would be biased toward zero, making it more difficult to find quantitatively significant effects.[28] It is thus useful to examine if our baseline estimates are sensitive to a possible pre-signing anticipation effect by moving the signing dates back in time one, two, or three months. The impacts on the estimated coefficients are quite minor.

Fifth, a perennial concern in policy event studies is selectivity. In the present case, it is possible that deficient employment growth might lead to the passage of JCTC legislation. This concern has been addressed and largely discounted by the logit models presented in Section III.B and Table 3. Moreover, the Inverse Probability Weighting (IPW) estimator discussed in Section III.E adjusts for selectivity or, more generally, various sources of endogeneity that may bias estimates. An informal test for the importance of endogeneity is to compare the IPW and OLS estimates, the latter possibly influenced by endogeneity. The OLS estimates prove to be very similar to those presented previously in Table 4. For an AFTER interval of 36 months, we have

---

[27] Kueng (2015) documents such an anticipation signing effect for municipal bondholders and federal personal income tax rates.

[28] For delayed JCTC states, pre-signing anticipation could lead to reductions in employment growth occurring prior to our BEFORE interval and hence our estimated AD effect ($\widehat{AD}$) will be closer to zero (less negative) than the true AD effect (AD*): $\widehat{AD} > AD^* < 0$. The AT effect for delayed states, however, is unaffected ($\widehat{AT}^{Del} = AT^{Del*}$). For immediate JCTC states, pre-signing anticipation could lead to reductions in employment growth occurring prior to the AT interval and a resulting rebound in the AT interval. Thus, our estimated AT interval effect for these states ($\widehat{AT}^{Imm}$) will be greater than the true effect ($AT^{Imm*}$): $\widehat{AT}^{Imm} > AT^{Imm*}$. Because the compensating rebound is defined as $CR = AT^{Del} - AT^{Imm}$, this inequality implies that our estimated CR ($\widehat{CR}$) is a lower bound on the true CR ($CR^*$): $\widehat{CR} = \widehat{AT}^{Del} - \widehat{AT}^{Imm} = AT^{Del*} - \widehat{AT}^{Imm} < CR^* = AT^{Del*} - AT^{Imm*}$.

BEFORE = -0.063 [*p* = 0.011], $AT_{Del}$ = 0.127 [0.016], $AT_{Imm}$ = 0.054 [0.158], $AFTER_{Del}$ = 0.028 [0.024], $AFTER_{Imm}$ = 0.028 [0.012], $CUM_{Del}$ = 0.817 [0.063], $CUM_{Imm}$ = 1.058 [0.011].

Sixth and finally, the tax competition literature suggests that JCTC-induced increases in employment growth might create interstate spillovers, which could be negative or positive. In particular, a JCTC in one state could draw jobs away from other states or, alternatively, the stimulus to economic activity in the JCTC state could "leak" out to other states via induced upstream demand. Understanding spillovers is of particular importance if our results based on state tax credits are to inform the policy debates surrounding a potential federal JCTC. If positive (negative) spillovers exist, then our estimates are a lower (upper) bound on the likely effect of a federal tax credit because interstate mobility of labor and intermediate inputs is much greater than international mobility.

To examine spillovers, we analyze the effect of JCTCs on employment growth in neighboring states. If the employment growth associated with a JCTC is largely coming at the expense of neighboring states, then we would expect the JCTC for state *i* to have a negative impact on employment growth in neighboring states. Conversely, if there is leakage of induced upstream demand to neighboring states, we would expect a given state's JCTC to have a positive impact on employment growth in those states. We test these propositions by forming for state *i* its spatial lag of employment growth. The spatial lag is simply an equal-weighted average of employment growth in neighboring states. We then run the following model, which has the same specification as our baseline model (equation (23)) except that the dependent variable is the spatial lag of employment growth instead of own-state employment growth,

$$
\begin{aligned}
S\left\{\Delta L_{i,t} / L_{i,t-1}\right\} = {} & \chi_{Del}^{BEFORE} \sum_{j=1}^{J_i^{BEFORE}} \frac{D_{i,t+j}^{Del}}{J_i^{BEFORE}} + \chi_{Del}^{AT} D_{i,t}^{Del} + \chi_{Del}^{AFTER} \sum_{j=1}^{J^{After}} \frac{D_{i,t-j}^{Del}}{J^{AFTER}} \\
& + \chi_{Imm}^{AT} D_{i,t}^{Imm} + \chi_{Imm}^{AFTER} \sum_{j=1}^{J^{AFTER}} \frac{D_{i,t-j}^{Imm}}{J^{AFTER}} \\
& + \kappa_1 \left(\Delta L_{i,t}^{P} / L_{i,t-1}^{P}\right) + \kappa_2\, COMPETITION_{i,t} \\
& + \kappa_3\, TAXRATE_{i,t} + \kappa_4\, REPUBLICAN_{i,t} \\
& + \alpha_i + \beta_t + \nu_{i,t}
\end{aligned}
\qquad (24)
$$

where $S\{.\}$ is a spatial lag operator that weights only the neighboring states. The $\chi$s are estimated coefficients that capture interstate effects.

The results are shown in Table 7 with three different definitions of neighboring states – all bordering states equally weighted (columns 1 and 2), all other 47 states supplier-trade weighted (columns 3 and 4), and the five closest states inverse-distance weighted (columns 5 and 6. We find very little evidence of negative spillovers. Rather, the point estimates in Table 7 generally exhibit the same signs as their corresponding estimates in Table 4, but with smaller magnitudes. For the delayed-JCTC states, the estimates for the BEFORE, AT, and AFTER intervals and for CUM in Table 7, averaged over the three different definitions of neighboring states, cluster closely around one-third of the comparable estimates in Table 4. For immediate-JCTC states, the AT interval estimates in Tables 7 or 4 are both numerically small and not significantly different from zero. However, for the AFTER interval and for CUM, the averaged estimates are 44% as large as the comparable estimates in Table 4. All in all, the results in Table 7 are suggestive of economically important, albeit modest, positive spillovers from JCTCs to neighboring states.

*IV.D. Cost per job created And the JCTC Fiscal Multiplier*

Are JCTCs effective state policy tools? How does the job creation they induce compare to that achieved by other government policies? As a final exercise, we address these questions by presenting a back-of-the-envelope calculation of the cost per job created (or retained) for the average JCTC-adopting state and the associated JCTC fiscal multiplier.

The cost of a given state's JCTC program over the event window from signing date ($t_i^S$) to 36 months after the qualifying date is:

$$C_i = (g_i^{CF} + CUM_i) * L_{i,t_i^S} * w_i * \tau_i \,, \tag{25}$$

where $L_{t_i^S}$ is the level of employment in state *i* as of its JCTC signing date, $w_i$ is its average annual wage, $\tau_i$ is the legislated credit rate (as a percentage of the wage), $CUM_i$ is the cumulative growth rate of employment over the event window *due to the tax credit*, and $g_i^{CF}$ is the (counterfactual) growth rate of employment that would have occurred in the absence of the tax credit. Thus, $g_i^{CF} * L_{i,t_i^S}$ is the *inframarginal* amount of net job creation subsidized via the tax credit even though it would have occurred anyway, and $g_i^{CF} * L_{i,t_i^S} * w_i * \tau_i$ is the total amount of inframarginal subsidy.

The number of jobs created in a given state by its JCTC is given by:

$$JC_i = CUM_i * L_{i,t_i^S} . \quad (26)$$

(We are assuming that, if firms react to the incentive, they do so within 36 months after the qualifying date.) Therefore, the cost per job created ($CPJC_i$) in state *i* is:

$$CPJC_i = \frac{(g_i^{CF} + CUM_i) * L_{i,t_i^S} * w_i * \tau_i}{CUM_i * L_{i,t_i^S}} = \underbrace{\frac{g_i^{CF} * w_i * \tau_i}{CUM_i}}_{\text{Inframarginal Subsidy}} + \underbrace{w_i * \tau_i}_{\text{Marginal Subsidy}} . \quad (27)$$

The first term of the final equation is the inframarginal subsidy, the cost of the tax credit that went to subsidizing job creation that would have occurred anyway. The second term is the marginal subsidy, the cost that went to subsidizing the job creation that was due to the tax credit.

We calculate the $CPJC$ along with the inframarginal and marginal components, for the average delayed-JCTC state and for the average immediate-JCTC state. For the average delayed-JCTC state, we calculate $g^{CF}$ by converting the average monthly employment growth rate over delayed-JCTC states, excluding months in the event window, to a growth rate over 42 months, the average length of the event window for delayed-JCTC states. Similarly, for the average immediate-JCTC state, we calculate $g^{CF}$ by converting the average monthly employment growth rate over those states, excluding months in the event window, to a 37-month growth rate, the length of the event window for immediate-JCTC states. These counterfactual growth rates are 4.86% and 2.85% for delayed-JCTC and immediate-JCTC states, respectively. We calculate the average nominal credit value ($w * \tau$), by regime, from the data on average annual wages in manufacturing ($49,527 for delayed-states and $35,983 for immediate-states) and the data described in Table 2 on mean legislated credit rates. The CUM, by regime, comes from Table 4 (with AFTER = 36 months) and is approximately 0.0083 for both regimes.

The results of these calculations are shown in Table 8. For the average delayed-JCTC state, the $CPJC$ is $14,811. The marginal subsidy portion of this cost is simply the average nominal credit per job, $2,159. The remaining $12,652, or 85%, is a subsidy to inframarginal job creation. For the average immediate-JCTC state, the CPJC is $17,848, of which 23% is due to the marginal subsidy and 77% is a subsidy to inframarginal job creation. The average cost per job created across all states is a little over $17,000, with about 80% of this cost being an inframarginal subsidy.[29]

Several other studies have quantified the effects of employment-related tax credits.[30] Kesselman, Williamson, and Berndt (1977) estimate a translog cost function on U.S. manufacturing data. Their estimates imply a cost per job created of $13,630, about 20% lower than the figure based on our estimates in Table 8.[31] Faulk (2002) examines an incremental job tax credit in Georgia. With cross-section data, she estimates separate employment equations for eligible firms that are participating or non-participating in the Georgia program and a probit selection equation to determine participation. For those eligible firms participating in the program, employment rose by between 23 to 28 percent. The cost was between $2,280 and $2,680 per job created.

More recently, Bartik and Bishop (2009) undertake a detailed simulation exercise of a temporary federal JCTC valued at 15% of the wage cost of new employment in 2010 and 10% in 2011. They conclude that the cost per job created would be $4,656 in 2010 and $6,301 in 2011. These estimates include important macroeconomic feedback effects. With these excluded, their estimates can be compared to those in Table 8, and their estimated cost per job created is approximately $37,000. Cahuc, Carcillo, and Le Barbanchon (2016) evaluate a French hiring credit that was temporary, unexpected, and targeted to low income workers in very small firms.

---

[29] Estimation uncertainty enters the CPJC calculation nonlinearly through CUM. The 90% confidence interval of the CPJC ranges from $66,621 to $7,683. Thus, even the upper bound suggests that incentives targeted specifically on employment have a lower CPCJ than the non-targeted fiscal policies discussed below.

[30] See Neumark (2013) and Neumark and Troske (2012) for surveys of this literature's policy recommendations.

[31] We compare the effective wage elasticities from the two studies. The Kesselmen, Williamson, and Berndt elasticity is based on the data in their Table 2, panel 4: column 1 (or column 2) for the wage change and column 7 for the employment change. (The resulting 0.130% elasticity is an average of the four entries in this table.) The Chirinko and Wilson elasticity is our estimated percent change in employment (CUM = 0.0083) divided by the average percent change in the effective wage rate due to JCTCs. The latter is the weighted-average mean JCTC dollar amount divided by the weighed-average mean wage, averaging across the two JCTC regimes (1/3 weight on Delayed-JCTC states and 2/3 weight on Immediate-JCTC states). The Kesselmen et al. elasticity of 0.130% is 34% larger than our elasticity of 0.097. We insert $CUM^{Kesselmen} = 0.0083*1.34 = 0.011$ into equation (27) to get the $13,630 cost per job created estimate implied by Kesselman et al..

Based on their estimated structural model, they conclude that the gross cost per job created for this credit is about one fourth of the average annual wage, which would correspond to roughly $10,000 in the U.S. They estimate a permanent credit in an environment of flexible wages would have a cost per job created 14 times larger.

The studies above focused specifically on job creation tax credits. Recent years have also seen broader fiscal policy efforts aimed at stimulating employment growth. In particular, the American Recovery and Reinvestment Act (ARRA) sought to stimulate employment growth through a combination of federal spending and tax cuts. A number of recent studies have estimated the cost per job created of the ARRA spending. Wilson (2012) examined the impact of ARRA spending on job creation at the state level using exogenous formula apportionment of ARRA funds as an instrument for total ARRA spending by state. He estimated the cost per job created (or saved) from the spending to be around $125,000. This estimate falls roughly in the middle of other cross-state analyses of the cost per job created of ARRA spending, such as the $202,000 obtained by Conley and Dupor (2013) and the $26,000 obtained by Chodorow-Reich, Feiveson, Liscow, and Woolston (2012).

Thus, even the lowest estimates of the cost per job created from the broad fiscal stimulus of the ARRA are well above our estimate of the cost per job created associated with JCTCs. Moreover, the JCTCs to which our cost per job created estimates apply are permanent JCTCs. The evidence cited above indicates that the cost per job created from temporary JCTCs is likely to be even lower. This suggests temporary incentives targeted specifically at job creation may be more cost-effective policies for stimulating employment than general government spending.

Our CPJC estimate can be mapped into a JCTC fiscal multiplier comparable to fiscal multipliers on government consumption expenditures appearing in the literature.[32] The fiscal multiplier, $\Delta Q/\Delta G$, is defined as the change in output due to a $1 change in government expenditures. Here, $\Delta G$ is the increase in tax expenditures associated with a JCTC. Two steps are required to complete the mapping,

$$\frac{\Delta Q}{\Delta G} = \frac{\Delta L}{\Delta G} * \frac{\Delta Q}{\Delta L}. \tag{28}$$

[32] We thank Olivier Blanchard for raising the question about the relation between our CPJC and the spending multiplier.

$\Delta L/\Delta G$ would appear to be just the inverse of the CPJC. In this case, our CPJC estimate of $17,000 implies that 59 new jobs would be created by one million dollars of JCTC tax expenditures. However, this employment increase is a mixture of substitution and income effects; only the latter effect increases output. Using a CES production function and the conditions characterizing optimal behavior, we isolate the income effect (see Appendix C for the derivation). For a newly-enacted JCTC, the percentage change in e8mployment due to factor substitution equals the substitution elasticity among productive factors multiplied by the percentage change in the effective wage rate. The latter is the statutory value of the JCTC adjusted for the rolling base feature of the tax credit. For a substitution elasticity of 1.0 (i.e., a Cobb-Douglas production function), we find that the substitution effect is 71%.[33] Hence the income effect is 29%., and the first object in equation (28) is computed as follows, $\Delta L / \Delta G = 59 * 0.29 \approx 17$. Of the 59 jobs created by one million dollars of JCTC tax expenditures, 17 jobs are due to higher output while the remaining 42 jobs are due to substitution toward labor away from capital and other productive factors.

The second step, calculating $\Delta Q/\Delta L$, translates the 17 jobs coming from higher output into the corresponding change in GDP. Using Okun's Law, Feyrer and Sacerdote (2011, Section VIII) estimate that each job created or saved by government spending is associated with roughly $180,000 in higher GDP. Thus, $1 million of JCTC tax expenditures is estimated to generate $3.06 million of output ($180,000*17) – an output multiplier of 3.06. This multiplier is large relative to estimates found in the literature, a result that follows straightaway from our relatively low cost per job created estimates. One should keep in mind, however, that this multiplier is a rather rough estimate. It is sensitive to the assumed elasticity of substitution between capital and labor, and it abstracts from general equilibrium effects such as the JCTC affecting the pre-credit wage and labor supply.

## V. CONCLUSIONS

This paper uses the experience of 21 U.S. states to inform policy discussions about fiscal foresight and the effectiveness of job creation tax credits (JCTCs). The relevant legislative dates for all boad-based state JCTCs passed in the U.S. since 1990 are compiled. Important for our

---

[33] If the substitution elasticity is 0.50, the substitution effect would be 35%.

analysis of fiscal foresight, the JCTCs are of two types, ones that take effect with a delay and others that take effect immediately. We develop a theoretical model that captures the effects of the rolling base feature of JCTCs and shows that this feature is quantitatively very important. The theoretical model highlights three key conditions necessary for the existence of fiscal foresight and delivers a set of empirical predictions evaluated in an event study framework.

Our econometric estimates lead to several conclusions. Fiscal foresight matters. Based on our unique dataset, we document the quantitative importance of Anticipatory Dips (ADs) and Compensating Rebounds (CRs). This intertemporal behavior runs counter to policy objectives and makes it difficult to accurately evaluate the impacts of fiscal policy. The evidence based on JCTCs suggests that failing to account for the distorting effects of fiscal foresight can lead to a substantial overstatement of the impacts of fiscal policy. For instance, we find that ignoring fiscal foresight would overstate the estimated stimulus to employment growth by 33%.

We also find that the cumulative effect (CUM) of JCTCs is positive, but the effect takes two to three years to be fully observed in the data. These long lags, coupled with evidence from our logit analysis, suggest that the permanent state JCTCs we study in this paper are not countercyclical tools adopted to address transitory weaknesses in employment. Rather, they appear to be economic development policies with a longer run focus. Our estimates imply a cost per job created by permanent state JCTCs of approximately $17,000, which implies a JCTC fiscal multiplier of about 3. Given other studies in the literature, these JCTCs appear to be quite cost effective compared with less targeted fiscal initiatives aimed at stimulating employment such as the 2009 federal stimulus package, though less cost effective than explicitly temporary JCTCs.

Our data collection effort revealed the surprising fact that many broad-based state JCTCs have an implementation lag. The quantitatively important AD found in this study raises a question: why would policymakers adopt legislation that would temporarily lower employment? The CR documented in our empirical work indicates that there will be a big jump in employment in the qualifying month and thus suggests an answer, albeit a cynical one. With a delayed JCTC, politicians can point to the large boost to employment growth, which tends to occur in the first month the credit goes into effect, as evidence of the wisdom of their policies and their concern for the unemployed.

## REFERENCES

Abadie, Alberto, Diamond, Alexis, and Hainmueller, Jens. "Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program." *Journal of the American Statistical Association,* 105 (2010), 493–505.

Abel, Andrew B. "Dynamic Effects of Permanent and Temporary Tax Policies in a q Model of Investment." *Journal of Monetary Economics*, 9 (May 1982), 353-374.

Altschuler, Rosanne. "A Dynamic Analysis of the Research and Experimentation Credit." *National Tax Journal*, 41 (December 1988), 453-466.

Ashenfelter, Orley. "Estimating the Effect of Training Programs on Earnings." *Review of Economics and Statistics,* 60 (1978), 47-57.

Auerbach, Alan J. "Tax Reform and Adjustment Costs: The Impact on Investment and Market Value." *International Economic Review*, 30 (November 1989), 939–962.

Auerbach, Alan J. and Gale, William. "Activist Fiscal Policy to Stabilize Economic Activity." in *Financial Stability and Macroeconomic Policy*, Federal Reserve Bank of Kansas City. (2009), 327-374.

Bartik, Timothy J. *Who Benefits from State and Local Economic Development Policies?* 1991. Kalamazoo, Michigan, W.E. Upjohn Institute for Employment Research.

Bartik, Timothy J. *Jobs for the Poor: Can Labor Demand Policies Help?* 2001. New York, Russell Sage Foundation.

Bartik, Timothy J., and John H. Bishop. "The Job Creation Tax Credit." Oct. 20, 2009. EPI Briefing Paper #248.

Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan. 2004. "How Much Should We Trust Differences-in-Differences Estimates?" *Quarterly Journal of Economics*, 119(1): 249-275.

Blanchard, Olivier, and Perotti, Roberto. "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output." *Quarterly Journal of Economics*, 117 (2002), 1329-1368.

Cahuc, Pierre, Carcillo, Stephane, Le Barbanchon, Thomas. "The Effectiveness of Hiring Credits" Unpublished Manuscript, January 2016.

Cameron, A. Colin, and Trivedi, Pravin K., *Microeconometrics: Methods and Applications* (Cambridge: Cambridge University Press, 2005).

Chodorow-Reich, Gabriel, Laura Feiveson, Zachary Liscow, and William Gui Woolston (2012). "Does State Fiscal Relief During Recessions Increase Employment? Evidence from the American Recovery and Reinvestment Act," *American Economic Journal: Economic Policy* 4(3): pp. 118-145.

Coglianese, John, Davis, Lucas W., Kilian, Lutz, and Stock, James H. "Anticipation, Tax Avoidance, and the Price Elasticity of Gasoline Demand." NBER Working Paper No. 20980 (February 2015).

Conley, Timothy G., and Bill Dupor. "The American Recovery and Reinvestment Act: Solely a Government Jobs Program?" *Journal of Monetary Economics*, 60 (Jan. 2013), 535-549.

Faulk, Dagney. "Do State Economic Development Incentives Create Jobs? An Analysis of State Employment Tax Credits." *National Tax Journal,* 55 (June 2002), 263-280.

Feyrer, James, and Sacerdote, Bruce. "Did the Stimulus Stimulate? Real Time Estimates Of The Effects of the American Recovery and Reinvestment Act." NBER Working Paper No. 16759 (February 2011).

Fischer, Stanley. "What have we learned from the crises of the last 20 years?" Speech at the International Monetary Conference, Toronto (June 1, 2015).

Heckman, James J., and Smith, Jeffrey A. "The Pre-Programme Earnings Dip and the Determinants of Participation in a Social Programme. Implications for Simple Programme Evaluation Strategies." *Economic Journal*, 109 (July 1999), 313-348.

Hirano, Keisuke, Guido W. Imbens, and Geert Ridder. Efficient Estimation of Average Treatment Effects Using the Estimated Propensity Score. *Econometrica* 71 (2003), 1161–1189.

Hsieh, Chang-Tai. "Do Consumers React to Anticipated Income Changes? Evidence from the Alaska Permanent Fund." *American Economic Review*, 93 (March 2003), 397-405.

Johnson, David S., Jonathan A. Parker, and Nicholas S. Souleles. "Household Expenditure and the Income Tax Rebates of 2001." *American Economic Review*, 96 (December 2006), 1589-1610.

Katz, Lawrence F. "Wage Subsidies for the Disadvantaged." in *Generating Jobs: How to Increase Demand for Less-Skilled Workers*, edited by Richard B. Freeman and Peter Gottschalk. 1998. New York: The Russell Sage Foundation, 21-53.

Kueng, Lorenz. "Tax News: The Response of Household Spending to Changes in Expected Taxes." Northwestern University (2015).

Krueger, Alan B., "How Tight Is the Labor Market? The 2015 Martin Feldstein Lecture," *NBER Reporter*, 2015 (3).

Leduc, Sylvain, and Wilson, Daniel J. "Roads to Prosperity or Bridges to Nowhere? Theory and Evidence on the Impact of Public Infrastructure Investment." NBER Macroeconomics Annual 27 (2013), 89-142.

Leeper, Eric M., Richter, Alexander, W., and Walker, Todd B., "Quantitative Effects of Fiscal Foresight." *American Economic Journal: Economic Policy*, 4 (May 2012), 115-144.

Mertens, Karel, and Ravn, Morten O. "Measuring the Impact of Fiscal Policy in the Face of Anticipation: a Structural VAR Approach." *The Economic Journal*, 120 (May 2010), 393-413.

Mertens, Karel, and Ravn, Morten O. "Empirical Evidence on the Aggregate Effects of Anticipated and Unanticipated U.S. Tax Policy Shocks." *American Economic Journal: Economic Policy*, 4 (May 2012), 145-181.

Neumark, David, "Spurring Job Creation in Response to Severe Recessions: Reconsidering Hiring Credits," *Journal of Policy Analysis and Management* 32 (2013), 142-171.

Neumark, David and Grijalva, Diego. "The Employment Effects of State Hiring Credits during and after the Great Recession." NBER Working Paper No. 18928 (March 2013).

Neumark, David, and Kenneth Troske. "Point/Counterpoint: 'Addressing the Employment Situation in the Aftermath of the Great Recession'." *Journal of Policy Analysis and Management*, (2012) 160-68.

Parker, Jonathan A., Souleles, Nicholas S., Johnson, David S., McClelland, Robert. 2013. "Consumer Spending and the Economic Stimulus Payments of 2008." *American Economic Review* 103:6, 2530-2553.

Perotti, Roberto. "The Effects of Tax Shocks on Output: Not So Large, But Not Small Either." *American Economic Journal: Economic Policy* 4 (May 2012), 214-237.

Pesaran, M. H. (2007). "A Simple Panel Unit Root Test in the Presence of Cross Section Dependence." *Journal of Applied Econometrics* 22 (2007), 265-312.

Poterba, James M. "Are Consumers Forward Looking? Evidence from Fiscal Experiments." *American Economic Review* 78 (May 1988), 413-418.

Ramey, Valerie A. (2011). "Identifying Government Spending Shocks: It's all in the Timing," *Quarterly Journal of Economics* 126(1), 1-50.

Ramey, Valerie A., and West, Kenneth D., “Inventories.” In *Handbook of Macroeconomics, Volume.I*. Edited by John Taylor and Michael Woodford. 1999. Elsevier Science, Amsterdam, 863-923.

Rogers, Cami. “State Guidelines: The Jobs Creation Tax Credit.” *Journal of State Taxation* 16 (Winter 1998), 44-63.

Shapiro, Matthew D., and Slemrod, Joel. “Did the 2008 Tax Rebates Stimulate Spending?,” *American Economic Review* 99 (May 2009), 374-79.

Wildasin, David E. “Comments: ‘A Defense of the Commerce Clause’s Role in Constraining State Business Tax Incentives’ by Peter D. Enrich, ‘A Market for Jobs Approach for Analyzing the Competition for Capital’ by Ann Markusen, and ‘State Investment Tax Incentives: What Are the Facts?’ by Robert S. Chirinko and Daniel J. Wilson.” *National Tax Association, Proceedings of 99th Annual Conference on Taxation* (2007; CD-ROM): 45-49.

Wilson, Daniel J. “Fiscal Spending Jobs Multipliers: Evidence from the 2009 American Recovery and Reinvestment Act.” *American Economic Journal – Economic Policy*, 4 (August 2012), 251-282.

Wilson, Daniel J. and Notzon, Charles. “Tax Credits for Job Creation and Retention: What Can We Learn from the States?” *FRBSF Economic Letter*, 2009-08 (February, 2009).

Yang, Shu-Chun Susan. “Quantifying Tax Effects under Perfect Foresight.” *Journal of Monetary Economics*, 52 (2005), 1557-1568.

**<u>*** NOT FOR PUBLICATION ***</u>**

## APPENDIX A: GLOSSARY

AD = Anticipatory Dips. The phenomenon whereby economic agents know with a great deal of certainty that a JCTC will go into effect on a known date in the future. This situation only occurs during the period between the signing date and the qualifying date for tax credits with implementation periods; that is, delayed-JCTC states. See line segment AB in Figure 5. This phenomenon is one aspect of "fiscal foresight."

$COMPETITION_{i,t}$. Fraction of bordering states with JCTCs during the prior 12 months:

$$= \sum_{j=1}^{48} \omega_{j,i}^{Bordering} ACTIVE_{j,t}^{JCTC} / B(i),$$

$\omega_{j,i}^{Bordering} = 1$ if state j borders state i, $\omega_{j,i}^{Bordering} = 0$ otherwise;

$ACTIVE_{j,t}^{JCTC} = MAX\left\{0, D_{j,t-m}^{SIGNING} \text{ for } m = 1, 12\right\}$,

B(i) is the number of states that border state i.

$CPJC_i$= Cost per job created in state *i*. The total subsidy to both inframarginal and marginal jobs divided by the number of jobs created by the JCTC. Cf. equation (27) and surrounding text.

CR = Compensating Rebound. The phenomenon whereby economic agents compensate for deferred hiring (due to the Anticipatory Dip) and replenish inventories. This situation only occurs for tax credits with implementation periods; that is, delayed-JCTC states. See line segments BC and DE in Figure 5. Note that Point C has the same value as Point A. This phenomenon is one aspect of "fiscal foresight."

$D_{i,t}^{Del}$. An indicator variable that equals one in the qualifying month for a delayed-JCTC state and equals zero otherwise.

$D_{i,t}^{Imm}$. An indicator variable that equals one in the latter of the signing month and qualifying month for an immediate-JCTC state and equals zero otherwise.

$D_{i,t}^{Qualifying}$. An indicator variable taking the value of 1 in the JCTC qualifying month ($t = t_i^{Qualifying}$); 0 otherwise. This indicator variable will be 0 for all t for all states without a JCTC. During the sample period, Colorado passed two JCTCs; $D_{Colorado,t}^{Qualifying} = 1$ only for the first adoption.

$D_{i,t}^{Signing}$. An indicator variable taking the value of 1 in the JCTC signing month ($t = t_i^{Signing}$), 0 otherwise. This indicator variable will be 0 for all t for the 26 states without a JCTC. (Alaska, Hawaii, and the District of Columbia are excluded from our sample and hence this set of 26 states.) This variable is defined from January 1990 to December 2010. During this sample period, Colorado passed two JCTCs; $D_{Colorado,t}^{Signing} = 1$ only for the first adoption. Prior to the sample period, only Nebraska had passed a JCTC, as indicated in Figures 1 and 2; $D_{Nebraska,t}^{Signing} = 0$ for all t.

Fiscal Foresight. Alterations of current behavior by forward-looking agents in anticipation of future policy changes. Fiscal foresight results in an AD and CR.

i: An index for state *i*.

Implementation Interval. Interval between signing and qualifying months when $t_i^{Signing} < t_i^{Qualifying}$.

Implementation Regime. A JCTC with an implementation period.

Inventory overshooting effect. JCTC-induced response of employment that occurs on the effective date and reflects the accumulation of inventory that compensates for prior draw downs and/or reflects intertemporal substitution in the face of temporarily lower labor costs. Line segment DE in Figure 5.

$L_{i,t}$. The level of employment. Monthly, seasonally adjusted, private non-farm employment data for the period January 1990 to September 2009. Source: Bureau of Labor Statistics.

$LGROWTH_{i,t}$. Employment growth over some number of prior months. This variable is defined in eight different ways. See $LGROWTH_{i,t}^{M,N}$ and $LGROWTH_{i,t}^{M,N,Bordering}$ for $M = 0,3,6,12$ and $N = 3,6,12,24$.

$LGROWTH_{i,t}^{M,N}$. Employment growth defined by a pair of the M and N parameters; that is, $M = 0,3,6,12$ and $N = 3,6,12,24$ forming the four pairs, (0,3), (3,6), (6,12), and (12,24): $= (L_{i,t-M} - L_{i,t-N}) / L_{i,t-N}$.

$\text{LGROWTH}_{i,t}^{N,\text{Bordering}}$. Employment growth in the states bordering state i defined by a pair of the M and N parameters: that is, $M = 0,3,6,12$ and $N = 3,6,12,24$, forming the four pairs (0,3), (3,6), (6,12), and (12,24):

$$= (L_{i,t-M}^{\text{Bordering}} - L_{i,t-N}^{\text{Bordering}}) / L_{i,t-N}^{\text{Bordering}},$$

$$L_{i,t}^{\text{Bordering}} = \sum_{j=1}^{48} \omega_{j,i}^{\text{Bordering}} L_{j,t}$$

$$\omega_{j,i}^{\text{Bordering}} = 1 \text{ if state j borders state i, } \omega_{j,i}^{\text{Bordering}} = 0 \text{ otherwise}$$

$\text{REPUBLICAN}_{i,t}$. An indicator variable taking the value of 1 if both the governorship and the legislature are Republican controlled, a value of 1/2 if only one of these elected bodies is Republican controlled, and 0 if neither of these elected bodies are Republican controlled. Source: Statistical Abstract of the United States (U.S. Census Bureau (Various Years)).

$t_i^{\text{Qualifying}}$ (or $t_i^Q$). Qualifying month for the JCTC; the earliest month a new hire may qualify for a JCTC. Source: Authors' compilation.

$t_i^{\text{Signing}}$ (or $t_i^S$). Signing month for the JCTC; the month during which the governor in state i officially signs or enacts JCTC legislation into law. Source: Authors' compilation.

$\tau_{i,t}$. The legislated rate of a Job Creation Tax Credit. Source: see discussion in Section III.A. and Appendix B.

$\text{UCC}_{i,t}$. The user cost of capital that measures the nominal incentive effects due to business capital taxes.

$W_{i,t}$. The nominal wage rate.

# APPENDIX B: THE JCTC DATASET

JCTCs are credits against a state's corporate income or franchise tax. This appendix describes the unique state-level JCTC data that we have collected and contains details about the identification, valuation, and design of JCTCs.

*1. Identifying And Dating*

We focus on broad-based JCTCs and identify states with these tax credits in three steps. First, we use Rogers (1998) to identify state JCTCs in place as of 1997. Only Nebraska's credit was enacted prior to 1990. Second, *Site Selection*'s website (www.siteselection.com) contains tables documenting various state tax incentives from 1997 onward. Third, we supplement these sources with, for each state, a general web search for "tax credits" and a more targeted search in the legal database *WestLaw*. We believe that we have identified all broad-based JCTCs for which both the signing and effective dates are prior to December 2007, the start of the Great Recession. Such credits have a high potential of being enacted as countercyclical fiscal policy tools and hence of being endogenous with respect to contemporaneous employment growth.

Having identified all 21 states that adopted a broad-based, permanent JCTC between January 1990 and December 2007, we then use *WestLaw* to obtain the state statute code for the legislation associated with the JCTC.[34] The state statute code identifies the session law that includes the bill signed into law, officially authorizing the credit. States session laws and bills are found either in *WestLaw* or on the state's house/assembly website. These bills contain all of the relevant JCTC information needed for this paper.[35] In particular, the bills indicate the signing and qualifying dates for the JCTC.[36]

---

[34] These 21 JCTCs were passed without an expiration date and hence were intended at the time to be permanent. Rhode Island enacted a credit that was explicitly temporary; we exclude this credit from our sample.

[35] These bills are available from the authors upon request.

[36] For six of the 14 immediate JCTC states, the JCTC is retroactive in the sense that the qualifying date precedes the signing date by more than 15 days. For each retroactive JCTC state in our sample, the qualifying date is January 1 of the year in which the credit was signed into law. In these cases, only net employment increases made after January 1 can qualify for a credit. Since the empirical implications for firms confronting these retroactive JCTC states are similar to those for the other immediate JCTC states, there is no a priori reason for separating them in the econometric analyses.

*2. Valuation Of The Legislated Tax Credit*

The legislated tax credit rates for the state JCTCs in our sample are computed in one of three ways, depending on the details of the enabling legislation,

$$\tau_{i,t} = \left\{ \tau_{i,t}^{WAGES}, \tau_{i,t}^{WITHHOLD}, \tau_{i,t}^{DOLLAR} \right\} . \qquad \text{(B1)}$$

In most JCTC states, the legislation explicitly provides a tax credit rate as a fraction of the new hire's annual wages ( $\tau_{i,t}^{WAGES}$ ). This rate is taken directly from the legislation. In other JCTC states, the legislation specifies a rate based on the new hire's income tax withholdings ( $\tau_{i,t}^{WITHHOLD}$ ). We estimate this tax credit rate as the product of the rate in the legislation and average income tax withholding in a state-year, the latter calculated as the product of average annual manufacturing wage and the statutory personal income tax rate (for the income bracket corresponding to that annual wage) in that state-year. The wage data are obtained from the Annual Survey of Manufacturers Geographic Area Statistics. In a third set of JCTC states, as well as the federal JCTC in President Obama's proposed (but not adopted) American Jobs Act of 2011, the legislation specifies an annual dollar tax credit per new employee. We compute the associated tax credit rate ( $\tau_{i,t}^{DOLLAR}$ ) as the dollar tax credit in the legislation divided by average annual wages in a state-year. For five of the 21 credits in our sample, the tax credit value is determined by a state agency or committee on an employer-by-employer basis. Unfortunately, these states do not routinely report both the tax expenditures and the incremental jobs or wages claimed by companies that used the credits, which would be needed to compute an average credit value. We must thus exclude these states from our estimation using the pecuniary JCTC in Table 5. (The number of JCTCs used in Table 4 (indicator JCTC) and Table 5 (pecuniary JCTC) differs by these five states.)

For some of the state JCTCs, firms can take the credit for multiple years as long as the new hire (or more accurately, the incremental addition to the firm's level of employment) is retained. In those cases, we compute the present discounted value of this stream of yearly credit amounts based on the number of years for which the firm gets the credit.

We also adjust the effective legislated tax credit rate (as well as the JCTC indicator variable) for the number of eligible firms. JCTCs are granted only for firms that are not contracting, and we multiply $\tau_{i,t}$ by the proportion of firms eligible to use the credit ($\text{ELIGIBLE}_{i,t}$). The later variable equals one minus the fraction of establishments ineligible for a JCTC as determined by plant closings or employment reductions. Data by state and year on this fraction are obtained from the Bureau of Labor Statistics.

*3. The General Design*[37]

As mentioned above, we focus on broad-based JCTCs with little or no restrictions on eligible industries and few or no restrictions on eligible geographic areas within the state.[38] Focusing on a broad-based tax credit allows us to avoid the distorting effects of a "stigma" that accompanies targeted tax credits, as employers may use the availability of a targeted credit as a signal of unobservable labor productivity (Bartik, 2001, Chapter 8 and Katz (1998)). In addition, our primary empirical objective is to assess the extent to which JCTCs impact aggregate employment; narrowly targeted credits are much less likely to have an economically meaningful impact on aggregate employment. The details of these tax credits vary widely, but their basic designs are quite similar.

These tax credits are intended to subsidize net job creation by businesses. That is, only new jobs that expand a business' total payroll employment level qualify for the tax credit. With many state JCTCs, a firm can only claim the credit if the number of jobs and/or wages associated with new jobs are above specified thresholds and meet certain other requirements, such as providing health insurance. In order to target net job creation instead of gross job creation, the thresholds are defined on a "rolling basis" – the initial threshold is based on previous levels of employment or wages and future thresholds are increased to reflect recent. Some states offer multiple tax credit rates that increase with the number of, or wages associated with, the added jobs.

---

[37] This description is based largely on the information provided in Wilson and Notzon (2009).

[38] Georgia is an exception because only jobs in manufacturing are eligible for the credit. California and New Jersey have extremely narrowly targeted JCTCs, and they are excluded from our dataset.

# APPENDIX C: COMPUTING THE JCTC FISCAL MULTIPLIER

This appendix derives expressions for computing the substitution and income effects associated with a JCTC. In a standard diagram of an isoquant with labor and some other productive factor on the axes, the adoption of a JCTC rotates the line segment representing the relative price of labor, forcing the optimizing firm to substitute along the isoquant and then shifting to a higher isoquant. Since the JCTC fiscal multiplier involves only the latter effect, we derive an expression that isolates the substitution effect and compute the income effect as a residual.

We assume that a neoclassical firm produces output constrained by a constant-returns-to-scale CES production function that depends on labor and one or more additional factors of production, faces competitive input and output markets, and chooses labor and other inputs to maximize profits. The first order condition for labor is as follows,

$$L = \phi^{\sigma} (W^{e})^{-\sigma} Q U, \qquad \text{(C-1)}$$

where L is labor input, $\phi$ is the CES distribution parameter, $\sigma$ is the substitution elasticity between labor and any other productive factor, $W^e$ is the effective wage rate, Q is output, and U is a shock (usually thought of as a productivity shock but indistinguishable from a demand shock). Taking logs and differentiating with respect to a <u>fall</u> in $W^e$, we obtain the following equation,

$$\%\Delta L = -\sigma * \%\Delta W^{e} + \%\Delta Q . \qquad \%\Delta W^{e} < 0 \qquad \text{(C-2)}$$

As we move along an isoquant, $\%\Delta Q = 0$, and equation (C-2) can be written as follows,

$$\%\Delta L = -\sigma * \%\Delta W^{e} . \qquad \%\Delta W^{e} < 0 \qquad \text{(C-3)}$$

In order to derive a quantitatively useful expression, we need to relate $\%\Delta W^e$ to the legislated rate for the JCTC. We assume that, in the "initial" period, there is no JCTC and, in the the "stimulus" period, $W^e$ equals its steady-state value (equation (10b)). A general expression for $W^e$ is as follows,

$$W^{e} = W * F[JCTC]. \qquad \text{(C-4a)}$$

$$F[JCTC] \equiv \left(1 - JCTC * \left(\rho / (1-\rho)\right)\right) \qquad \text{(C-4b)}$$

where JCTC is the statutory job creation tax credit, $F[JCTC]$ captures the effects of the JCTC on the effective wage rate, W is the market wage rate (assumed to be invariant with respect to changes in the JCTC), and $\rho$ is a real discount rate. The percentage change in $W^e$ with respect to the JCTC is written as follows,

$$\%\Delta W^e = \frac{W*F[JCTC>0] - W*F[JCTC=0]}{W*F[JCTC=0]} = F[JCTC>0]-1, \qquad \text{(C-5)}$$

where $F[JCTC=0]=1$. We assume that $\rho$ equals 0.07, and hence equation (C-5) can be written as follows,

$$\%\Delta W^e = F[JCTC]-1 = -0.065*JCTC. \qquad \text{(C-6)}$$

Equation (C-6) can be used to quantify the impact of JCTC’s on the effective wage rate, though the impacts will differ across regimes because the mean values of the JCTC’s differ across regimes. The mean values are taken from Table 2, panel C, column 1. In turn, these computations are used to quantify the substitution effect via equation (C-3),

**Delayed Regime**

$$\%\Delta L = -\sigma * \%\Delta W^e = \sigma * 0.065 * 0.04274 = \sigma * 0.0027781, \qquad \text{(C-7a)}$$

**Immediate Regime**

$$\%\Delta L = -\sigma * \%\Delta W^e = \sigma * 0.065 * 0.11436 = \sigma * 0.0074334, \qquad \text{(C-7b)}$$

The overall $\%\Delta L$'s for the baseline results in Table 4 are approximately 0.083 for both regimes. For a given change in the JCTC, we need to separate the overall change in employment into a substitution effects (equations (C-7)) and the output effect (the residual given the overall $\%\Delta L$). The results are presented in the following table,

| | **Delayed Regime** | | **Immediate Regime** | | **Weighted (1/3, 2/3)** | |
|---|---|---|---|---|---|---|
| | **Substitution** | **Income** | **Substitution** | **Income** | **Substitution** | **Income** |
| $\sigma$=0.5 | 17% | 83% | 45% | 55% | 35% | 65% |
| $\sigma$=1.0 | 34% | 66% | 90% | 10% | 71% | 29% |
| $\sigma$=1.5 | 50% | 50% | 134% | -34% | 106% | -6% |

Columns 5 and 6 are weighted averages of the substitution and income effects for delayed and immediate regimes with weights of 1/3 and 2/3, respectively, corresponding to the number of delayed and immediate JCTC states.

We use the figures in column 6 to multiply the gross employment increase due to the JCTC to derive the employment representing an income shift.[39] In turn, this figure is multiplied by 0.18 to estimate the JCTC spending multiplier in equation (28).

[39] Note that when the elasticity of substitution between capital and labor is very large, at 1.5, the estimated income effect becomes negative. In other words, with such a large elasticity of substitution, the implied substitution effect on employment from the decline in the effective wage rate is larger than our empirical estimate of the total employment effect. This negative income effect occurs for any elasticity of substitution above 1.411.

Figure 1: Diffusion of JCTCs

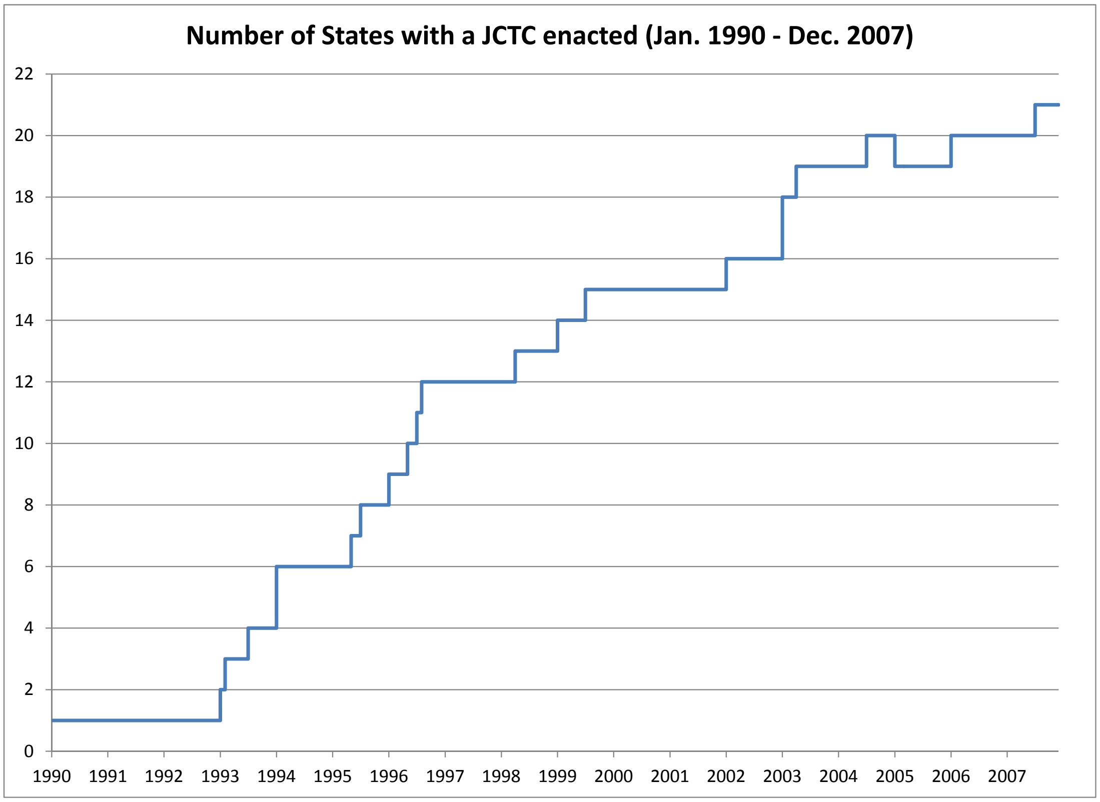
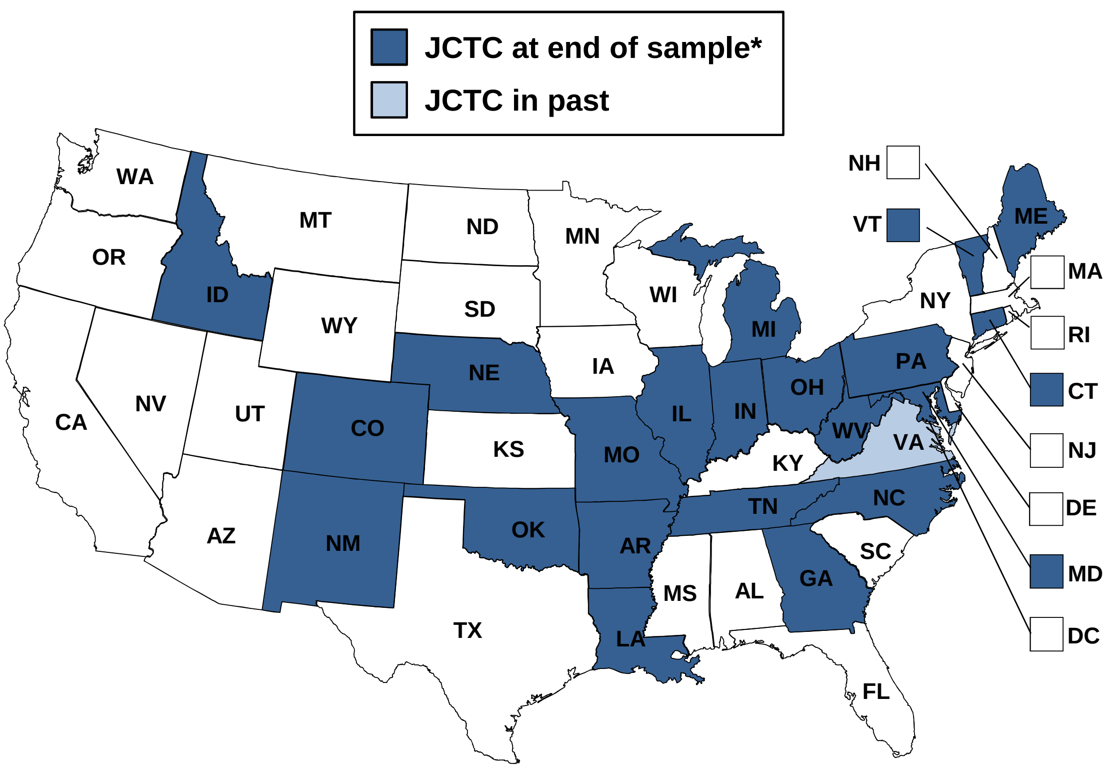



Figure 2: Geographical Distribution of JCTCs




* As of Dec. 2007

Figure 3

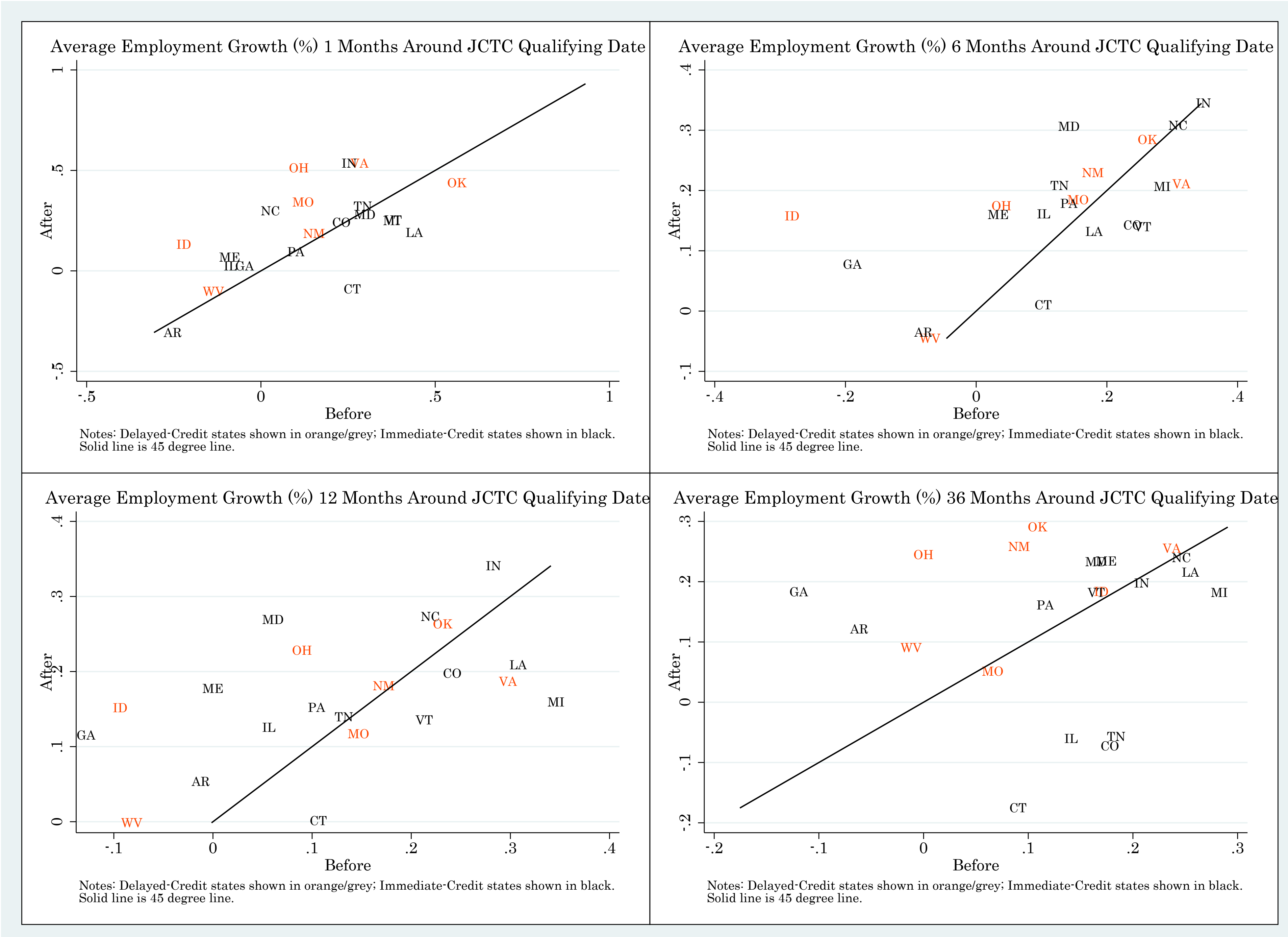
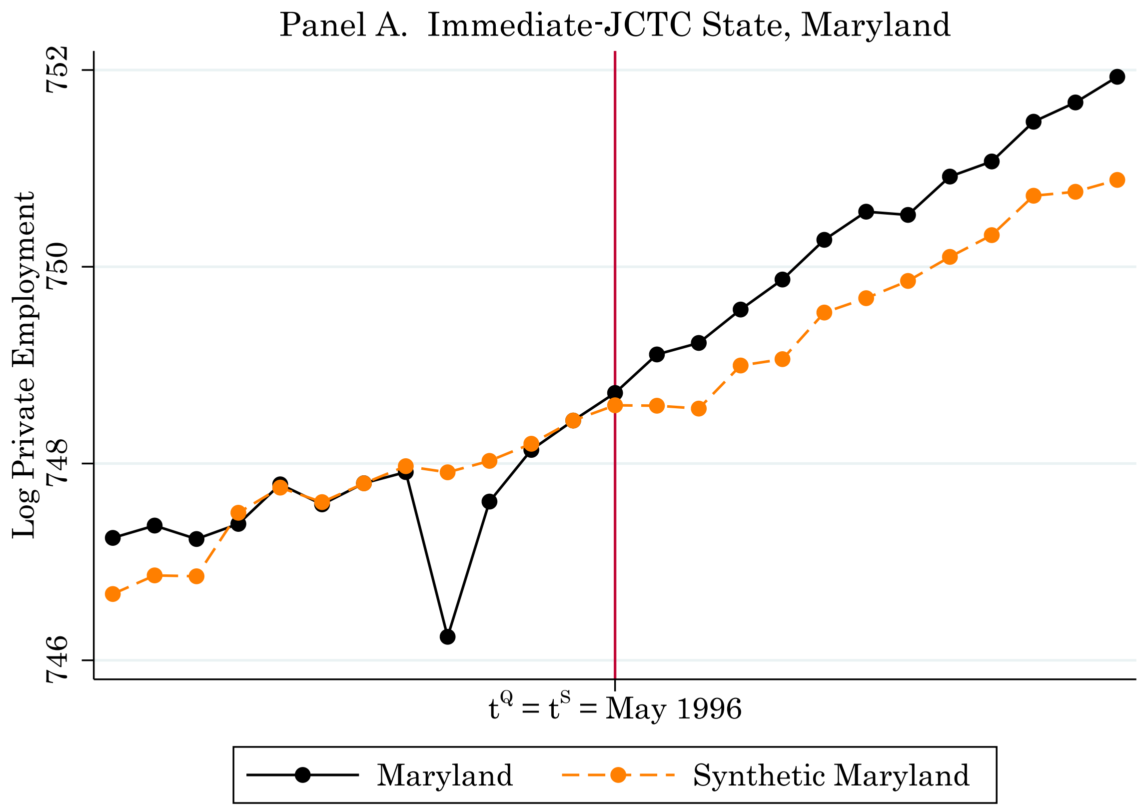
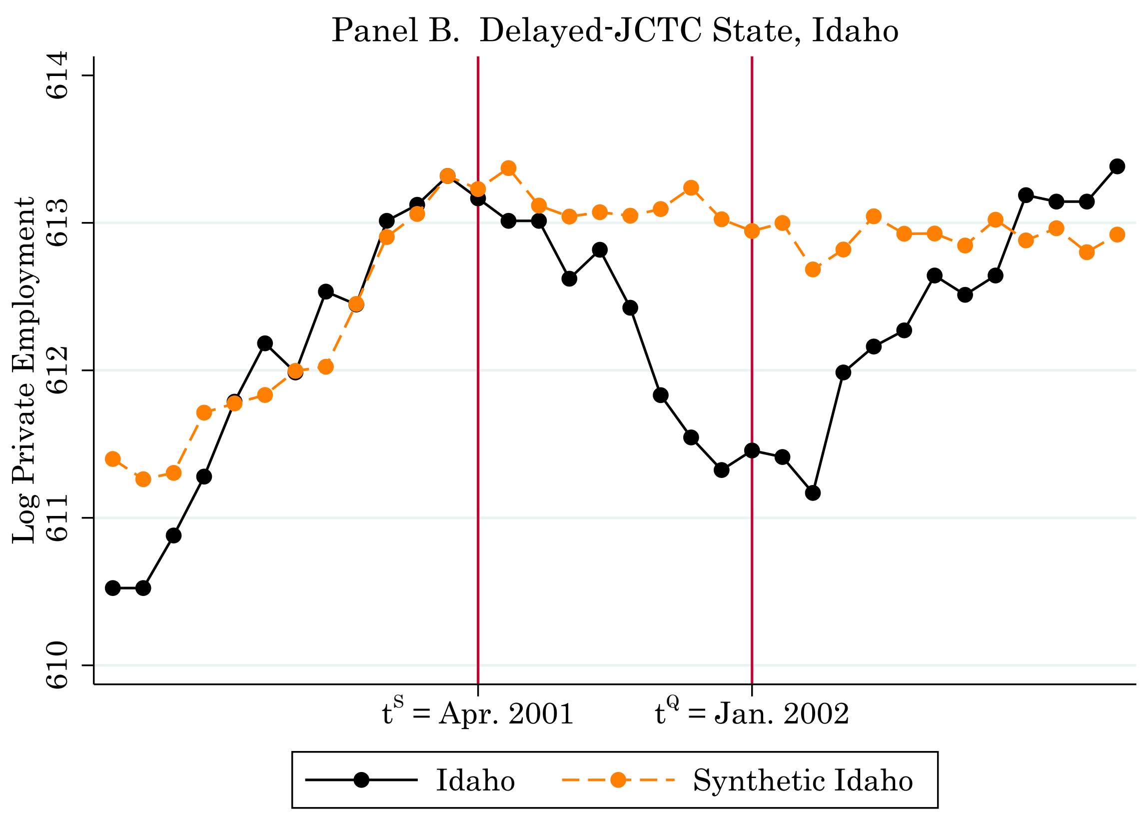

Average Employment Growth (%) 1 Months Around JCTC Qualifying Date
After
Before
Notes: Delayed-Credit states shown in orange/grey; Immediate-Credit states shown in black.
Solid line is 45 degree line.
Average Employment Growth (%) 6 Months Around JCTC Qualifying Date
After
Before
Notes: Delayed-Credit states shown in orange/grey; Immediate-Credit states shown in black.
Solid line is 45 degree line.
Average Employment Growth (%) 12 Months Around JCTC Qualifying Date
After
Before
Notes: Delayed-Credit states shown in orange/grey; Immediate-Credit states shown in black.
Solid line is 45 degree line.
Average Employment Growth (%) 36 Months Around JCTC Qualifying Date
After
Before
Notes: Delayed-Credit states shown in orange/grey; Immediate-Credit states shown in black.
Solid line is 45 degree line.

Figure 4: Employment Dynamics Around JCTC Enactments, Treated State vs. Sythetic Control




Notes: Each graph plots monthly log private-sector employment for the treated state and its synthetic control from 12 months prior to the credit signing date ($t^s$) through 12 months after the credit qualifying date ($t^q$). Log employment in the synthetic control is scaled to equal log private employment in treated state at one month prior to $t^s$. The synthetic control is a weighted average of the other 47 states, excluding any states that also had a credit enactment over the event window. The weights are estimated to minimize the distance between pre-signing-date values of monthly employment growth, COMPETITION, REPUBLICAN, the corporate tax rate and the Bartik shift-share variable.

Figure 5: Theoretical Predictions of the Path of Employment around a JCTC "event"

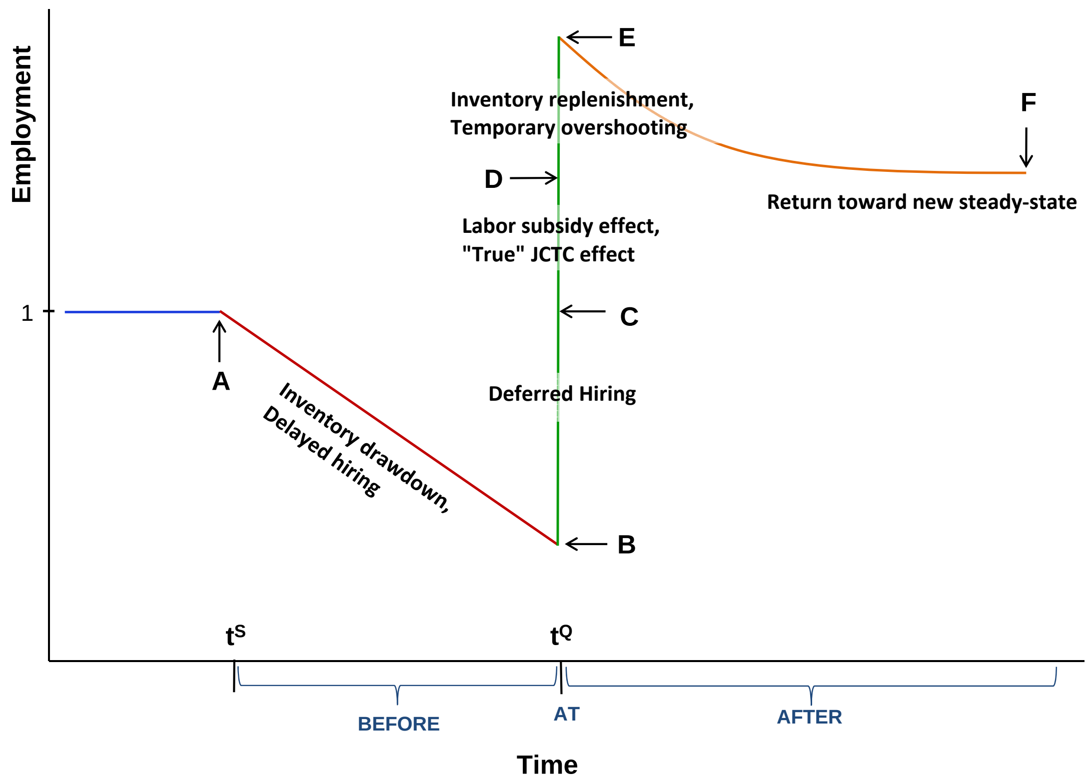
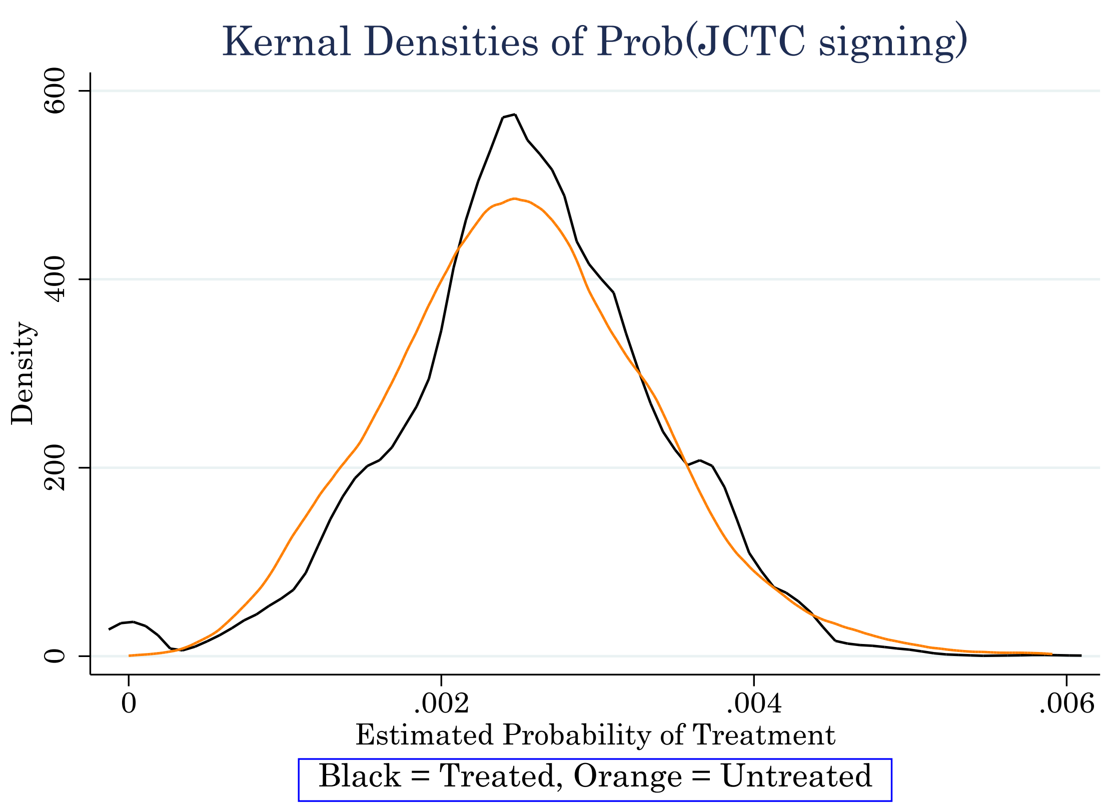



Figure 6




Notes: "Treated" are state-month observations in which a JCTC has been signed and has not been repealed or expired. "Untreated" are all other observations.

**Table 1:** Expected Impacts Of JCTCs On Employment Growth
By Regime, By Interval
Theoretical Predictions

| **Regimes** | **Intervals** | | | |
|---|---|---|---|---|
| | Before<br>(1) | At<br>(2) | After<br>(3) | Total<br>(4) |
| Delayed | -<br>[AD] | ++<br>[CR] | + or - | +<br>[CUM] |
| Immediate | N/A | +<br>[CR] | + or - | +<br>[CUM] |

**Table 2:** Summary Statistics
Employment Level, Employment Growth, and Legislated JCTCs

| **State JCTC Status** | **Mean** | **Median** | **Std. Dev.** | **N** |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| **A. Employment Level (Thousands)** | | | | |
| Delayed-JCTC | 1,765.4 | 1,178.9 | 1,431.0 | 1,365 |
| Immediate-JCTC | 2,339.2 | 2,112.4 | 1,426.2 | 2,730 |
| No-JCTC | 2,243.8 | 1,295.3 | 2,695.5 | 5,222 |
| All | 2,201.7 | 1,497.9 | 2,236.5 | 9,317 |
| | | | | |
| **B. Employment Growth (%, monthly frequency)** | | | | |
| Delayed-JCTC | 0.132 | 0.138 | 0.294 | 1,365 |
| Immediate-JCTC | 0.093 | 0.110 | 0.339 | 2,730 |
| No-JCTC | 0.143 | 0.155 | 0.313 | 5,222 |
| All | 0.127 | 0.138 | 0.319 | 9,317 |
| | | | | |
| **C. Legislated JCTCs (% of average state wage)** | | | | |
| Delayed-JCTC | 4.274 | 3.196 | 2.952 | 1,170 |
| Immediate-JCTC | 11.436 | 5.000 | 18.632 | 1,950 |
| No-JCTC | 0 | 0 | 0 | 5,222 |
| All | 3.640 | 0 | 10.470 | 8,342 |

Notes: Data for the period January 1990 to December 2010. The data in Panel C are for 21 job creation tax credit adoptions. Employment Level is in thousands. Employment Growth and JCTC values are in percentage points.

**Table 3:** JCTC Adoption Decision

Logit Estimator

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Employment growth from t-3 to t | -0.000 | 0.038 | | -0.014 | |
| | (0.432) | (0.479) | | (0.483) | |
| | [1.000] | [0.937] | | [0.976] | |
| Employment growth from t-6 to t-3 | 0.354 | 0.400 | | 0.275 | |
| | (0.460) | (0.464) | | (0.472) | |
| | [0.441] | [0.388] | | [0.560] | |
| Employment growth from t-12 to t-6 | 0.033 | 0.124 | | -0.044 | |
| | (0.240) | (0.280) | | (0.333) | |
| | [0.890] | [0.659] | | [0.895] | |
| Employment Growth from t-24 to t-12 | | | | 0.127 | |
| | | | | (0.152) | |
| | | | | [0.403] | |
| Relative employment growth from t-3 to t | | | 0.039 | | -0.015 |
| | | | (0.481) | | (0.485) |
| | | | [0.935] | | [0.976] |
| Relative employment growth from t-6 to t-3 | | | 0.401 | | 0.275 |
| | | | (0.466) | | (0.474) |
| | | | [0.389] | | [0.562] |
| Relative employment growth from t-12 to t-6 | | | 0.126 | | -0.041 |
| | | | (0.282) | | (0.335) |
| | | | [0.655] | | [0.902] |
| Relative Employment Growth from t-24 to t-12 | | | | | 0.127 |
| | | | | | (0.153) |
| | | | | | [0.405] |
| COMPETITION | 0.003 | 0.099 | 0.099 | 0.096 | 0.096 |
| | (0.008) | (0.037) | (0.037) | (0.039) | (0.039) |
| | [0.708] | [0.007] | [0.007] | [0.014] | [0.014] |
| CORPORATE INCOME TAX RATE (CITR) | 0.076 | -1.396 | -1.396 | -1.318 | -1.319 |
| | (0.081) | (0.895) | (0.896) | (0.896) | (0.896) |
| | [0.350] | [0.119] | [0.119] | [0.141] | [0.141] |
| REPUBLICAN | -0.370 | 1.482 | 1.484 | 1.652 | 1.653 |
| | (0.610) | (1.245) | (1.244) | (1.281) | (1.281) |
| | [0.545] | [0.234] | [0.233] | [0.197] | [0.197] |
| Joint Significance of emp growth lags (p-value) | 0.694 | 0.630 | 0.630 | 0.861 | 0.862 |
| Observations | 8349 | 2151 | 2151 | 1899 | 1899 |

Notes: Cells show coefficient, std. error (in parentheses), and p-value [in brackets]. State fixed effects are excluded from the model in Column (1) but included in the models in Columns (2)-(5).

**Table 4:** Effects of JCTCs on Employment Growth by Regime and Interval
Alternative AFTER Lengths
ATE-IPW Estimator
JCTC Measured By Indicator Variable

| | AFTER = 12m | | AFTER = 24m | | AFTER = 36m | |
|---|---|---|---|---|---|---|
| | Delayed | Immediate | Delayed | Immediate | Delayed | Immediate |
| Before | -0.065 | 0.000 | -0.062 | 0.000 | -0.059 | 0.000 |
| | (0.026) | (0.000) | (0.027) | (0.000) | (0.026) | (0.000) |
| | [0.013] | [0.000] | [0.025] | [0.000] | [0.025] | [0.000] |
| At | 0.128 | 0.031 | 0.131 | 0.032 | 0.133 | 0.034 |
| | (0.051) | (0.035) | (0.051) | (0.035) | (0.051) | (0.036) |
| | [0.011] | [0.372] | [0.010] | [0.358] | [0.009] | [0.336] |
| After | -0.010 | 0.016 | 0.022 | 0.016 | 0.028 | 0.022 |
| | (0.027) | (0.014) | (0.017) | (0.013) | (0.012) | (0.011) |
| | [0.698] | [0.225] | [0.216] | [0.239] | [0.022] | [0.040] |
| Cumulative Effect (CUM) | -0.328 | 0.229 | 0.331 | 0.406 | 0.844 | 0.826 |
| | (0.287) | (0.174) | (0.494) | (0.325) | (0.466) | (0.399) |
| | [0.253] | [0.188] | [0.503] | [0.211] | [0.070] | [0.038] |
| Number of JCTCs | 7 | 14 | 7 | 14 | 7 | 14 |

Notes: Cells show coefficient, standard error (in parentheses), and p-value [in brackets]. The cell entries for the BEFORE, AT, and AFTER intervals measure the effects on employment growth per month. The Cumulative Effect sums the product of each interval's coefficient and the number of months in that interval for either the delayed or immediate regime. Each model includes Two-Way Fixed Effects And Controls.

**Table 5:** Effects of JCTCs on Employment Growth by Regime and Interval
Alternative AFTER Lengths
ATE-IPW Estimator
JCTC Measured by Pecuniary Credit Rate Variable

| | AFTER = 12m | | AFTER = 24m | | AFTER = 36m | |
|---|---|---|---|---|---|---|
| | Delayed | Immediate | Delayed | Immediate | Delayed | Immediate |
| Before | -1.355 | 0.000 | -1.256 | 0.000 | -1.266 | 0.000 |
| | (0.389) | (0.000) | (0.400) | (0.000) | (0.384) | (0.000) |
| | [0.000] | [0.000] | [0.002] | [0.000] | [0.001] | [0.000] |
| At | 1.056 | 0.126 | 1.141 | 0.309 | 1.133 | 0.318 |
| | (1.434) | (0.643) | (1.434) | (0.631) | (1.448) | (0.630) |
| | [0.462] | [0.845] | [0.426] | [0.624] | [0.434] | [0.614] |
| After | -0.530 | -0.892 | 0.585 | 0.533 | 0.346 | 0.398 |
| | (0.391) | (0.306) | (0.276) | (0.305) | (0.157) | (0.358) |
| | [0.176] | [0.004] | [0.034] | [0.080] | [0.027] | [0.266] |
| Cumulative Effect (CUM) | -12.753 | -10.572 | 8.260 | 13.107 | 6.631 | 14.643 |
| | (4.160) | (3.868) | (7.355) | (7.301) | (5.803) | (12.901) |
| | [0.002] | [0.006] | [0.261] | [0.073] | [0.253] | [0.256] |
| Number of JCTCs | 6 | 10 | 6 | 10 | 6 | 10 |

Notes: See Table 4 notes. $\gamma_{Del}^{BEFORE}$ is multiplied by -1 to maintain comparability with Table 4 (see text for details).

**Table 6:** Effects of JCTCs on Employment Growth by Regime and Interval
ATE-IPW Estimator
AFTER Length is 36 Months
JCTC Measured By Indicator Variable

| | Baseline | | No Controls | | No Controls or State FEs | | No Controls or Time FEs | |
|---|---|---|---|---|---|---|---|---|
| | Delayed | Immediate | Delayed | Immediate | Delayed | Immediate | Delayed | Immediate |
| Before | -0.059 | 0.000 | -0.060 | 0.000 | -0.037 | 0.000 | -0.068 | 0.000 |
| | (0.026) | (0.000) | (0.027) | (0.000) | (0.022) | (0.000) | (0.142) | (0.000) |
| | [0.025] | [0.000] | [0.027] | [0.000] | [0.086] | [0.000] | [0.635] | [0.000] |
| At | 0.133 | 0.034 | 0.130 | 0.040 | 0.132 | 0.004 | 0.203 | 0.041 |
| | (0.051) | (0.036) | (0.050) | (0.035) | (0.043) | (0.033) | (0.101) | (0.062) |
| | [0.009] | [0.336] | [0.010] | [0.260] | [0.002] | [0.904] | [0.045] | [0.513] |
| After (36m) | 0.028 | 0.022 | 0.022 | 0.023 | 0.024 | -0.012 | 0.082 | 0.047 |
| | (0.012) | (0.011) | (0.010) | (0.012) | (0.026) | (0.013) | (0.043) | (0.037) |
| | [0.022] | [0.040] | [0.024] | [0.058] | [0.344] | [0.364] | [0.057] | [0.210] |
| Cumulative Effect (CUM) | 0.844 | 0.826 | 0.627 | 0.853 | 0.810 | -0.411 | 2.798 | 1.721 |
| | (0.466) | (0.399) | (0.379) | (0.444) | (0.978) | (0.463) | (2.203) | (1.361) |
| | [0.070] | [0.038] | [0.098] | [0.054] | [0.407] | [0.375] | [0.204] | [0.206] |
| Number of JCTCs | 7 | 14 | 7 | 14 | 7 | 14 | 7 | 14 |

Notes: See Table 4 notes.

**Table 7:** Effects of JCTCs on Employment Growth in Other States
ATE-IPW Estimator
JCTC Measured By Indicator Variable

| | Bordering States, Equal Weighted | | All Other States, Supplier-Trade Weighted | | 5 Closest States, Inverse-Distance Weighted | |
|---|---|---|---|---|---|---|
| | Delayed | Immediate | Delayed | Immediate | Delayed | Immediate |
| Before | -0.018 | 0.000 | -0.022 | 0.000 | -0.017 | 0.000 |
| | (0.010) | (0.000) | (0.015) | (0.000) | (0.006) | (0.000) |
| | [0.074] | [0.000] | [0.140] | [0.000] | [0.005] | [0.000] |
| At | 0.057 | -0.009 | 0.023 | -0.000 | 0.036 | 0.006 |
| | (0.033) | (0.042) | (0.013) | (0.011) | (0.043) | (0.046) |
| | [0.084] | [0.823] | [0.092] | [0.982] | [0.404] | [0.904] |
| After (36m) | 0.011 | 0.015 | 0.002 | 0.004 | 0.016 | 0.011 |
| | (0.010) | (0.012) | (0.004) | (0.004) | (0.012) | (0.013) |
| | [0.277] | [0.221] | [0.720] | [0.356] | [0.160] | [0.409] |
| Cumulative Effect (CUM) | 0.376 | 0.514 | -0.034 | 0.133 | 0.543 | 0.386 |
| | (0.341) | (0.439) | (0.184) | (0.149) | (0.418) | (0.494) |
| | [0.270] | [0.241] | [0.854] | [0.372] | [0.194] | [0.434] |
| Number of JCTCs | 7 | 14 | 7 | 14 | 7 | 14 |

Notes: Employment Growth in "Other" states defined by a weighted average of employment growth in other states. For "Bordering States," the weights are either $1/N_i$, where $N_i$ is the number of states bordering state $i$, for each bordering state and 0 otherwise. For "All Other States, Supplier-Trade Weighted," the weights are $p_{ij}/\sum_j^{50} p_{ij}$, where $p_{ij}$ is the value of commodity shipments from state $j$ to state $i$. For "5 Closest States, Inverse-Distance Weighted," the weights are $(1/D_{ij})/\sum_j^{50}(1/D_{ij})$, where $D_{ij}$ is the distance between the population centroids of states $i$ and $j$. See Table 4 notes and text for other details.

Table 8: Estimated JCTC Cost Per Job Created (CPJC)

| | Delayed States | Immediate States | All JCTC States |
|---|---|---|---|
| | (1) | (2) | (3) |
| Cost Per Job Created | $14,811 | $17,848 | $17,106 |
| | | | |
| Marginal Subsidy | $2,159<br>(15%) | $4,029<br>(23%) | $3,328<br>(19%) |
| Inframarginal Subsidy | $12,652<br>(85%) | $13,819<br>(77%) | $13,778<br>(81%) |

Notes: The dollar values in each column are based on equation (27) in the text and use average values for that group of states (Delayed-JCTC states, Immediate-JCTC states, and All JCTC states) for each component in the equation.