



Estimating Wal-Mart's Impacts in Maryland: A Test of Identification Strategies and Endogeneity Tests

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In this paper, I estimate the impact of Wal-Mart on labor markets in Maryland. My goal is to compare estimation techniques that incorporate corrections for endogeneity of Wal-Mart's entrance and those that test for and fail to reject exogeneity in Wal-Mart's entrance decision. The instrumental variable approaches I test include those offered by Basker and Neumark et al., and a new test introduced in this paper. I also explain why differences in choice of sample time and location may lead to different findings as to the impact of Wal-Mart. I find that there is weak evidence of endogeneity in Wal-Mart's entrance decision, but that the bias is opposite of that anticipated by most researchers. Most interestingly, there are no significant differences across instrumental variable techniques employed in the literature. As for Wal-Mart in Maryland, that exposure to Wal-Mart leads to lower retail employment (from zero to 414 retail jobs), but significantly higher retail wages (as much as \$1.95 per hour) at the county level. I also find that exposure to Wal-Mart has no effect on aggregate labor markets, though aggregate wages are positively affected, although the impact is very small (roughly \$160 per year). I recommend that Maryland adopt a policy neutral approach to Wal-Mart. *Eastern Economic Journal* (2008) 34, 56–73. doi:10.1057/palgrave.eej.9050002

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BACKGROUND

Wal-Mart's ubiquity has spawned considerable analysis from a variety of research traditions. Most of these studies assess the local economic consequences of Wal-Mart's entrance on employment, wages, and retail and wholesale structure. However, only a handful of these employ methods that effectively attempt to evaluate the incremental effects of a Wal-Mart on these variables. This leaves many important questions unanswered.

A central question to researchers is the problem of endogeneity within Wal-Mart's entrance decision. Simply, estimates of Wal-Mart's impact must be disentangled from growth in regions that were occurring or would have occurred anyway. Failure to do so potentially biases the estimates. To date, three approaches have been employed to account for endogenous entrance decisions in an estimation of the impacts on labor markets and retail structure. In this paper I review these methods, adding a fourth identification strategy based upon comments regarding Wal-Mart's entrance decisions made by a company executive. I also test endogeneity of Wal-Mart's entrance decision on several variables, which may be employed to choose location, timing, and date. I extend this analytical framework to the impact Wal-Mart may have on overall employment and wages.

I begin by reviewing the most recent studies that attempt to evaluate endogeneity and treat its presence econometrically. I then add to the identification debate by



introducing another identifying equation derived from evidence of Wal-Mart's entrance practices. My comparisons of these results are performed through an examination of retail labor markets (wages and employment) and overall labor markets. I conclude with recommendations for further analysis and policy considerations.

RESEARCH ON WAL-MART AND LABOR MARKETS

Research into Wal-Mart has taken many flavors. The dominant public policy analysis has focused on the local economic impacts, to include labor markets and retail structure.¹ The first of the econometric studies to empirically address endogeneity in Wal-Mart's entrance [Hicks and Wilburn 2001] analyzed a panel of 55 counties in West Virginia from 1988 to 2000. The authors excluded endogeneity of the Wal-Mart entrance decision by testing entrance timing and location on contemporaneous and lagged per capita income growth. This is similar to the technique employed by Franklin [2001], who examined the Wal-Mart Supercenter impacts on the structure of grocery stores in metropolitan areas. Both studies concluded empirically that Wal-Mart entrance decisions are independent of regional growth conditions. Also, these researchers offered anecdotal evidence that Wal-Mart is largely unconcerned with local economic conditions when making decisions to open new locations. This is largely consistent with Graff's [1998] description of Wal-Mart's entrance strategy.

Hicks and Wilburn [2001] found that the entrance of a Wal-Mart store led to a modest increase in the number of retail establishments, a permanent retail employment increase of roughly 54 workers, and no impact on retail wages. They also found that entrance of a Wal-Mart in a contiguous county reduces retail employment in a county.

However, this approach has been criticized for failing to include an endogeneity test within the estimation framework [Curs et al. 2004]. Also, criticism of the study region has been offered, as West Virginia is in general poorer and more rural than average [see www.preservationist.net/sprawl and Neumark et al. 2005].

A later study [Basker 2005a, b] performed a similar analysis of a much larger sample of US counties. Basker employed a clever instrument to control for endogeneity, using proxies of the planned entrance date for each store location. She reports that after an initial increase in retail employment, after roughly 3 years this dissipates to a roughly 55 worker increase, with a modest reduction in the number of small retail firms. Basker also found very modest impacts of Wal-Mart entrance on adjoining counties. The striking similarity of these employment findings to those of Hicks and Wilburn [2001] was noted by Villareal [2005].

Basker's work has been criticized for its choice of instruments [Curs et al. 2004; Neumark et al. 2005] and for its censoring of the sample (excluding sparsely populated counties, those with early Wal-Marts, and those with negative employment growth). This excludes virtually all of the counties with the most urgent and compelling policy concerns (Goetz and Swaminathan 2004). Further, failure to control for interstate fiscal differences may offer a different endogeneity concern as local governments in states with high levels of local financing may actively seek Wal-Mart stores [Wassmer 2002]. Of greater concern than these issues is the absence of a correction for spatial autocorrelation in the model providing concern of bias in the estimation results.

Goetz and Swaminathan [2004] estimated the poverty impacts of Wal-Mart's presence. This study is important in addressing a major criticism of Wal-Mart in general, and changing structural conditions perhaps evidenced by the increase in the number of Wal-Mart stores around the nation. Employing an instrumental variable estimation technique, which should account for some endogeneity concerns, the authors found that a new Wal-Mart, entering a county between 1987 and 1998 had a marginal impact of 0.002 percent on the county poverty rate, and that the stores that existed prior to 1987 increased the poverty rate by about half that amount.

There are two major concerns with this study. First, the magnitude of the poverty impact of Wal-Mart estimated by these authors is small at 0.099 percent for existing Wal-Marts and 0.204 percent for new Wal-Marts. Also, the assertion that the poverty result implies an externality of exchange at Wal-Mart is weak. Both this study and Basker's [2005a, b] were found to have employed data that contained several errors in store timing dates [see Neumark et al. 2005].

Neumark et al. [2005] offer a novel identification strategy to overcome the endogeneity concerns. Their reading of Sam Walton's autobiography noted that the expansion of new Wal-Marts included a specific geographic concern over distance from existing managerial infrastructure (they also provide compelling visual illustration in their graphing of the expansion of Wal-Mart towards the coasts from Arkansas). This pattern was also noted by Graff [1998] in his comparative study of location strategies of Wal-Mart and Kmart. These authors incorporate this strategy into their estimation using a time and distance function (from Bentonville, Arkansas) to identify the equation upon which they test Wal-Mart's effect. Using national data received directly from Wal-Mart, these authors found that retail employment declines 2–4 percent (with significant geographic variability) and that payrolls per worker may also decline. This study has been editorially criticized, by at least one economist, for the implausibility of its finding that Wal-Mart is associated with significant nominal wage declines across the entire county labor market Reynolds [2005].

Global Insight [2005] conducted a national study of retail wages and employment, testing for exogeneity as did Hicks and Wilburn [2001] and Franklin [2001]. They failed to reject exogeneity in Wal-Mart's location decision. Subsequently, they employ a structural model of county level retail employment and wages, reporting net employment increases in the long run of about 100 workers, and nominal wage declines of roughly 2 percent. They also found, as did Hausman and Leibtag [2005] and Basker [2005b], that Wal-Mart has a considerable price effect on grocery and other retail goods within the county it locates. They concluded that this effect led to a real wage increase for retail workers despite reductions in their nominal wages.

Dube et al. [2005] performed a test of Basker's data, using Neumark, Zhang and Ciccarella's instruments on a model of rural and urban retail wages from 1992 to 2000. They found that wages for the retail sector in urban areas fall by less than a percent when a county is exposed to a Wal-Mart. However, they found that in rural settings retail wages may increase concomitant with a Wal-Mart entrance.

Sobel and Dean [2005] tested the impact of Wal-Mart on the composition of small businesses employing both detailed cross-sectional and a spatial autoregressive estimates. The authors found no reduction in small businesses attributable to Wal-Mart, a finding similar to Basker's [2005a, b] result. This study is particularly interesting in that it addresses, specifically, the impact on small businesses, using spatial methods of analysis.

Table 1 summarizes the findings of studies that consider endogeneity in their estimation.

One clear conclusion to be drawn from these studies is that variations in the identification and treatment of endogeneity, specification of the model, or the sampled time and location lead to different conclusions about Wal-Mart's impact on labor markets.

THREE STYLIZED DESCRIPTIONS OF WAL-MART'S EFFECTS

The theoretical treatment of Wal-Mart by all of these studies has been heuristic, as it provides a fairly basic treatment of common economic theory. However, understanding how the change in consumer demand follows Wal-Mart's entrance may help explain some of the divergent results. There are three stylized descriptions of Wal-Mart effects that may occur during retail market adjustment periods.

First, if Wal-Mart enters a market and significantly lowers prices (as Hausman and Leibtag, [2005] and Basker, [2005b] conclusively find), consumers will experience an income effect for retail goods. If the income effect is positive — as it almost certainly is — then it is indeed plausible that consumer demand for retail goods would rise, leading to higher net employment and incomes in the retail sectors.

Second, if Wal-Mart enters a market attracting clusters of retail firms then there could be considerable cross-county shopping and an observed increase in net employment, wages, and firms in a Wal-Mart county. This effect would likely dominate among early Wal-Marts with a dissipating impact as the retailer becomes more saturated (in adjoining counties). A prediction in this case would be that surrounding counties lose retail employment as the migration to clusters occurs.²

Third, Wal-Mart's much noted increase in labor productivity should lead to lower retail employment (as fewer workers produce more goods and service). However, theory strongly suggests that the effect of increased productivity is higher wages.

These three results suggest that researchers looking at different times and locations may well find different results due not to methodological discrepancies but to actual variations in the adjustment mechanism to Wal-Mart. Studies by Hicks and Wilburn [2001], Basker [2005a, b], Hicks [2005, 2007a], Neumark et al. [2005], Dube et al. [2005], and Sobel and Dean [2005] may all be correct, albeit clearly not generalizable. Thus the choice of location and timing of the sample period may play a critical role in the estimation results of Wal-Mart's impact on labor markets. Further, the type of endogeneity may vary across regions and time; hence it is useful to isolate analysis to smaller geographic and temporal periods.

ENDOGENEITY TESTS AND IDENTIFICATION STRATEGY

The concern regarding econometric estimates of Wal-Mart's net impact on employment, earnings, retail structure, and overall labor markets is the manner in which Wal-Mart chooses to locate. The concern is that Wal-Mart may make market entrance timing and location choices depending upon some variable, say local incomes, population density, or proximity to key wholesalers. If this is the case (at the county level) then econometric estimates of the subsequent impact of Wal-Mart on any of these factors will suffer statistical bias. More specifically, if Wal-Mart is intentionally entering markets that are growing then estimates of its impact on such

Table 1 Studies of labor markets

<i>Author</i>	<i>Study design</i>	<i>Findings</i>	<i>Consistent with theories of:</i>
Hicks and Wilburn [2001]	Time space recursive panel model of 55 WV counties, 1988–2000, annual data	Increase in employment by roughly 54 retail jobs, small increase in firms, no wage impact	Income effect, retail clustering
Basker [2005a, b]	IV panel of 1,700 larger US counties, 1977–2000	Increase in employment by roughly 50 retail jobs, partially offset by loss of 10 wholesale jobs, and small (1–3) reduction in retail firms	Income effect, retail clustering
Hicks [2005a, b]	A panel of eight Pennsylvania counties with a Wal-Mart entrance in 2002. Estimate of labor market impacts using Quarterly Workforce indicators	A roughly 50 worker net increase in retail sector and a \$0.50 per hour increase in new hire wages.	Income effect, retail clustering
Global Insight [2005]	Structural model of all US counties, 1969–2003	Increase in employment, decrease in nominal wages	Income effect, retail clustering
Neumark et al. [2005]	IV panel of all US counties, 1977–1995. Estimate of retail wage and employment, and total earnings and employment at the county level	Decline in retail employment of 2–4%, evidence of retail wage decrease, increase in overall employment, but decrease in overall real wages	Productivity increase
Dube et al. [2005]	IV of selected US counties, 1992–2000	Find wage decrease in urban retail markets following Wal-Mart entrance, and possible wage increase in rural areas.	Income effect, productivity effect
Sobel and Dean [2005]	Cross-sectional and SAR test of US states	Finds no Wal-Mart impact on small businesses	Income effect

factors as retail employment and number of retailers will be overstated as $E(e_{i,t}|X) > 0$. Similarly, if Wal-Mart is targeting entrance in slower growing regions then the error term will be biased as well, resulting in econometric estimates of negative impacts to growth.

The literature provides three mechanisms for testing for, and correcting, endogeneity in the Wal-Mart entrance. The first route of research was to test the entrance of Wal-Mart on county-level growth and prosperity. These studies report no relationship between Wal-Mart's actual entrance and levels or changes in pre-existing economic conditions in a region [see Franklin 2001; Hicks and Wilburn 2001; Global Insight 2005]. The second set of papers [Basker 2005a, b; Hicks 2005, 2007a] used a measurement of the lag between announced and actual openings of Wal-Mart's within individual counties to instrument the impact estimates. Basker's ingenious method proxied announcements of Wal-Mart openings matched to actual opening data, while Hicks simply used one or two period leads of Wal-Mart's entrance. The third approach employed information from Sam Walton's biography to posit that Wal-Mart entrance was based upon geographic managerial reach. This approach suggests identification of Wal-Mart through a time/distance function from its corporate headquarters [Neumark et al. 2005]. Dube et al. [2005] also employ this method.

Each approach is open to potential criticism. The first approach [Franklin 2001; Hicks and Wilburn 2001; Global Insight 2005] individually tests for only one measurement of endogeneity, potentially omitting the correct choice variable. In the second approach, Basker's [2005a, b] data have been demonstrated to have significant errors, and also does not preclude the possibility that the economic conditions extant when Wal-Mart is in the planning stages are different from the entrance conditions.³ Finally, the approach offered by Neumark et al. [2005], while seemingly capturing the apparent entrance pattern of Wal-Mart nationwide, yields estimates that are, in magnitude, difficult to accept (e.g., Wal-Mart having large impacts on aggregate county-wide labor markets). Yet another criticism of several of these papers is the use of a national sample of counties when the impact of Wal-Mart may well vary regionally. Of course the papers focusing on smaller regions, or a single state such as Hicks and Wilburn [2001] and Hicks [2005, 2007a] are not immediately generalizable to the nation as a whole. To date, a clear empirical understanding of Wal-Mart's impact has yet to emerge.⁴

Unfortunately, each of the papers noted above ask different questions or employ different data (either regionally or over time) or experience sufficiently different specifications that direct comparison of their methods is not possible. This paper will undertake a comparison of these approaches, adding another instrumental approach motivated by a conversation involving a Wal-Mart executive, who identified market size as a potential selection variable for market entrance.⁵ This motivates yet another instrument to identify Wal-Mart's market entrance decision.

To identify the Wal-Mart entrance decision, I construct a regional income variable for each county in our sample, which is $\sum_{j=1}^n PI_j + PI_i$, where regional market size in county i is the sum of personal income in j , adjoining counties and personal income in county i , in real terms. Thus, as an identification strategy comparison, I construct two models to which are applied four different techniques. These are ordinary least square (OLS) and three instrumental variable approaches: a derivative of Basker's instrument, an instrument nearly identical to Neumark et al. [2005], and the market size instrument.



DATA AND MODEL

The region we study is Maryland's 23 counties from 1988 to 2003, capturing a pre-Wal-Mart baseline through the most recently available data. All of the Wal-Mart data are provided by Wal-Mart in two consecutive data releases, the most recent being a public data release of store-specific data coincident with the November 4, 2005 economic conference.⁶ These data include store location, entrance data, and type. The economic data were collected from the Regional Economic Information System.

Wal-Mart exposure variables were constructed in a manner suggested by Neumark et al. [2005] as the weighted year exposure value, where years of exposure (following initial entrance) are additive across subsequent (or same year) entrance. Adjacent Wal-Mart measures are this variable weighted by the first-order contiguity matrix, which is simply the mean exposure for the j contiguous counties to county i of the data. Other researchers have employed either Wal-Mart presence dummies [Hicks and Wilburn 2001; Hicks 2007b] or lag polynomial of entrance, with a 5-year lead component [Basker 2005a, b]. Each of these treatment variables measure different aspects of Wal-Mart's presence. I will employ the weighted exposure variable, despite its linear restrictions, as a representation between the presence impact at equilibrium, and the phased exposure measurement employed by Basker. A graphical depiction of these variables appears in Figure 1.

Summary statistics for the relevant variables appear in Table 2.

The econometric model I employ in this analysis attempts to provide a treatment model approach to estimating Wal-Mart's impact. In this model, the dependent variable is estimated through county fixed effects, an intercept, an exposure variable, and a one-period autoregressive component providing a simple treatment/control model devoid of control variables. The OLS estimate of the approach is formally

The model

$$(1) \quad \Omega_{i,t} = \alpha + \sum \alpha_i + \beta_1 WM \exp_{i,t} + \delta \theta_{t-1} + e_{i,t}$$

where $\Omega_{i,t}$ is the dependent variable of interest; $\alpha + \sum \alpha_i$ are the common intercept and cross-sectional fixed effects. The $WMexp$ and remaining named variables have been explained, above, with the one-period autoregressive element and random error, which is assumed to be $e_{i,t} \rightarrow iid N(0, \sigma^2)$.

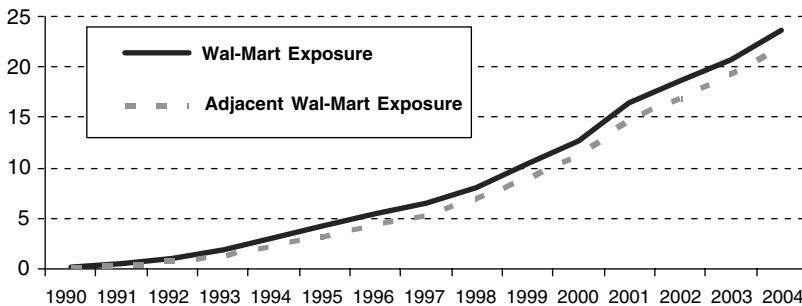


Figure 1. Mean county Wal-Mart exposure (in cumulative years since entrance)

Table 2 Selected summary statistics

	<i>Mean</i>	<i>Median</i>	<i>Maximum</i>	<i>Minimum</i>	<i>Std. Dev.</i>
Wal-Mart exposure	2.583123	0	96	0	8.331636
Adjacent Wal-Mart exposure	2.174482	0	45	0	5.270795
Retail employment	14,637	5,817	87,134	597	21,225
Retail income (\$1,000's)	222,937	65,595	2,054,295	3,756	391,903
Pull factor (adjusted) ^a	0.009	0.009	0.02	-0.001	0.007
Population (2003)	55,522	34,562	136,941	19,483	37,325

^aThe pull factor is the share of retail employment 'pulled' from adjoining counties. It is expressed in a number of ways.

ENDOGENEITY AND INSTRUMENTATION

As detailed above, the OLS estimate potentially suffers from endogeneity in the Wal-Mart entrance. This is an empirical question, though as with an appropriate choice of an instrument, may never meet with widespread acceptance. I will attempt to test an endogeneity hypothesis by estimating the impact of several local economic and growth variables on Wal-Mart's entrance into a county. This has been done before [Hicks and Wilburn 2001; Franklin 2001; Global Insight 2005], but has been criticized for a limited variable selection. I construct a simple entrance model:

The endogeneity test

$$(2) \quad WMENT_{i,t} = \alpha + \sum \alpha_i + \beta X_{i,t-1} + e_{i,t}$$

where the dependent variable WMENT is a count variable of Wal-Mart's entrance (with a basic store or Supercenter) in time t , which is tested on α , a common intercept and a cross-sectional dummy, and $X_{i,t-1}$, the county-wide variable posited to generate an entrance choice decision. This model was tested using both OLS and probit specification.

In the presence of endogeneity, an instrument variable approach is recommended, but suffers from the typical concern of finding an instrument that is contemporaneously uncorrelated with the error term but correlated with the regressor (here I am primarily concerned with Wal-Mart exposure). As noted, three approaches have been employed in the literature: a direct exogeneity test followed by OLS, a proxy for entrance timing, and a time/distance function of annual time and distance from Wal-Mart headquarters (in Benton Arkansas).

The goal of this paper is to provide a systematic comparison of results from these three approaches and a fourth method, the market size which is presented here for the first time. Importantly, this paper is not a direct replication of the existing techniques, which is impossible due to variations in the model specifications and samples, but rather attempts to honor the approach of the earlier studies. To do this I provide the following identifying equations.

Time distance instrument

$$(3) \quad \Omega_{i,t} = \alpha + \sum \alpha_i + \delta_1 DIST_i + \delta_2 (DIST_i \cdot T) + e_{i,t}$$

in which the dependent variable is identified through a cross-sectional fixed effect (common to each instrument), and a distance and time/distance equation with random error term. Notably, the distance value is travel distance in my estimates.

Planned entrance instrument

$$(4) \quad \Omega_{i,t} = \alpha + \sum \alpha_i + \delta_1 WMENT_{t+2} + e_{i,t}$$

where planned entrance is proxied through a two-period lead of actual entrance, a method designed to mimic Basker's [2005a, b] technique. Again, due to data errors in her original work, direct replication is not possible.

Market share instrument

$$(5) \quad \Omega_{i,t} = \alpha + \sum \alpha_i + \delta_1 \left(\sum PI_{j,t} + PI_{i,t} \right) + e_{i,t}$$

where the market share is the sum of real personal income in county *i*, and *j* adjoining counties in time *t*, for each county.

I stress that these models are not exact representations of Basker [2005a, b] and Neumark et al. [2005]. Basker employed estimated entrance dates (drawn from store numbers), while I simply use a two-period lag entrance for the identifying equation. Similarly, NZC employed the GIS software to develop a Mahalonbis distance function from counties to Bentonville, Arkansas. I use driving distance to the central county zip code employing commercial mapping software.

These models provide the basis for estimation of Wal-Mart's impact on total and retail employment and wages at the county level. The data do not appear non-stationary, although the sample period is so brief as to generate caution on any appropriate test for a unit root. I correct for cross-sectional heteroscedasticity using White's [1980] method.

RESULTS OF THE ENDOGENEITY TEST AND INSTRUMENT CHOICE

My tests of exogenous entrance decisions by Wal-Mart (as outlined in equation (2)) were tested on 15 factors that potentially influence the timing and location of Wal-Mart's entrance. The results appear in Table 3.

Interestingly, only personal income growth rates rise to the traditional minimum level of statistical significance, although per capita personal income and population enjoy sufficient statistical significance to give pause. Interestingly, Hicks and Wilburn [2001] tested entrance on this metric, and failed to reject exogeneity in the entrance decision. There are two implications from this finding. The first is that some potential endogeneity cannot be ruled out, and so consideration of an instrumental variable approach is warranted. Second, the direction of endogeneity suggests that the absence of the correct instrument will bias the findings towards opposite to the typically assumed direction. Since Wal-Mart entrance is negatively correlated with the income growth measures, direct estimates of Wal-Mart's impact would be biased towards lower positive or greater negative impacts than would be the case. Thus, estimates of Wal-Mart's impact based on OLS estimates, such as Hicks and Wilburn [2001], Franklin [2001], and Global Insight [2005] do not

Table 3 Entrance model (all values are prior year entrance)

	<i>Coefficient</i>	<i>t-statistic</i>	<i>R</i> ²	<i>F-statistic</i>
Real earnings per worker	1.05	1.13	0.10	1.51*
Real per capita personal income	0.0005	0.77	0.09	1.47*
Real personal income	2.10E-06	1.26	0.10	1.62*
Real earnings	2.84E-06	1.29	0.10	1.74*
Population	1.69E-06	1.63	0.10	1.73**
Big-box stores per capita ^a	-2387	-1.06	0.11	1.67*
Pull factor	6.71	1.45	0.10	1.76**
Real per capita personal income growth rates (one year)	-1.27	-1.58	0.11	1.83**
Real personal income growth rate (one year)	-1.40*	-1.90	0.11	1.86***
Population growth rate (one year)	-1.49	-1.28	0.10	1.60*
Change in pull factor, <i>t</i> to (<i>t</i> -3)	10.62	1.23	0.10	1.76*
Number of Big-box retailers	-0.006	-0.95	0.21	2.05***
Total employment	1.79E-06	1.00	0.09	1.66*
Adjacent Wal-Mart or supercenter	-6.9E06	-0.003	0.09	1.76*
Existing Wal-Mart or supercenter	-0.014	-0.847	0.09	1.79*

^aBig-Box stores are those retail stores having more than 100 employees.

Note: ***Denotes statistical significance at the 0.01 level, **denotes statistical significance at the 0.05 level, *denotes statistical significance at the 0.10 level, and ~ denotes statistical significance at the 0.15 level.

apparently overstate the impact of Wal-Mart due to endogeneity. One simple caveat is that, of these three, only the Global Insight study evaluated Maryland. There may well be large geographic differences in the impacts that cross state or regional borders. Also, this does not imply that Wal-Mart is not choosing locations at random (or otherwise), only that their choice of county in Maryland is potentially endogenous to personal income growth. It is far more likely that their location decisions within a county are dealt with more carefully.⁷

The instrumental variable approach is insightful, both with respect to the question at hand — the impact Wal-Mart has on labor markets — and also because of the comparative results across instruments and the OLS approach. Perhaps the most compelling feature of the findings reported in this paper is that there are no meaningful differences across instrumental choices in each of our sets of models, for each question.

In the model, the differences in the estimates of Wal-Mart's impact vary from between 6 and 9 percent (falling well within a modest confidence interval for each instrumental variable estimate). The point estimate differences within the structural model are larger, but again are not statistically different at any level of significance.

Differences between the instrumental variable estimates and the OLS model are somewhat larger (although a first impression is the strong similarity across techniques). However, there is no symmetry in the directional difference of the estimates. Where the fourth approach estimates negative impacts of Wal-Mart, the OLS approach concurs, but finds these impacts are smaller (in absolute value) than the fourth estimates. Where the fourth approach finds positive impacts, again the OLS estimate is positive, but smaller than any of the fourth estimates. This is highly consistent with the reported direction of endogeneity in the test outlined in equation (2). Within the model, the fourth and OLS estimates, all Wal-Marts enjoy high levels of statistical significance.

Two alternative versions were performed. The first model includes county/year effects, which yielded modestly different coefficient estimates from the original

model. This model performed far less well, exhibiting considerable autocorrelation, and is therefore not discussed at length because of potential bias in the estimates. Table A1 displays an abbreviated version of these results. The second model includes a correction for spatial autocorrelation, which is defined as $\tilde{W}_i \Omega_{j,t}$, the first-order contiguity matrix \tilde{W}_i of adjacent county values of the dependent variable $\Omega_{j,t}$. In this model the retail employment and income impacts of Wal-Mart largely dropped from statistical significance, meeting even modestly acceptable levels in only the OLS estimates.⁸

The impact on aggregate labor markets perhaps tells a more important story about the role Wal-Mart plays in local economies than does retail employment. While retail employment may decline, the aggregate impact is far more important than the sectoral shifts of the kinds discussed above. To evaluate this question I also estimated aggregate employment and incomes at the county level using the same model. Again, the results across instrument types were markedly similar, with only the OLS estimate deviating from the consensus results across the three instruments.

In general then, the findings reported in this paper suggest that the choice of instrument (across these three methods) plays no more than a modest role in assessment of the impact. Also, the use of an OLS estimator tends to understate (in absolute value) the impact of Wal-Mart on labor market. A discussion of the magnitude of these variables follows.

WAL-MART'S IMPACT ON RETAIL LABOR MARKETS

Estimates of wage and employment impacts require some interpretation. Since I employ a Wal-Mart exposure variable, understanding the magnitude of the impacts to both variables requires some interpretation and caution. First, this exposure measure implies a linear increasing impact of Wal-Mart. This is a restrictive assumption, whose greatest benefit is that it accounts for both a non-instantaneous convergence to equilibrium and the cumulative impact of subsequent Wal-Mart entrances in a county. The latter effect accounts for a plurality of entrants, especially in the more recent years. Basker [2005a, b] offers some evidence of the convergence of employment. In her polynomial estimates she finds the post-entrance adjustment for employment ends between 1 and 2 years following the entrance of a Wal-Mart. Other impacts in the retail sector follow a similar pattern. Happily, this is sufficiently similar to the mean exposure variable (2.38) to suggest that multiplying the coefficient in the regressions times two provides a rough estimate of county-wide Wal-Mart impacts on the retail trade sector. The impact is between 228 and 414 jobs (see Table 4).

Wage increases range between \$1.07 per hour and \$1.94, with the low range increases being the OLS estimates, and the higher range wage increases associated with the fourth approach. County-wide retail employment losses range from 248 to 408 workers.⁹ These impacts are consistent with expectations of employment dynamics under a period of increasing labor productivity. Wage increases and employment declines are *ceteris paribus* results of increasing marginal product of labor. Virtually all studies of Wal-Mart suggest that this is a dominant effect of the retailing giant.¹⁰

One caution is the inevitable weakness of the data. These data include retail employment which does not distinguish between full and part time employment. Thus, the wage gains and employment declines could result from either pure

Table 4 Retail employment

	OLS	Instrumental variable		
		Planned Ent.	Market size	Time/distance
C	18407.82***	19078.05***	19197.59***	19114.65***
Wal-Mart exposure	-124***	-194***	-207***	-198***
AR(1)	0.767001***	0.768708***	0.770469***	0.769485***
Adjusted R^2	0.99	0.99	0.99	0.99
s.e. of regression	2364.92	2381.13	2385.00	2382.87
Durbin-Watson stat.	2.08	2.15	2.16	2.15

Note: ***Denotes statistical significance at the 0.01 level, **denotes statistical significance at the 0.05 level, *denotes statistical significance at the 0.10 level, and ~ denotes statistical significance at the 0.15 level.

Table 5 Retail earnings

	OLS	Instrumental variable		
		Planned Ent.	Market size	Time/distance
C	178.447***	171.041***	169.70***	169.664***
Wal-Mart exposure	1.123***	1.883***	2.012**	2.015***
AR(1)	0.820912***	0.828519***	0.83689***	0.836724***
Adjusted R^2	0.87	0.86	0.86	0.86
s.e. of regression	11.12	11.41	11.51	11.51
Durbin-Watson stat.	1.87	1.94	1.95	1.95

Note: ***Denotes statistical significance at the 0.01 level, **denotes statistical significance at the 0.05 level, *denotes statistical significance at the 0.10 level, and ~ denotes statistical significance at the 0.15 level.

productivity increases or a shift of employment from part to full time (increasing the numerator and decreasing the denominator of the wage equation) (see Table 5).

I also test the robustness of these estimates by running separate models on MSA/non-MSA counties in Maryland. In these urban/rural models, I find that the employment impact is (not surprisingly) universally larger in urban areas. However, the wage increases in rural areas are significantly larger than those in urban areas. They are also consistent with the findings of Dube et al. [2005].

Thus, these estimates suggest impacts that are modestly suggestive of the much reported productivity gains associated with Wal-Mart (higher wages and lower retail employment). Comparison of these findings with those from the aggregate labor markets is the most useful finding for policymakers.

WAL-MART'S IMPACT ON AGGREGATE LABOR MARKETS

Each of the stylized theories of potential impacts of Wal-Mart on retail labor markets discussed earlier offer the possibility that aggregate employment within a county will be unaffected by Wal-Mart's presence. In short, that is what I have found (see Table 6).

Table 6 Aggregate employment

	OLS	Instrumental variable		
		Planned Ent.	Market size	Time/distance
C	-127,286	48,582**	49,729	45,563
Wal-Mart exposure	53.16	-17.75	-0.25	8.79
AR(1)	1.008***	0.97***	0.97***	0.97***
Adjusted R^2	0.99	0.99	0.99	0.99
s.e. of regression	3301	626	627	627
Durbin-Watson stat.	1.28	1.35	1.35	1.34

Note: ***Denotes statistical significance at the 0.01 level, **denotes statistical significance at the 0.05 level, *denotes statistical significance at the 0.10 level, and ~ denotes statistical significance at the 0.15 level.

Across the instrument choice I find no net impact of Wal-Mart on employment within a county. While the coefficient estimates were all positive, none of these estimates approached statistical significance of any acceptable level. However, the OLS estimate was statistically significant, and sufficiently large as to give pause, especially in that the estimate was of a loss of 375 jobs. However, given the stark difference between the OLS and instrumental variable techniques, I believe most econometricians would heavily discount the usefulness of OLS in this setting.

As a robustness test I included the rural/urban county estimates as with the retail markets. Here the results indicate that job losses in rural areas are not noted as a consequence of exposure to Wal-Mart. With the exception of the OLS estimate (which was statistically acceptable, but pointed to a loss of 40 jobs), none of the remaining estimates were of both magnitude and statistical certainty to suggest any impact of Wal-Mart in rural areas.

The urban estimates found a consistent pattern of large, but statistically uncertain positive impacts of Wal-Mart, except for the OLS estimate, which was negative, large (a potential loss of 140 jobs), and statistically trustworthy.

In terms of net employment impacts, it seems likely that Wal-Mart has no noticeable effect on aggregate labor markets in Maryland. While there may be employment losses in retail, the net impact is statistically indifferent from zero.

I find income impacts of Wal-Mart at the county level ranging from about \$160 per worker across the instrumental variable estimates. The OLS estimate suggests no impact. These results are in addition to any potential income effect noted by Hausman and Leibtag [2005] and Basker [2005a, b]. A rough sketch of these impacts provides some magnitude of the impact. For the average resident of Maryland, the range of this impact is from an additional \$0.34 to \$0.39 per hour wage increase following the second year after Wal-Mart's entrance. These results suggest that Wal-Mart is affecting local labor markets, perhaps resulting in a tighter demand for workers as suggested by Keil and Spector's [2007 analysis of Alabama (see Table 7).

Not surprisingly, these results differ across rural and urban counties. In urban counties, the wage impacts lose statistical reliability (although the estimated impacts are generally about the same). However, the impacts in rural counties are much more statistically reliable and more than twice as large as the impacts in the aggregate models. In short, exposure to Wal-Mart is causing rural wages to increase, on average in a county, from \$0.75 to \$0.90 per hour. Again, this rather large effect

Table 7 Real earnings per worker (aggregate labor markets)

	<i>Instrumental variable</i>			
	<i>OLS</i>	<i>Planned Ent.</i>	<i>Market size</i>	<i>Time/distance</i>
C	0.19***	−0.34	−4.65	−1.09
Wal-Mart Exposure	0.00007	0.00085**	0.0009**	0.0009**
AR(1)	1.039***	1.004***	1.00***	1.00***
Adjusted R^2	0.98	0.98	0.98	0.98
s.e. of regression	0.006	0.007	0.007	0.007
Durbin–Watson stat.	1.85	1.79	1.77	1.78

Note: ***Denotes statistical significance at the 0.01 level, **denotes statistical significance at the 0.05 level, *denotes statistical significance at the 0.10 level and ~ denotes statistical significance at the 0.15 level.

is separate from the real price impact of lower priced goods. These findings are useful, particularly when compared to findings from earlier studies.

A COMPARISON OF THESE FINDINGS WITH EARLIER STUDIES

At the outset of this study, we note the lack of concordant findings with regard to Wal-mart's impact on labor markets. This is unfortunate, and exacerbated by the presence of a large number of studies using methods that cannot account for net impacts, or studies sponsored by advocacy groups either for or against Wal-Mart.¹¹

Only two studies reviewed here found negative nominal wage impacts [Neumark et al. 2005; Global Insight]. The remaining studies find either small positive or no wage impacts attributable to Wal-Mart. One study that did not engage in extensive treatment of endogeneity (and was not discussed) analyzed labor market impacts in Alabama and concluded that there was tightening in labor markets, which led to a reduction in the black/white unemployment rate gap (although it had not yet influenced wages).

Importantly, none of these studies provide useful insight into the impact of Wal-Mart on non-wage compensation. This inability to speak to benefits is one of the more important public policy discussions underway (with Maryland engaging most heavily in the legislative effort), suggesting that more comprehensive analysis of this question is necessary.

The findings I report in this study fall within the range of the existing studies, but do not resolve some of the outstanding questions of labor market results. This may be due to the ambiguities described in the stylized theoretical explanation for Wal-Mart impacts offered earlier.

CONCLUSIONS

It seems likely from the results presented in this study that economists have considerable additional questions to ask about the retail giant Wal-Mart. I have attempted however, to offer an explanation of why such seemingly straightforward questions remain unanswered, and why such fine economists as Emek Basker, David



Neumark, and Russell Sobel might find very different results when examining the same data.

My tentative findings suggest that the choice of identification strategy, from among the three options described above, yields indistinguishably different results, and the OLS estimates yield similar estimates as well. This is heartening, as it suggests that the instrument choice is appropriately modeling Wal-Mart's entrance decisions.

To reiterate, I find that retail labor markets are responding to Wal-Mart as if they are experiencing traditional productivity gains. That is, there are fewer retail jobs, but they pay higher wages (both nominally and in inflation adjusted terms) than they did before Wal-Mart or in areas without a Wal-Mart. The employment impacts are equivalent to about one Wal-Mart store (or Supercenter), and the wage gains are significant (as much as \$1.98 an hour for retail workers over other regions).

Most importantly from a policy standpoint, the aggregate labor markets experience no significant employment impacts from Wal-Mart. While retail jobs may disappear, the net employment level remains unchanged. However, for workers in counties with a Wal-Mart, wage increases (about \$160 per year per worker) accompany exposure to Wal-Mart. This finding is consistent with tighter labor markets (among other explanations).

However, there is much more necessary analysis. I believe that further geographic analysis coupled with a better understanding of the adjustment period to a new Wal-Mart are fruitful areas of analysis. Further, a better understanding of non-wage compensation is critical to developing a good understanding of Wal-Mart's impact.

One unambiguous conclusion of the results presented in this study is the strong policy inference of these results for state and local governments to adopt a policy neutral approach to Wal-Mart. Not only are some of the most important questions regarding Wal-Mart (i.e., the non-wage compensation) unattended by economists, the widely held notion that a Wal-Mart drives down wages and employment is simply not the finding of a majority of serious studies on the subject. Thus public policy efforts designed to compel changes to Wal-Mart's behavior are, at the very best, quite premature. It is as likely that such policies as Maryland's Fair Health Care Act and others like it may be counterproductive to their stated goals of promoting prosperity for individual workers.

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Notes

1. For non-econometric studies see Artz [1999], Artz and McConnon [2001], Barnes and Connell [1996], Franz and Robb [1989], Hornbeck [1994], Ketchum and Hughes [1997], McGee and Gresham [1995], Stone [1988, 1995, 1997], and Stone et al. [1992].
2. The real estate research literature describes this as demand externalities. See Eppli and Benjamin [1994]. This is also highly consistent with the findings of Hicks and Wilburn [2001] and Basker [2005a, b].



3. Basker painstakingly reproduced data on Wal-Mart from commercial maps that suffered unanticipated errors; these errors were not identified until Neumark, Zhang, and Cicarella (NZC) [2005]. Dube and Jacobs [2005] employed NZC's instrument on Basker's data and found similar results to those of NZC. Hicks [2005, 2007a] employed an instrument similar to Basker's on Ohio counties and found similar (though not directly comparable) results to Basker. Hicks' paper could be viewed as suffering the same identification critique as those leveled at Basker by, among others, Neumark et al. [2005].
4. Generalizability of these results to large regions may also not be possible given the heterogeneity in local fiscal structure as noted by Wassmer [2002].
5. In a December 6, 2005, radio broadcast on WUNC, the North Carolina Public Broadcasting show, 'The State of Things,' Glen Wilkins, community affairs manager for the southeast region of Wal-Mart, identified market size as a location choice consideration. Graff [1998] suggests that location decisions for Supercenters are expressly linked to mid-sized towns in less densely populated areas proximal to other Wal-Mart stores (where the firm is already known).
6. The November 4, 2005 conference, hosted by Global Insight, was memorable for the opportunity several of the paper presenters had to explain endogeneity to the national media representatives.
7. Several discussions with local developers over the past few years led me to believe that two important facets of Wal-Mart entrance bear into the choice of instrumentation. First, Wal-Mart is not choosing locations, but rather choosing developers to choose locations. There are many different developers, even within the same geographic regions. Second, the intra-county location choices seem to matter more to the developers than the inter-county choices.
8. These results are available from the author.
9. Interestingly, this corresponds to my observations when first speaking publicly about my Wal-Mart at a Richmond FRB conference in rural West Virginia, I was told that a new Wal-Mart hired workers in town by offering Kmart workers \$1 more an hour in the parking lot during shift change. This range is somewhat larger than my estimates of new hire wages in selected Pennsylvania counties 2001–2004 [see Hicks 2007b].
10. The rather high adjusted goodness of fit in these models is most likely due to the very high intertemporal correlation captured by the autoregressive component.
11. Many studies, particularly those provided to local governments, estimate local fiscal effects of a new Wal-Mart (or other similar retail outlet) focusing on a very small region. These studies are designed to answer very specific questions and so any criticism of them should be viewed within this light.

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Appendix

Table A1 Coefficient values in models with time-state dummy (Coefficients for Wal-Mart exposure only, *t*-statistics in parentheses)

	<i>OLS</i>	<i>WMENT</i>	<i>Time Dist.</i>	<i>Mktshare</i>
Retail employment	−60 (−0.81)	−76 (−0.32)	−60 (−0.81)	−232 (1.32)
Retail income	0.37 (4.87)	−0.62 (−0.55)	1.34 (1.90)	4.64 (2.27)

Table A2 Coefficient values in retail employment urban/rural models (Coefficients for Wal-Mart exposure only, *t*-statistics in parentheses)

	<i>OLS</i>		<i>WMENT</i>		<i>Time Dist.</i>		<i>Mktshare</i>	
	<i>Urban</i>	<i>Rural</i>	<i>Urban</i>	<i>Rural</i>	<i>Urban</i>	<i>Rural</i>	<i>Urban</i>	<i>Rural</i>
Retail employment	−140 (−3.34)	−40 (−2.60)	−221 (−3.10)	−64 (−2.96)	−220 (−3.12)	−67 (−3.11)	−231 (−3.17)	−67 (−3.09)
Retail income	0.89 (3.19)	1.83 (4.38)	1.65 (3.01)	2.87 (3.65)	−4.48 (−0.25)	1.15 (0.61)	1.75 (2.97)	3.17 (3.45)
Medicaid	8.15 (2.26)	−0.82 (−0.59)	13.88 (2.65)	7.12 (1.99)	11.58 (2.05)	6.75 (1.93)	11.78 (2.11)	7.80 (2.04)
Foodstamps	−1.25 (−1.62)	−0.48 (−2.30)	−2.01 (−2.27)	−0.61 (−2.13)	−2.12 (−2.30)	−0.63 (−2.19)	−2.15 (−2.30)	−0.65 (−2.20)

