NBER WORKING PAPER SERIES

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Working Paper 18238
http://www.nber.org/papers/w18238

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
July 2012

The authors thank Pinka Chatterji for helpful comments. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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JEL No. I11,J2,J3

ABSTRACT

Autism is a developmental disorder characterized by impairments in social interaction, communication, and restricted or repetitive behaviors. This previously rare condition has dramatically increased in prevalence from 0.5 in 1000 children during the 1970s to 11.3 in 1000 children in 2008. Using data from the California Department of Developmental Services, we study how changes in the number of autism cases at each of the 21 regional development centers affected local wages and quantity of auxiliary health providers. We focus on this subset of health providers because, unlike physicians and psychologists who can diagnose autism, these workers cannot induce their own demand. If the incidence of autism is increasing independently of other mental disorders, then the demand for auxiliary health providers should increase, leading to higher wages and an increase in the number of these providers over time, else the increase in autism diagnosis is merely displacing other mental disorders. Using wages and provider counts from the American Community Survey, we find a 100% increase in the number of autism cases increases the wage of auxiliary health workers over non-autism health occupations by 8 to 11 percent and the number of providers by 7 to 15 percent the following year. Further, we find that four additional autism cases reduces the number of mild mental retardation cases by one, but is not found to have a statistically significant effect on the level of cerebral palsy or epilepsy.

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I. Introduction

Autism is a developmental disorder characterized by impairments in social interaction, communication, and restricted or repetitive behaviors (American Psychiatric Association, 1994). The previously rare condition has experienced a dramatic increase in prevalence from 0.5 in 1000 children during the 1970s to 11.3 in 1000 children in 2008 (Baio, 2012). Currently, autism is only second to mental retardation as the most commonly diagnosed developmental disability (Yeargin-Allsopp et. al., 2003; Bhasin et. al., 2006). Further the cost associated with caring for individuals with autism is not trivial. The annual costs of care for a child with autism are estimated to be 85% to 550% higher than the cost for a typically developing child and the average lifetime public expenditures are approximately $4.7 million (Guevara et. al., 2003; Jacobson et. al., 2000). This increase in prevalence, compounded with the cost of care, has prompted many researchers to investigate various factors that could potentially explain the cause of such an increase.

The three leading factors are an increase in environmental toxins, *de novo*[1] gene mutations caused by older parental age at birth, and a change in diagnosis determinants. The latter factor has led to much debate in the medical community as researchers cannot agree on the true incidence level of autism. The diagnosis of autism poses a difficult challenge to clinicians in that there are no biological markers and many of the observable characteristics are shared with other mental disorders such as Mental Retardation (MR) and Attention Deficit Disorder (ADD). For example, King and Bearman (2009) find that roughly 25% of the increased prevalence of autism is associated with a diagnostic change in determining mental retardation. Bishop et al. (2008) studies adults with a history of development language disorder and finds that one-third of

[1] *De novo* mutations are deletions, insertions, and duplications of DNA in the germ cells (sperm or egg) that are not present in the parents' DNA.

adults previously diagnosed with Development Language Disorder would have been diagnosed with autism using contemporary techniques.

In this paper, we use economic theory to help shed some light on the debate. If the incidence of autism is increasing independently of other mental disorders (such as mental retardation), then the demand for auxiliary health providers (e.g. speech pathologist, behavioral therapist, occupational therapist, etc.) should increase leading to higher wages for these providers and an increase in the number of providers. On the other hand, if the increase in autism diagnosis is merely displacing other mental disorders, then the effects of the increase on demand will be mitigated or not present as individuals are only changing diagnostic labels but maintaining the same level of services demanded. We construct an econometric model to distinguish between these two effects.

Using data from the California Department of Developmental Services, we study how changes in the number of autism cases at each of the 21 regional development centers affected local wages and quantity of auxiliary health providers. We focus on this subset of health providers because, unlike physicians and psychologists who can diagnose autism, these workers cannot induce their own demand.[2] Using wages and provider counts from the American Community Survey (ACS), we find a 100% increase in the number of autism cases at a center increases the wage of auxiliary health workers over non-autism health occupations by 8 to 11 percent; additionally, the number of providers increases by 7 to 15 percent the following year.

II. Background

Autism is a developmental disorder that limits an individual's ability to form social relations and appropriately respond to environmental stimuli. The prevalence of autism in the United States has increased rapidly over the last 30 years. In California, the number of autism

[2] See Fuchs (1978) for a theory of physician induced demand.

cases increased by 1,148 percent between 1987 and 2007, which is remarkable considering that cerebral palsy increased by 73 percent, epilepsy by 66 percent, and mental retardation by 95 percent over the same time period (Cavagnaro, 2007). However, the co-morbidity rate between autism and mental retardation has fallen from 79.6 percent in 1987 to 35.6 percent in 2007, which differs from national trends ranging now between 40 to 55 percent (ASD Best Practice Guidelines, 2002; American Psychiatric Association, 2000; Chakrabarti and Fombonne, 2001).

We highlight both the rise in reported autism cases as well as the trade-off between autism and mental retardation as these relationships are at the center of much debate. Grinker (2007) argues that the true prevalence of autism is not rising. Rather, physicians are finally diagnosing autism correctly. The author cites five factors causing the rise in autism cases: (1) broader definition of autism; (2) a change in school policy allowing autistic students to receive special education in 1992; (3) the stigma associated with an autism diagnosis decreased reducing the number of under-reported cases; (4) states started to allow families with autistic children to apply for Medicaid funds regardless of family income leading more families to seek care and more physicians to "up-code" patients so they can receive funding (an advantage not readily available for a diagnosis of mental retardation); and (5) relabeling, where due to the broadening of the autism diagnosis fewer cases are misdiagnosed into other mental disorders such as mental retardation and ADHD.

Mental disorders have a history of under-reporting and misdiagnosis. Elder (2010) uses regression discontinuity methods to compare ADHD diagnosis between students who are slightly above and below the birthday enrollment cut-off for kindergarten and finds that approximately 20% of children who use stimulants intended to treat ADHD are misdiagnosed. Epilepsy is found to have a misdiagnosis rate of 26.1 percent in adults (D. Smith et al., 1999) and 39 percent in children (Udldall et. al., 2006).

A similar pattern is observed with autism. Autism was first recognized as a disorder associated with schizophrenia beginning in 1911 (Bleuler, 1912). This association continued well through the 1960's. Autism is later categorized into four individual disorders comprising the autism spectrum: Rett Syndrome, Asperger Syndrome, Autistic Disorder, and Pervasive Developmental Delay – Not Otherwise Specified (PDD-NOS).

PDD-NOS is the primary source of growth within the spectrum and could be the source of misdiagnoses. Tomanik et. al. (2007) run an experiment where independent physicians are asked to review cases for autism. There are two groups of patients, 77 autistic patients and 52 non-autistic patients. The authors find that 21.2 percent of individuals who are not classified as autistic receive an autism diagnosis and 23.4 percent of autistic individuals are not diagnosed with autism. With respect to under-reporting, Liu et. al. (2010) finds the reduction in stigma associated with autism has lead to a 16% increase in the number of reported cases between 2000 and 2005. Further, autism diagnosis rates can differ based on demographic characteristics. Mandell et. al. (2002) uses administrative data for Medicaid patients in Philadelphia and finds African-American children receive an autism spectrum disorder diagnosis nearly three years later than Caucasian children, on average.

The study most related to our work is Shattuck (2006). The author analyzes administrative data from the US special education system for students between the ages of 6 and 11 and compares how changes in the administrative prevalence of autism versus other mental disorders affect the demand for special education classes. The author finds that the average administrative prevalence of autism among children increased from 0.6 to 3.1 per 1000 from

1994 to 2003, while the prevalence of mental retardation and learning disabilities declined by 2.8 and 8.3 per 1000, respectively, over the same time period. The increased administrative prevalence in autism is concluded to be off-set by the decrease in prevalence in other mental disorder categories.

III. Data

The autism data are collect from The California Department of Developmental Services (DDS). The California DDS is the central administrating body tasked with diagnosing and reporting mental health cases in the 58 counties of the state. The 58 counties are serviced by 21 regional centers. The service areas of these regional centers are shown in Figure 1. The data for this study are collected from the quarterly Client Evaluation Reports, which are available for each county or each regional center for the years 2002-2011.[3] We utilize the December issue of the Client Evaluation Reports, which includes the following client characteristics: number of total clients, number of autism cases, number of mental retardation (MR) cases (by severity), number of cases with physical handicap, primary language, gender, race, and age distribution.

Next, we identify the target group of auxiliary healthcare providers by non-medical treatment therapy used. The National Institute of Mental Health (NIMH) provides separate guidance manuals for autism and mental retardation.[4] Both manuals encourage the use of behavioral therapy (i.e. applied behavioral analysis), psychotherapy (i.e. The Developmental, Individual Difference, Relationship-based Model), as well as speech and language therapy. From these treatments, we identified the following providers: audiologists, occupational therapists, physical therapists, and speech-language pathologists. We expand this list of providers to include

[3] These reports are available from the California DDS at http://www.dds.ca.gov/FactsStats/Diagnostic_Main.cfm.
[4] The NIMH "A Parent's Guide to Autism Spectrum Disorder" http://www.nimh.nih.gov/health/publications/a-parents-guide-to-autism-spectrum-disorder/parent-guide-to-autism.pdf and the NIMH "Mental Retardation: A Manual for Psychologists" http://www.nimhindia.org/A%20Manual%20for%20Psychologists.pdf

recreational therapists and respiratory therapists. The Bureau of Labor and Statistics defines recreational therapists as individuals who plan, direct, and coordinate recreation programs for people with disabilities or illnesses. We include respiratory therapists since some individuals with poor brain activity report using hyperbaric oxygen therapy.

Information on provider wages and earnings is matched to these 21 regional centers for each year. Specifically, we utilize data from the 2005-2010 American Community Surveys (ACS) Public-Use Microdata Sample (PUMS) to compute occupation-specific wages and earnings in California. The ACS is administered monthly by the U.S. Bureau of Census. It is nationally-representative, and annual estimates are also representative of geographic units with a population of at least 65,000 individuals; representative estimates of smaller areas may be obtained by combining multiple years from the ACS-PUMS (3-year and 5-year estimates). The PUMS comprises approximately a 1% random sample of the total number of housing units in the nation. It thus contains information on about 1.3 million housing units and 3 million person records in total, and yields about 360,837 persons sampled in California in 2010.

The smallest geographic unit identified in the ACS-PUMS is the Census-defined PUMA or the Public Use Microdata Area. PUMAs are statistical geographic areas nested within states, and which have a population of at least 100,000 individuals.[5] The 21 regional centers that report the provision of services for developmental disabilities in California are matched to the PUMAs, based on the counties that each center serves, for 2005-2010.[6] (We are unable to utilize ACS information prior to 2005 since local-area identifiers within each state are not available in the PUMS.) Each individual respondent reports their average total income from wages and salary in

[5] There are 233 PUMAs defined for California. See the Census ACS webpage (http://www.census.gov/acs/www/) for information on these geographic areas and the sampling schemes of the ACS and the ACS-PUMS.
[6] There are seven regional centers which service Los Angeles County. Aggregating these centers into a single regional center servicing LA does not alter results (reported in Appendix Tables A1 and A3).

the past year and also their past year average total personal earnings, along with their occupation (4-digit occupation code based on the 2002 Census). We compute mean wages and earnings and the total number of individuals working within each occupation, for each regional center and year. Since wages and earnings reference the past year, we match the ACS information at time period *t* (referencing period *t-1*) with the DDS information at time period *t-1*, in order to assess the contemporaneous effects on wages and earnings of the demand shock stemming from the increase in autism diagnoses. In supplementary analyses, we also assess lagged effects on wages in the subsequent period by matching ACS wage information at time period *t* (referencing period *t-1*) with the DDS information at time period *t-2*. Since provider counts reference the year of interview, we match ACS information on the number of providers in each occupation at time period *t* with DDS information at time period *t-1* to assess lagged effects on provider entry. In addition, we append population figures and the demographic (age, race, ethnicity) composition of the population for each center and year, derived from the U.S. Census Bureau.

Table 1 presents the means for key variables across various periods spanning our analysis sample. Over 2004-2009, the average regional center reported 9229 clients served for mental health disorders, 19.4% of whom were diagnosed with an autistic disorder and 54.4% were diagnosed with mild or moderate mental retardation. Most of the clients served are minorities, with whites representing only about 43.1% of the cases in the average center. As illustrated in Figure 2, the percentage of autism cases has increased from 12% to 25% from 2002 - 2011. However, the percentage of Total MR cases has decreased from 80% to 70% and the percentage of Mild and Moderate MR cases decreased from 58% to 52%. Moreover the total number of both autism and MR cases has grown over this time period, but the ratio of autism cases to MR cases has increased from 0.16 to 0.35, and specifically the ratio of autism to Mild MR cases has increased from 0.32 to 0.69.

IV. Methods

The primary aim of this study is to assess whether, and to what extent, the increase in autism diagnoses impacts the demand for auxiliary healthcare workers. Since these workers do not diagnose autism, in contrast to physicians and psychologists, they cannot induce their own demand.[7] Any shift in autism diagnoses in the area therefore represents an exogenous shift in the demand for their services. In the short-term, this potential increase in demand would be reflected in the form of higher wages and salary among these workers, likely due to increased work effort and/or a higher price for their services. This may also induce a higher entry of such providers over time into the market area experiencing the increase in diagnoses, demand and wages.

Our main analyses therefore examine the impact of the increase in autism diagnoses on the wages of these providers in the short-term and, in alternate specifications, the number of providers in the subsequent period. We employ a quasi-experimental research design – akin to a pre- and post-comparison with treatment and control groups – in conjunction with multivariate regression methods. The following specification relates changes in wages to autism diagnoses:

$$\text{(1)} \qquad \text{Ln Wages}_{ijt} = \alpha_0 + \pi\,(\text{Ln Autism}_{jt}) + X_{jt}\,\beta + O_i\,\Psi + A_j\,\Omega + Z_t\,\Phi + \varepsilon_{ijt}$$

Equation (1) posits that log wages (*Ln Wages*), for the i^{th} auxiliary healthcare occupation in center j during year t, is a function of the number of autism diagnoses (*Ln Autism*). The parameter of interest is π, which captures the effects of autism diagnoses on the average wages of those healthcare providers whose services are complementary to the treatment of autism. The

[7] Parents seek out some of these alternative health workers for other symptoms such as delayed speech. The parents take the child to a speech pathologist and the speech pathologist may recommend that the child be tested for autism. Thus it might appear that the demand is induced, but if anything this would bias the results towards zero because the child would not yet be counted as an autism case. Therefore, this would be an increase in demand for the services of a speech pathologist in the absence of an increase in autism within the data.

parameter ε represents an error term at the level of the occupation, center, and year. We utilize a log transformation of wages and autism diagnoses, separately controlling for the county-specific population base and the total number of cases in each center, and allowing these coefficients to remain unrestricted. The log adjusts for the skewness of the wage and diagnoses distributions, facilitates interpretation (in terms of elasticity), and makes the effect magnitudes comparable across outcomes.[8] We estimate models for wages using OLS. For the number of providers, we use a Poisson regression model for two reasons. First, the discrete nature of the outcome variable as a count of service providers makes the Poisson probability distribution especially suitable. Second, the Poisson framework does not suffer from the 'incidental parameters' problem and can accommodate fixed effects well (Cameron and Trivedi, 1998). We adjust standard errors on the conservative side to account for arbitrary correlation within centers, across occupations and over time.

A challenge in any such analysis relates to disentangling the effects of autism diagnoses from other unobserved factors that may also affect the outcome. We account for such confounding factors in various ways. First, in alternate specifications, we control for a vector of time-varying center-specific (and county-specific) characteristics (*X*) including the total number of clients served within the center's geographic area, the racial and ethnic composition of the center's clients and at-need population, total population of the counties reporting to the center, and the demographic (age, race, ethnicity) composition of the served population. It is important to control for the racial/ethnic constitution of the county population and the clients served by the

[8] Elasticity estimates are not sensitive to alternate functional forms: 1) non-logged wages; 2) non-logged autism diagnoses; 3) rate of autism diagnoses relative to various population bases.

center since research indicates substantial disparities in autism diagnoses and the age of diagnosis across black and white families (see for instance, Mandell et al., 2002, 2009).[9]

Year fixed effects (*Z*) account for unobserved trends specific to the state of California, including changes in public and private insurance coverage, overall economic conditions, shifts in diagnosis criteria, and state-level policies enacted over the sample period.[10] Alternate specifications include center-specific fixed effects (*A*), which account for all unobserved time-invariant local factors that may be differentially affecting autism diagnoses, clients served, and treatment patterns across centers, and include occupation fixed effects (*O*), which account for unobserved time-invariant characteristics specific to each occupation (such as working conditions, non-monetary attributes, and stable labor demand) that may affect wages in these occupations.

Despite these controls, the possibility remains that there may be residual unobserved time-variant factors which potentially impact wages. We address this problem by considering a comparison group of occupations that should not be directly affected by a shift in autistic disorder diagnoses. Thus, any correlation between autism diagnoses and wages for these 'control' occupations reflects unobserved center-specific trends. This correlation can be differenced out from the effect (π) identified in Equation (1) to arrive at a cleaner estimate of the effects of autism diagnoses on the wages of impacted providers.

This difference-in-differences (DD) effect can be obtained directly from estimating the following specification:

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[9] Mandell et al. (2002) show that among Medicaid-eligible children, white children on average receive an Autistic disorder diagnosis at 6.3 years compared to 7.9 years for black children.

[10] Insurance status is unavailable in the ACS data prior to 2008. We construct center-specific rates of public coverage, private coverage, and uninsured for 2008-2010. Including these center-specific measures of insurance status in models estimated over 2008-2010 does not materially change the point estimates, though standard errors are inflated in these models due to the reduced sample size.

$$(2) \quad \text{Ln Wages}_{ijt} = \alpha_0 + \alpha_1 (\text{Target}_{ijt}) + \alpha_2 (\text{Ln Autism}_{jt}) + \pi^* (\text{Ln Autism}_{jt} * \text{Target}_{ijt}) + X_{jt}\,\beta + O_i\,\Psi + A_j\,\Omega + Z_t\,\Phi + \varepsilon_{ijt}$$

In the above equation, *Target* represents a dichotomous indicator equal to one for those healthcare occupations whose services are demanded by families with autistic children, and zero for occupations in the comparison group (providers whose services are not directly impacted by autism diagnoses). The DD estimate of the effect of autism diagnoses is the coefficient (π^*) of the interaction term between *Ln Autism* and the *Target* indicator. This effect is identified by comparing changes in wages associated with autism diagnoses for the target occupations in relation to changes for the control occupations, accounting for all other observable factors.

The choice of the target group of auxiliary healthcare occupations, whose services are utilized by families with autistic children is straightforward. As noted earlier, non-medical interventions include behavioral, educational, sensory, and communication therapy, typically requiring the services of healthcare providers such as a speech pathologist, behavioral therapist, or occupational therapist.[11] We therefore expect the demand for services for the following providers to be potentially and directly impacted by a shift in autism diagnoses: 1) audiologists; 2) occupational therapists; 3) physical therapists; 4) recreational therapist; 5) respiratory therapist; 6) speech-language pathologist; and 7) other therapists.[12] Additionally, these same therapists serve individuals with mental retardation.[13]

[11] See for instance: http://www.autism-society.org/living-with-autism/treatment-options/ and http://www.webmd.com/brain/autism/autism-treatment-overview. To see medical treatments used by autistic parents see http://www.autism.com/pdf/providers/ParentRatings2009.pdf

[12] Occupations in the ACS are identified by the 2002 Census codes. We therefore include codes 3140 (audiologists), 3150 (occupational therapists), 3160 (physical therapists), 3210 (recreational therapists), 3220 (respiratory therapists), 3230 (speech-language pathologists), and 3240 (other therapists) in the target group. Estimates are robust to excluding other therapists (code 3240).

[13] http://children.webmd.com/intellectual-disability-mental-retardation?page=2

We utilize two alternate control groups to account for unobserved trends in wages within centers over time: 1) all other healthcare practitioner and healthcare technical occupations (occupation codes 3000-3540); and 2) all other healthcare practitioner, healthcare technical, and healthcare support occupations (occupation codes 3000-3650).[14] The former control group includes occupations that provide direct healthcare services to the patient. Since auxiliary healthcare providers of services to autistic children are classified by the Bureau of Labor Statistics (BLS) in this grouping, this control group may represent those occupations which are most similar to those in the target group but not directly impacted by an increase in autism diagnoses. The latter control group comprises all healthcare-related occupations, and also includes support occupations such as aides, assistants, and other support workers. These control groups will account for trends specific to healthcare occupations within each center and county. However, to the extent that demand and wages for some of these other health practitioner (physicians) and health support occupations (aides and nurses, for instance) may also be impacted by an increase in autism diagnoses, effects may be potentially understated. We therefore draw conclusions based on the range of estimates from both sets of control occupations and interpret these estimates as potentially conservative effects.[15]

Unconditional means from Table 1 suggest that wages in occupations whose services are complementary to autism diagnoses increased by 41.5% between 2004 through 2009. This compares with wages for other healthcare practice occupations, which increased 27%, while those among all healthcare occupations increased 28.4%. Thus, wages among autism service

[14] Specifically, we define control healthcare practitioner and support occupations based on 2002 Census codes 3000 to 3650, excluding those defined above for the target group.
[15] In supplementary analyses, as a robustness check, we also considered all other occupations (healthcare and non-healthcare) as a global control group. Expectedly, these estimates were of a larger magnitude since healthcare occupations (including the auxiliary service providers for Autistic children) generally enjoy stronger wage growth relative to other jobs and effects are likely overstated, partly reflect just an overall positive trend in the wages of healthcare occupations.

providers has increased relative to those among similar healthcare practice providers as well as all other healthcare providers and support workers coinciding with an increase in the number of autism diagnoses over our sample period, and the increase in wages is statistically significant.

We extend the model specified in Equation (2) in order to test for a 'dose-response' relation and to assess the plausibility of the estimates by exploiting the suggestive displacement of other mental disorders for autism diagnoses. If the increase in the diagnoses of autistic disorders is partly displacing other mental disorders, then the effects of the increase on demand and wages would be mitigated. If one diagnosis is merely displacing another, then there is no effective increase in the demand for the services of the auxiliary healthcare workers and there should be no observed increase in their wages, conditional on trends. We therefore test whether the demand effects are relatively larger in those areas where this displacement is relatively low, in which case the increase in autism diagnoses is occurring independently of other mental disorders and would lead to a net increase in demand for the healthcare providers.

Specifically, we estimate the following model separately for each of the 21 regional centers, as part of a two-step procedure, in order to quantify the effects of higher autism diagnoses on the diagnoses of mild mental retardation (MR).

(3) $$\text{Mild MR}_t = \delta + \Lambda\,(\text{Autism})_t + \delta_1\,(\text{Total Clients})_t + \delta_2\,(\text{Center Demographics}) + \delta_3\,\text{Trend} + \nu_t$$

The parameter Λ, which is estimated separately for each center, represents the association between *Autism* and *Mild Mental Retardation* (MR), both measured as the number of total cases.[16] We multiply Λ, for each center, by -1 to obtain the magnitude of the displacement. Thus, if the displacement is 0.5, this signifies that for every two additional diagnoses of autism, one of these cases is displacing a displacing a diagnosis of mild MR in that center, on average.

[16] Estimates are not sensitive to alternate functions forms: 1) percent of total cases; and 2) log of total cases.

While Equation (3) controls for trends and demographic shifts within each center, we note that these rates should not be interpreted as causal since they may reflect residual unobserved trends. Nevertheless, we expect to find weaker effects on the demand for services in those centers where the displacement rate is high.

In the second step, we modify the baseline DD model (Equation 2) to allow an interaction between the effect of autism diagnoses and the center-specific displacement rate:[17]

$$(4) \quad \text{Ln Wages}_{ijt} = \alpha_0 + \alpha_1 (\text{Target}_{ijt}) + \alpha_2 (\text{Ln Autism}_{jt}) + \lambda_1 (\text{Ln Autism}_{jt} * \text{Target}_{ijt})$$
$$+ \lambda_2 (\text{Ln Autism}_{jt} * \text{Target}_{ijt} * \text{Displacement}_j)$$
$$+ X_{jt}\, \beta + O_i\, \Psi + A_j\, \Omega + Z_t\, \Phi + \varepsilon_{ijt}$$

The parameter λ_1 represents the effect of autism diagnoses on wages, *among those centers which had no displacement of MR cases for Autism*; hence, we expect λ_1 to be larger than the estimated DD effect π^* in Equation (2) which represented a weighted average effect that conflates effects for centers that have high and low displacement rates. The parameter λ_2 represents the effect of higher levels of displacement on the link between autism and wages. We expect λ_2 to be negative, since centers which have high rates of displacement would see lower demand and hence lower wages, relative to centers which have no displacement. This specification tests the proposition that higher autism diagnoses should only represent an effective increase in the demand for the services of the auxiliary healthcare workers if these diagnoses represent a 'true' increase rather than a substitution from MR diagnoses. Standard errors for Equation (4) are bootstrapped to account for the sampling variance in the estimate of the displacement rate.[18]

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[17] This becomes a DDD model, which we estimate as a fully flexible specification by also allowing interactions between *Displacement* and *Ln Autism*, and between *Displacement* and *Target.*

[18] Specifically, we report cluster bootstrapped standard error based on 100 replications at the center-year cluster level. Center-level clusters provide too few clusters for the bootstrap. We note, however, that non-bootstrapped standard errors clustered at the center-level or at the center-year level in our DD models yield highly similar variance estimates and inferences.

V. Results

Table 2 shows the association between autism diagnoses and mental retardation (MR) cases over the sample period. Model (1) indicates that a one percent increase in autism cases is associated with a statistically significant 0.40 percent decrease in mild MR cases, suggestive of a displacement of MR diagnoses for autistic disorder diagnoses. This displacement rate is robust to non-parametric (inclusion of year indicators) controls for trends in California (Model 2), and decreases slightly in magnitude to -0.34 with the addition of center-level fixed effects in Model (3). Thus, the negative association between autism and MR diagnoses is present both across centers (cross-sectionally) and within centers over time. Model (4) suggests a similar displacement rate (-0.38) when moderate MR cases are considered in addition to the mild cases. Displacement is also evident in levels (Models 5-8). These specifications suggest that about one out of every four additional autism cases is a shift from mild or moderate MR to an autism diagnosis. Models (9) and (10) present a placebo test and confirm that with respect to cerebral palsy and epilepsy there is no significant or substantial displacement coinciding with an increase in autism diagnoses. Individuals with these conditions also utilize occupational and behavioral therapist, but unlike MR, these conditions are easier to diagnose. Furthermore, since these conditions are also served by the developmental centers, it is possible that autism is potentially crowding out other conditions besides MR or there is an unobserved effort by administrators to increase autism diagnosis. However, we find no discernible displacement effect between these conditions and autism cases at the center level.

Table 3 presents the effects of an increase in the autism caseload on wages, based on the DD framework specified in Equation (2). Models 1-4 utilize non-autism healthcare practitioner occupations as a control group, whereas Models 5-8 utilize an alternate control group that includes all non-autism healthcare occupations (practitioner and support occupations). Model (1) suggests that a 100% increase in autism diagnoses raises wages among the target occupations (auxiliary healthcare providers of services to autistic clients) by 10.6%, relative to all other healthcare practice occupations. This effect remains robust and statistically significant (at 10.9%) with the inclusion of center-level fixed effects (Model 2) and center- and county-level demographics (Model 3). The effect magnitude decreases slightly to 8.3%, though it still remains statistically significant, when the full set of occupation-specific fixed effects is added to the regression (Model 4). The coefficient of *Ln Autism* is generally insignificant though not necessarily insubstantial in magnitude; this suggests that the control group is indeed picking up remaining (noisy) trends in healthcare wages within centers coinciding with the increase in autism diagnoses. The DD estimates purge these residual trends by differencing the effects for the control group. The coefficients of the Target indicator are expectedly negative, consistent with the patterns suggested by the unconditional means (Table 1) that providers of healthcare services to autistic clients in general have lower wages relative to other healthcare practitioners.

Models 5-8 indicate that the effect magnitudes of the DD estimates are highly similar when the control group is broadened to include healthcare support workers. Specifically, these estimates suggest that a 100% increase in autism diagnoses is associated with an 8.0-10.1% increase in the wages of the auxiliary healthcare providers (relative to all other healthcare occupations).

The DD effects are understated since part of the increase in autism diagnoses represents a displacement of MR cases, in which case the increase in the demand for the services of the target healthcare occupations is also mitigated. Table 1 suggests displacement rates of about one-third to one-half, in which case the DD effects reported above are also understated by a similar factor.

If some of the increase in autism cases is merely displacing MR cases, and if an effective increase in autism cases causally raises the demand for services of certain healthcare providers, then we expect that accounting for the level of displacement or directly controlling for MR cases should raise the magnitude of the wage effects. The models reported in Table 4 implement this plausibility check.

Models 1-3 present estimates of Equation (4), which interacts the displacement rate with the DD effect to assess whether the impact on wages is larger in those centers where displacement of MR for autism is lower. The coefficient of the interaction between *Ln Total Autism* and *Target* increases in magnitude to 16.6% (Model 1); it can be interpreted as the impact of an effective 100% increase in autism diagnoses, independent of MR cases, on wages. The effect is robust to the inclusion of area and center demographics (Model 2) and declines somewhat in magnitude to 12.2% with the inclusion of occupation fixed effects (Model 3). It is validating that these effects (12.2 - 16.6%) are larger, as hypothesized, relative to the effects in Table 3 that do not account for displacement (8.3 - 10.9%). Furthermore, the coefficient of the triple interaction term is negative and generally significant (-0.061 to -0.093), suggesting that the effect on wages varies inversely with displacement; in those centers where the increase in autism cases is mostly reflecting a shift from MR to autism, we would not expect large increases in the demand for services.

Model (4) explicitly controls for mild or moderate MR diagnoses at the center-year level. As expected, the DD effect of a 100% increase in autism cases (which now represents a pure demand shock for related auxiliary healthcare providers) increases in magnitude, suggesting a 17.0% higher income from wages and salary. It is validating that this estimate of the wage increase from a "pure" 100% increase in autism diagnoses is consistent with the effects emerging from the DDD models (12.2 - 16.6%) noted above. It is further validating that the inflation of the effect magnitudes in Models 1-4 in Table 4 relative to similar models in Table 3 (that do not account for displacement) is consistent with the displacement ratios estimated in Table 2. That is, the effect magnitudes with respect to a pure 100% increase in autism diagnoses are about 40% larger, corresponding with a displacement rate of autism for mild/moderate MR of about 30-40%. Models 5-8 suggest very similar patterns and effect sizes based on the alternative control group of all healthcare occupations.

Table 5 presents supplementary DD models similar to Equations (2) and (3), which inform whether an increase in autism prevalence affects the supply of auxiliary healthcare providers in the subsequent period. Specification (5) indicates that a 100% increase in the prevalence of autism raises the number of auxiliary healthcare workers in the area in the next year by a statistically significant 9.2%, relative to the supply of other healthcare providers and support workers. Controls for a full set of occupation fixed effects and center/area demographics (Model 6) raise this effect to 11.3%.

To the extent that the increase in autism diagnoses is supplanting alternate diagnoses of mental retardation, these effects underestimate the impact of an effective 100% increase in autism cases. Specification (7) estimates the DDD model shown in Equation (4), including the explicit interactions with the center-specific displacement rate. The coefficient of the interaction between *Ln Total Autism* and *Target* suggests that, among centers that do not experience any displacement of MR for autism and for whom the increase in autism diagnoses reflects a real increase in the demand for services, the elasticity of provider supply with respect to autism cases is 0.13. This effect magnitude is about 20-40% larger relative to the effects that do not account for displacement (Models 5 and 6), consistent with the 25-35% displacement rates noted in Table

2. It further adds to the plausibility of this estimate that the coefficient of the triple interaction is negative (-0.087), suggestive of a dose-response relation - though it is imprecisely estimated. The effect of autism diagnoses on the supply of auxiliary healthcare workers is diminished with larger displacement rates; for those centers where the increase in autism is crowding out MR diagnoses, this increase would not be expected to substantially raise the demand for services of workers in the target occupations. Model (8) explicitly controls for mild or moderate MR cases in order to isolate the full effect in a different way. After accounting for MR cases, the estimate indicates a robust 14.7% increase in auxiliary healthcare workers in the target group, relative to the control group. Specifications (1) through (4) present similar estimates based on the control group of non-autism healthcare practice and technical occupations. While these estimates also suggest a similar pattern, they are imprecise and statistically insignificant.

In supplementary analyses, we also assessed two-year lagged effects on provider supply. These estimates (not reported) suggest even larger (by about 15-20%) positive effects than those estimated for the subsequent year in Table 5. In contrast, we do not find substantial or significant lagged effects with respect to wages and earnings. Appendix Table A1 presents effects of an increase in the autism caseload on wages in the subsequent period. While all of these estimates are statistically significant, they are highly similar in magnitude to those presented in Tables 3 and 4 with respect to contemporaneous effects. This pattern of results is suggestive of an adjustment mechanism favoring higher wages in the short-run and higher provider entry and labor supply in the longer-term in response to an increase in the demand for auxiliary healthcare workers induced by a greater number of autism diagnoses.

One concern, which cannot be directly tested, is that there may be residual confounding trends that differentially affect the target and control groups leading to biased DD estimates.

Table 6 indirectly assesses this possibility by implementing a placebo test based on a pseudo target group comprised of healthcare occupations whose services (and hence wages or provider supply) should not be directly affected by an increase in autism cases. In order to define this pseudo target group, we chose the first seven occupations within the BLS classification of healthcare practitioner and technical occupations that service human patients and are not complementary to autism diagnoses. Specifically, the pseudo target group comprises the following seven occupations in sequence in the BLS classification: chiropractors; dentists; dieticians and nutritionists; optometrists; pharmacists; radiation therapists; and dental hygienists. The control group represents all other healthcare practice occupations (excluding the autism-related providers). If our DD estimates are effectively purging residual center-specific trends, then we would not expect an increase in autism cases to affect the wages or supply of providers in these pseudo occupational categories (relative to the control group). Indeed, Table 6 confirms that there are no significant or substantial effects on either wages or provider supply for occupations in this pseudo target group. This falsification check is further validating in that it also adds a degree of confidence to the use of our control groups as a counterfactual for the target autism-related occupations.

Appendix Table A2 presents estimates for a sample of 15 regional centers where the six centers that service Los Angeles County are aggregated together. Appendix Table A3 presents estimates for average annual personal earnings. All of these estimates remain robust and highly similar, both in terms of magnitudes and statistical significance, to those discussed above.

VI. Discussion

As the prevalence of autism has expanded dramatically over the past three decades, a central debate relates to the various factors that could potentially explain this increase. This study directly assesses whether the increase in autism diagnoses in regional developmental disability service centers in California is associated with a displacement of mental retardation (MR) diagnoses. We also test this proposition indirectly by examining the impact of the higher number of autism cases on the demand for auxiliary healthcare workers – occupations whose services are complementary to the diagnoses of autism – within a difference-in-differences multivariate regression framework.

If the incidence of autism is increasing independently of other mental disorders, then the demand for auxiliary health providers (i.e. speech pathologist, behavioral therapist, occupational therapist, etc.) should increase leading to higher wages for these providers in the short term and possibly a higher supply of these providers over time. If, on the other hand however, the increase in autism diagnosis is merely displacing other mental disorders, then the effects of the increase on demand will be moderated or not present.

We find robust evidence that the higher prevalence of autism in California has raised wages and earnings among those target occupations whose services would be potentially impacted, conditional on confounding trends. The elasticity of wages and earnings with respect to autism diagnoses controlling for displacement effects is estimated to be between 0.11 and 0.17. This elasticity diminishes in magnitude with a higher displacement rate of MR for autism diagnoses, consistent with mitigated demand. We find that the average displacement rate is on the order of one-third, suggesting that one out of every three new autism diagnoses is merely supplanting MR diagnoses and does not represent a true increase in autistic disorders. Between 2002-2011, the total number of autism diagnoses in California increased by 68.8%, adjusting for overall time trends in access and total clients served. This suggests a 45.9% increase (assuming a displacement of one-third) in effectively ‘new’ autism diagnoses. Combined with the above elasticity estimates, this increase in prevalence would raise the wages and earnings among auxiliary healthcare providers who provide behavioral intervention services for children with autistic disorders by 5.0 – 7.8%. In follow-up analyses, we aim to decompose how much of this effect reflects higher wage rates versus expanded work hours.

The short span of the data set precludes a comprehensive analysis of the effects on the number of providers in the long run. Nonetheless, we find suggestive evidence that expanded prevalence of autistic disorders does raise the number of auxiliary healthcare workers in the subsequent period, with elasticity estimates ranging from 0.07 to 0.15. As with wages, we would expect this effect to be mitigated if the increase in autism is substituting for MR cases, which is indeed what the estimates suggest.

These results further confirm that provider income and wages are responsive to an increase in the demand for their services. Future research should consider the mechanisms through which these workers experience an increase in their wages, whether it be through an increase in the price of their services and/or increased work effort and/or interaction with third-party payors. We note that these wage effects are not reflective of a "supplier-induced demand" since these healthcare workers do not themselves diagnose autism and thus cannot induce their own demand. Thus, at least part of the increase in the autism caseload represents an effective increase in their demand given that we observe an increase in their wages. This further suggests that at least part of the increase in autism diagnoses, about one-half to two-thirds based on the direct and indirect estimates of displacement, reflects an increase in the true prevalence of the disorder.

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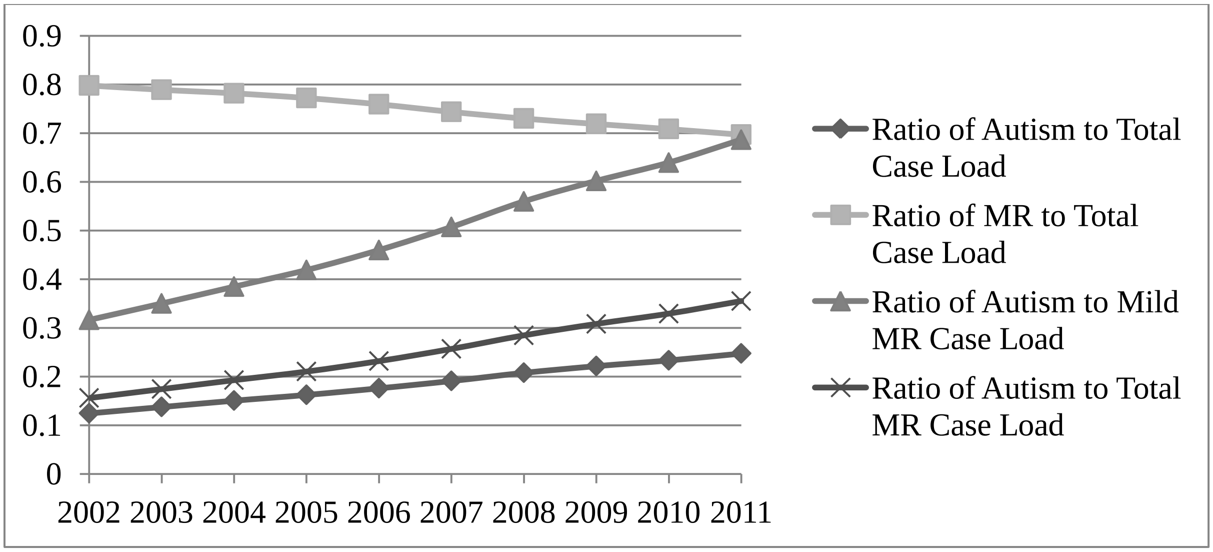
Figure 1: Map of Regional Centers in California

Source: California Department of Developmental Services

Figure 2: Ratio of Autism to Mental Retardation (MR)



Source: Data from the California Department of Developmental Services are used

Table 1
Descriptive Statistics
21 California Regional Centers

Time Period	**2002**	**2004**	**2009**	**2011**	**2004-2009**
Total clients	7799.6	8403.1	9831.5	10376.1	9228.8
Total Autism cases	970.4	1265.4	2176.5	2566.0	1786.0
Total mild MR cases	3067.0	3290.4	3619.6	3740.3	3479.1
Total mild or moderate MR cases	4499.4	4783.8	5190.2	5370.2	5017.9
% Clients White	0.4603	0.4527	0.4162	0.3998	0.4306
% Clients Black	0.1029	0.1043	0.0993	0.0976	0.1012
% Clients Hispanic	0.2805	0.2951	0.3208	0.3322	0.3103
Total population		4608971	4684279	4777294	4643298
% Population Black		0.0712	0.0706	0.0723	0.0711
% Population Other Race (non-white & non-black)		0.1493	0.1553	0.1756	0.1552
% Population Hispanic		0.3421	0.3603	0.3726	0.3524
% Population Ages ≤ 13		0.1964	0.1896	0.1789	0.1913
Wages (Autism Occupations)		42563.2	60243.4		45159.3
Earnings (Autism Occupations)		49277.2	65152.3		50897.4
Wages (Other Healthcare occupations)		43476.8	57512.0		47224.7
Earnings (Other Healthcare occupations)		50540.2	65771.9		53175.1
Wages (Non-healthcare occupations)		18314.5	19661.1		18993.7
Earnings (Non-healthcare occupations)		20460.4	21360.8		21114.3
Wages (All non-Autism occupations)		19073.3	20384.2		19852.7
Earnings (All non-Autism occupations)		21367.6	22209.2		22089.8

Notes: Means are reported across 21 regional centers in California for the noted periods. Information on average wages and earnings are from the American Community Surveys (2005-2010) referring to years 2004-2009; means are weighted by occupation counts. Information on population demographics are from the U.S. Census Bureau (2005-2011).

Table 2
Displacement of Mental Retardation (MR) Diagnoses for Autism Diagnoses
21 California Regional Centers
2002 – 2011

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Outcome		Mild MR (% clients)		Mild or Moderate (% clients)		Total Mild MR Cases		Total Mild or Moderate MR Cases	Total Cerebral Palsy Cases	Total Epilepsy Cases
Autism (% of clients)	-0.40264** (0.14454)	-0.40247** (0.14712)	-0.33529*** (0.08693)	-0.38060** (0.14167)	–	–	–	–	–	–
Total Autism Cases	–	–	–	–	-0.26503** (0.10402)	-0.26488** (0.10581)	-0.25238** (0.09653)	-0.18031 (0.16275)	-0.04404 (0.06559)	-0.08555 (0.05369)
Controls for Trends	Linear + Quadratic	Year Indicators	Year Indicators	Year Indicators	Linear + Quadratic	Year Indicators	Year Indicators	Year Indicators	Year Indicators	Year Indicators
Center Indicators & Client Demog.	No	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
R-squared	0.23625	0.23660	0.99173	0.98628	0.89712	0.89717	0.99809	0.99815	0.99930	0.99922
Observations	210	210	210	210	210	210	210	210	126	126

Notes: Coefficient estimates from OLS models are presented. Standard errors are adjusted for arbitrary correlation within center cells. Models (9) and (10) are based on data from 2002-2007. All models also control for the total number of clients served at the center. Asterisks denote statistical significance as follows: *** p-value ≤ 0.01; ** 0.01 < p-value ≤ 0.05; * 0.05 < p-value ≤ 0.10.

Table 3
Ln Wages
Difference-in-Differences (DD) Estimates
American Community Surveys 2005-2010
21 California Regional Centers

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Control Group	Non-Autism Healthcare Practitioner & Technical Occupations				Non-Autism All Healthcare Occupations			
Ln TotalAutism	0.05289 (0.03705)	0.21630 (0.19864)	0.23802 (0.35007)	0.32191 (0.34416)	0.07049* (0.03935)	0.20992 (0.18097)	0.07663 (0.23504)	0.16906 (0.23602)
Ln TotalAutism* Target	**0.10555*** **(0.05578)**	**0.10872*** **(0.05477)**	**0.10506*** **(0.05412)**	**0.08284*** **(0.04188)**	**0.09634*** **(0.05298)**	**0.10117*** **(0.05223)**	**0.09828*** **(0.05170)**	**0.07964*** **(0.04227)**
Target (Autism Occupations)	-0.80437* (0.41222)	-0.83082* (0.40461)	-0.80371* (0.39985)	_	-0.53425 (0.39280)	-0.57308 (0.38725)	-0.55141 (0.38324)	_
Year Indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Center Indicators	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Area Demographics	No	No	Yes	Yes	No	No	Yes	Yes
Center Demographics	No	No	Yes	Yes	No	No	Yes	Yes
Occupation Indicators	No	No	No	Yes	No	No	No	Yes
R-squared	0.89830	0.89945	0.89973	0.93413	0.86840	0.86979	0.87003	0.93116
Observations	3345	3345	3345	3345	4117	4117	4117	4117

Notes: Coefficient estimates from OLS models are presented. Standard errors are adjusted for arbitrary correlation within center cells. Area demographics include total county population, percent of the population that is black, percent other race, percent Hispanic, percent ages 13 or below, percent ages 15-44, percent ages 45-64, and percent ages 65 and over. Center demographics include total number of clients served, percent of the total clients who are white, percent black, and percent Hispanic. Asterisks denote statistical significance as follows: *** p-value ≤ 0.01; ** 0.01 < p-value ≤ 0.05; * 0.05 < p-value ≤ 0.10.

Table 4
Ln Wages
DDD Estimates – Differential Effects by Displacement
American Community Surveys 2005-2010
21 California Regional Centers

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Control Group	Non-Autism Healthcare Practitioner & Technical Occupations				Non-Autism All Healthcare Occupations			
Ln TotalAutism	0.26356 (0.26106)	0.16715 (0.59655)	0.22963 (0.55921)	0.20065 (0.35692)	0.27128 (0.22325)	0.04016 (0.46482)	0.10774 (0.43219)	0.04084 (0.23823)
Ln TotalAutism* Target	**0.16585**** **(0.06533)**	**0.16192**** **(0.06471)**	**0.12218*** **(0.06256)**	**0.17033**** **(0.07931)**	**0.15342**** **(0.07056)**	**0.15003**** **(0.07017)**	**0.11313*** **(0.06670)**	**0.16104*** **(0.07905)**
Ln TotalAutism* Target*Displacement	**-0.09338**** **(0.04508)**	**-0.09231**** **(0.04455)**	**-0.06077** **(0.04461)**	**–**	**-0.08120*** **(0.04338)**	**-0.08000*** **(0.04310)**	**-0.04770** **(0.04239)**	**–**
Target (Autism Occupations)	-1.24667** (0.48807)	-1.21753** (0.48373)	-1.30995*** (0.46275)	-0.09279 (0.47679)	-0.95679* (0.52626)	-0.93140* (0.52362)	-0.52994 (0.48874)	0.13000 (0.48001)
Year Indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Center Indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Area Demographics	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Center Demographics	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Occupation Indicators	No	No	Yes	No	No	No	Yes	No
Mental Retardation (MR) & Mild/Moderate MR*Target	No	No	No	Yes	No	No	No	Yes
R-squared	0.89957	0.89985	0.93420	0.89982	0.86990	0.87012	0.93121	0.87010
Observations	3094	3094	3094	3094	3813	3813	3813	3813

Notes: Coefficient estimates from OLS models are presented. For models 1-3 and 5-7, bootstrapped standard errors clustered within center-year cells based on 100 replications are reported. For models 4 and 8, standard errors are adjusted for arbitrary correlation within center cells. Area demographics include total county population, percent of the population that is black, percent other race, percent Hispanic, percent ages 13 or below, percent ages 15-44, percent ages 45-64, and percent ages 65 and over. Center demographics include total number of clients served, percent of the total clients who are white, percent black, and percent Hispanic. In models 1-3 and 5-7 displacement represents the percent displacement of mild MR cases for Autism diagnoses, obtained from estimating Model (5) in Table 1 separately for each center and controlling for center demographics. These models also control for interactions between Displacement and Ln Total Autism, and Displacement and Autism Occupations. Asterisks denote statistical significance as follows: *** p-value ≤ 0.01; ** 0.01 < p-value ≤ 0.05; * 0.05 < p-value ≤ 0.10.

Table 5
Provider Counts (1-year Lag)
Poisson Regression
American Community Surveys 2005-2010
21 California Regional Centers

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Control Group	Non-Autism Healthcare Practitioner & Technical Occupations				Non-Autism All Healthcare Occupations			
Ln TotalAutism	-0.66106** (0.26132)	-0.50726** (0.21434)	-0.42243 (0.46006)	-0.51717** (0.24461)	-0.81099*** (0.19885)	-0.61220*** (0.14474)	-0.60294** (0.29309)	-0.61560*** (0.16528)
Ln TotalAutism* Target	**0.03695 (0.04721)**	**0.06886 (0.04794)**	**0.08158 (0.04989)**	**0.08750 (0.05652)**	**0.09182* (0.05064)**	**0.11295** (0.05501)**	**0.12611** (0.04967)**	**0.14710** (0.06649)**
Ln TotalAutism* Target*Displacement	–	–	**-0.06082 (0.08384)**	–	–	–	**-0.08696 (0.08362)**	–
Target (Autism Occupations)	-1.48059*** (0.34958)	–	–	–	-2.05554*** (0.36882)	–	–	–
Year Indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Center Indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Area Demographics	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Center Demographics	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Occupation Indicators	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Mental Retardation (MR) & Mild/Moderate MR*Target	No	No	No	Yes	No	No	No	Yes
R-squared	0.89957	0.89985	0.93420	0.89982	0.86990	0.87012	0.93121	0.87010
Observations	3094	3094	3094	3094	3813	3813	3813	3813

Notes: See Tables 3 and 4.

Table 6
Ln Wages & Provider Count
Falsification: Pseudo Occupations
American Community Surveys 2005-2010
21 California Regional Centers

Model	(1)	(2)	(3)	(4)
Outcome	Ln Wages (OLS)		Provider Count (1-year lag) (Poisson)	
Control Group	Non-Autism Healthcare Practitioner & Technical Occupations			
Ln TotalAutism	0.19858 (0.19970)	0.20319 (0.37768)	-0.23373 (0.29552)	-0.82322*** (0.26273)
Ln TotalAutism* Pseudo-Target	**-0.00466** **(0.02831)**	**-0.00511** **(0.02823)**	**0.01934** **(0.08396)**	**0.01980** **(0.08339)**
Pseudo-Target	0.22259 (0.19903)	0.22589 (0.19811)	-1.34034** (0.59507)	-1.34365** (0.59088)
Year Indicators	Yes	Yes	Yes	Yes
Center Indicators	Yes	Yes	Yes	Yes
Area Demographics	No	Yes	No	Yes
Center Demographics	No	Yes	No	Yes
R-squared	0.91214	0.91235	-	-
Observations	2420	2420	2596	2596

Notes: See Tables 3 and 5. Pseudo-Target represents the following non-Autism healthcare practitioner occupation codes: 3000 (chiropractors); 3010 (dentists); 3030 (dieticians and nutritionists); 3040 (optometrists); 3050 (pharmacists); 3200 (radiation therapists); and 3310 (dental hygienists). Autism occupations are excluded from all models.

Appendix Table 1
One-year Lagged Effects on Ln Wages
Difference-in-Differences (DD) Estimates
American Community Surveys 2005-2010
21 California Regional Centers

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Control Group	Non-Autism Healthcare Practitioner & Technical Occupations				Non-Autism All Healthcare Occupations			
Ln TotalAutism	0.05109 (0.03688)	0.19418 (0.18123)	-0.14392 (0.28604)	-0.09176 (0.30558)	0.06876* (0.03890)	0.19911 (0.15124)	-0.13763 (0.19055)	-0.11512 (0.20741)
Ln TotalAutism* Target	**0.10459*** **(0.05490)**	**0.10754*** **(0.05376)**	**0.10424*** **(0.05402)**	**0.08142*** **(0.04217)**	**0.09551*** **(0.05221)**	**0.10003*** **(0.05135)**	**0.09786*** **(0.05142)**	**0.07830*** **(0.04233)**
Target (Autism Occupations)	-0.78511* (0.39958)	-0.80962* (0.39111)	-0.78570* (0.39278)	_	-0.51701 (0.38120)	-0.55312 (0.37493)	-0.53698 (0.37500)	_
Year Indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Center Indicators	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Area Demographics	No	No	Yes	Yes	No	No	Yes	Yes
Center Demographics	No	No	Yes	Yes	No	No	Yes	Yes
Occupation Indicators	No	No	No	Yes	No	No	No	Yes
R-squared	0.89830	0.89945	0.89979	0.93415	0.86840	0.86980	0.87006	0.93116
Observations	3094	3094	3094	3094	3813	3813	3813	3813

Notes: Coefficient estimates from OLS models are presented. Standard errors are adjusted for arbitrary correlation within center cells. Area demographics include total county population, percent of the population that is black, percent other race, percent Hispanic, percent ages 13 or below, percent ages 15-44, percent ages 45-64, and percent ages 65 and over. Center demographics include total number of clients served, percent of the total clients who are white, percent black, and percent Hispanic. Asterisks denote statistical significance as follows: *** p-value ≤ 0.01; ** 0.01 < p-value ≤ 0.05; * 0.05 < p-value ≤ 0.10.

Appendix Table 2
Ln Wages
American Community Surveys 2004-2009
15 California Regional Centers (Aggregated centers in Los Angeles county)

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Control Group	Non-Autism Healthcare Practitioner & Technical Occupations				Non-Autism All Healthcare Occupations			
Ln TotalAutism	-0.18395 (0.40180)	-0.11714 (0.39103)	-0.62488 (0.81477)	-0.29538 (0.35723)	-0.41975 (0.25138)	-0.32270 (0.24969)	-0.81781 (0.65928)	-0.49210** (0.22024)
Ln TotalAutism* Target	**0.07270*** **(0.03485)**	**0.07241**** **(0.02686)**	**0.12718** **(0.07934)**	**0.12091** **(0.12081)**	**0.06481*** **(0.03370)**	**0.06822**** **(0.02723)**	**0.12495** **(0.08322)**	**0.11435** **(0.12513)**
Ln TotalAutism* Target*Displacement	–	–	**-0.07700** **(0.05352)**	–	–	–	**-0.07407** **(0.05177)**	–
Target (Autism Occupations)	-0.59988** (0.27249)	–	-0.99112* (0.56956)	-0.33273 (0.48628)	-0.33517 (0.26447)	–	-0.76796 (0.59822)	-0.05860 (0.51622)
Year Indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Center Indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Area Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Center Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation Indicators	No	Yes	No	No	No	Yes	No	No
Mental Retardation (MR) & Mild/Moderate MR*Target	No	No	No	Yes	No	No	No	Yes
R-squared	0.69534	0.82747	0.69464	0.69550	0.66372	0.84545	0.66580	0.66380
Observations	2296	2296	2126	2296	2821	2821	2612	2821

Notes: See Tables 3 and 4.

Appendix Table 3
Ln Personal Earnings
American Community Surveys 2004-2009
21 California Regional Centers

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Control Group	Non-Autism Healthcare Practitioner & Technical Occupations				Non-Autism All Healthcare Occupations			
Ln TotalAutism	-0.33903 (0.27619)	-0.34071 (0.27441)	-0.43157 (0.56942)	-0.37849 (0.27296)	-0.25396 (0.24723)	-0.23008 (0.24514)	-0.35773 (0.48694)	-0.30304 (0.23785)
Ln TotalAutism* Target	**0.09860*** **(0.04975)**	**0.08999**** **(0.03887)**	**0.15567**** **(0.06889)**	**0.16241**** **(0.07123)**	**0.10236*** **(0.05108)**	**0.09244**** **(0.04216)**	**0.16099**** **(0.06824)**	**0.16603**** **(0.07264)**
Ln TotalAutism* Target*Displacement			**-0.09319**** **(0.03970)**				**-0.09350**** **(0.03738)**	
Target (Autism Occupations)	-0.80544** (0.36633)	. .	-1.22033** (0.51672)	-0.11056 (0.37777)	-0.62946 (0.37840)	. .	-1.05757** (0.51049)	0.06018 (0.39534)
Year Indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Center Indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Area Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Center Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation Indicators	No	Yes	No	No	No	Yes	No	No
Mental Retardation (MR) & Mild/Moderate MR*Target	No	No	No	Yes	No	No	No	Yes
R-squared	0.72166	0.83385	0.72198	0.72188	0.68771	0.84569	0.68802	0.68790
Observations	3094	3094	3094	3094	3813	3813	3813	3813

Notes: See Tables 3 and 4.