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The Effect of Birth Registration on Child Labor and Education in Early 20th Century USA

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Abstract

A birth certificate establishes a child's legal identity and age, but few quantitative estimates of the significance of birth registration exist. Birth registration laws were enacted by U.S. states in the 19th and early 20th centuries. Using 1910-1930 census data, this study finds that minimum working age legislation was twice as effective in reducing under-aged employment if children were born with a birth registration law, with positive implications for school attendance. Registration laws also improved the enforcement of schooling laws somewhat, but the connection is weaker. The long-term effect of registration laws was to increase educational attainment by 0.06-0.1 years.

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1 Introduction

For any law with an age requirement to fulfill its purpose, credible formal proof of age is required. Whether this exists, depends on whether the birth of the individual was officially registered, and whether a certificate exists, or can be requested from an official file.

In most developed countries today, the registration of births is taken for granted. However, in many developing countries, the births of a significant proportion of children go unregistered. For example, according to most recent survey-based estimates, the share of children under five whose births were registered was 7 percent in Ethiopia, 41 percent in India, 53 percent in Indonesia and 60 percent in Kenya (UNICEF, 2011).¹ In the past decade, international organizations have been campaigning to raise birth registration rates in developing countries (see e.g. Cody, 2009). A more general recording exercise, in the form of biometric identity creation, is currently underway in India.²

A birth certificate establishes a person's legal identity and functions as official proof of age (see e.g. Todres, 2003). According to UNICEF (2005), without a birth certificate, children cannot necessarily be considered legally under-aged for certain activities, such as marriage, work, or prosecution. Access to health care, social security or education may also be denied without a birth certificate in several developing countries. Additionally, the registration of births and other vital events generates accurate figures on the population and is therefore also considered important from a planning perspective, in particular in the context of health care.

Despite the potentially large-scale significance of birth registration from an economic and welfare perspective, the study of birth registration has not attracted attention from economists. The importance of identity documentation in general has been recognized in relation to access to formal finance in developing countries (see e.g. Demirgüç-Kunt et al., 2008) and in a recent study, Giné et al. (2011) find that the use of fingerprinting as a proof of identity raised repayment rates of microfinance borrowers in Malawi. Some general reports on the consequences of lack of birth registration exist (see e.g. ADB, 2007 and Harbitz and Boekle-Giuffrida, 2009), but there is a general lack of causal statistical evidence on the economic, and social significance of birth registration.

A few historians have discussed the significance of birth registration as an important, but neglected institution for economic development. Szreter (2007) describes the importance of parish registers in England between the 16th and 18th centuries in the process of verifying property and inheritance rights as well as social security claims (the Poor Laws). Higgs (1996) describes how the need to clarify property rights lies behind the establishment of civil registration systems in Britain in the 19th century. An established economic literature on the importance of property rights for economic development exists (e.g. de Soto, 2000), but the potential importance of the legal existence of an individual in this context has been a more neglected aspect.

1 Based on surveys between 2006-2008.

2 See e.g. The Economist, 14 January 2012

In order to understand more about the potential economic significance of birth registration, this study focuses on early 20th century USA, when state-level laws and institutions for birth registration were established across U.S. states. The purpose of these laws was to ensure that births were registered, a central record existed and that certificates of birth were made available. The quantitative analysis exploits the fact that the timing of the enactment of state birth registration laws varied across states. At this point in time, if births were registered, this happened early in the child's life. Delayed registration of births was not a standard practice until the early 1940s, when economic necessities led to states adopting standard procedures for delayed birth registration (see Hetzel, 1997 and Landrum, 2010a).

The study focuses on a question for which outcome data are available and on which historical documentation exists; the relevance of birth registration for the enforcement of minimum working age and compulsory schooling legislation. The incidence of child labor in the U.S. declined significantly in the early 20th century. The study examines whether the legal age requirements were more effective in reducing under-aged employment and in raising school attendance of school-aged children when birth certificates were available as proof of age. These questions remain relevant for today's developing world.³ The census data used in this study do not include information on whether the birth of an individual had been registered, so it is assumed that an individual was significantly more likely to possess a birth certificate if they had been born with a birth registration law in place than before such as law.

The roles played by compulsory schooling laws and child labor laws in either educational attainment, or in the incidence of child labor in the U.S., have been studied previously by economists (see e.g. Osterman, 1979, Brown et al., 1992, Angrist and Krueger, 1991, Margo and Finegan, 1996, Moehling, 1999, Lleras-Muney, 2002, Manacorda, 2006, Goldin and Katz, 2008). Econometric studies indicate that the laws may have been relevant for raising education levels, or reducing child employment, but that their contribution was not large. The economic literature on these laws has so far ignored the role of birth registration in legal enforcement.⁴

The core part of the analysis in this study utilizes individual-level data from 1 percent samples of three U.S. federal censuses; for 1910, 1920 and 1930. Whether a child was born with a registration law in place depended on his, or her year of birth and state of birth. The minimum working age and compulsory schooling laws varied by state and over time. The econometric framework used to identify the legal effects controls for state of birth, state of residence as well as birth cohort effects. The minimum working age legislation and child labor as the outcome are studied in more detail. The data source used does not capture regular school attendance well, and it is argued that historical writing includes more discussion on the use of birth certificates in the enforcement of minimum working age laws rather than schooling laws.

³ For example, according to UNICEF (2011), one in six children aged between 5-14 are engaged in child labor.

⁴ In this connection it should be noted that the author is aware of an unpublished study by Puerta (2010) on the effects of child labor laws on the value added in the U.S. manufacturing sector, where a robustness check takes into account whether the child labor law required documentary proof of age.

The study finishes with a brief retrospective analysis on the implications of birth registration for educational attainment, using the 1960 census and individuals born between 1896-1925.

The analysis on child labor focuses on the 1910-1930 census data and 12-15 year old children. The findings show that the minimum working age legislation reduced the tendency of under-aged children to work in relation to the work-eligible, but the law was twice as effective when children had been born during, or after the year, when their state of birth had enacted a birth registration law. The result is robust to several specifications and a falsification exercise. A further investigation suggests that the effect of the registration laws was confined to children residing in counties where agriculture was not the dominant economic activity. It is found that those below the minimum working age were also more likely to attend school when they had been born with rather than without a birth registration law in place.

The compulsory schooling age is not found to be a relevant factor for child employment, or school attendance for 12-15 years olds, after minimum working age is controlled for. Birth registration laws do not alter this conclusion. However, for a sample of younger children (6-11), those within the compulsory schooling age range were more likely to attend school than those outside, when they had been born with a birth registration law. An analysis with the 1960 census indicates that children born with a birth registration law in place had around 0.06-0.1 more years of education than those born before a birth registration law.

The study confirms that birth registration is an important institution for the enforcement of laws that specify an age requirement. This has implications for studies on such laws both for today's developing countries, and in a historical context. Although the aim is not to evaluate the effects of a particular legal age requirement on household net welfare, at the level of an individual, the results on education could be considered indicative of longer term welfare improvements.

The paper is organized as follows. Section 2 discusses the developments in birth registration in the USA. Section 3 discusses the relevant existing literature on the effectiveness of child labor and compulsory schooling laws in the U.S. context and Section 4 discusses the hypotheses on the relevance of birth registration laws. Sections 5 and 6 describe the data and econometric analysis with respect to child labor and schooling respectively. Section 7 concludes.

2 Birth registration in the U.S.

The roots of modern birth registration systems in the USA are reported to lie in the need for accurate statistics on births and deaths in the face of rapid urbanization in the 19th century, spread of epidemics and associated mortality. Proponents of sanitary reform advocated for accurate statistics on the incidence of births and deaths to further their cause (see Hetzel, 1997). The development of birth registration systems in the early 20th century could also be regarded as an element of Progressive-era child welfare reforms (Landrum, 2011).

Shapiro (1950) describes Massachusetts as the first state to pass a “modern” state-level law requiring that births and deaths are registered. The law was passed in 1841 and strengthened in 1844 to include full details on associated fees and penalties for late registration. Uniform birth certificates were to be issued throughout the state, a state-wide file of copies of the records was created and attention was paid to enforcement of the legislation.⁵

According to Hetzel (1997, p. 48), “between 1850 and 1860, registration was working well in a handful of cities and in two States.” The American Public Health Association, founded in 1872 played an advocacy role and the Census Office (Bureau of the Census), became the primary body involved in developing a system for the collection of annual vital statistics data, aiming at nationally comparable statistics. The process by which states enacted laws making birth registration mandatory at the level of states was a gradual one. Hetzel (1997, p. 53) cites a National Resources Committee report as follows: “in some States, the boards of health had to be educated to the need, before the citizens of that State could approach the legislature. In others, the legislatures were apathetic, in spite of strong pressures...”

Significant progress in the enactment of state-level registration laws, and birth registration is considered to have been made after a model registration bill was passed in 1907. According to Shapiro (1950, p. 91), this Model Vital Statistics Act specified the “central authority of the State boards of health over registration matters, provided for the establishment of a strong local apparatus, fixed responsibility for registering births on the attendant at birth (physician, midwife)⁶, called for rigid enforcement of the law, and listed a minimum set of items for inclusion on State certificates”.⁷ Pennsylvania adopted a draft version of this bill in 1905 (came into force in 1906) and according to Shapiro (1950), the improvements in birth registration were “immediate”. Many other states followed suit, or amended existing laws to conform to the Model Act (Shapiro, 1950). The discussion in Hetzel (1997) and Shapiro (1950) suggests that the core aims of state registration laws were to enable birth registration and make it mandatory, standardize registration practices and provide uniform birth certificates and as well as establish central repositories of birth certificates, which would facilitate their use.

Enforcement of these state-level registration laws was not perfect to begin with. In some cases, early state laws did not include penalties and were therefore potentially less effective in registering the population (see Nichols, 1980). The National Birth Registration area was established in 1915. Ten states (in north-eastern and north central parts) and the District of Columbia were included (Shapiro, 1950). The criteria for the initial inclusion are somewhat unclear, but from thereafter states were included when 90 percent of births were estimated to be registered (Shapiro, 1950). From 1915 onwards, annual birth statistics were gathered for the expanding birth registration area (see Hetzel, 1997). Through time, the

5 Landrum (2011) explains that by 1861 in Massachusetts, town clerks were incentivized by payments for each birth they reported to the state and fined for not registering births. Parents could be fined up to 5 dollars for not reporting a birth.

6 According to Landrum (2011), the model law specified that doctors and midwives were not allowed to collect a fee for filing a certificate with the local registrar. They faced penalties for not undertaking this duty.

7 See Hetzel (1997), p. 28 for a table on the content of a U.S. standard birth certificate across time since 1900.

registration of births and deaths became a regular health department function.

Prior to early 1940s, regulation, or procedures for delayed birth registration were either missing, or slow and complex, which strongly inhibited late registration (see Hetzel, 1997).⁸ According to estimates, in 1940 the births of nearly 55 million Americans⁹ had never been registered (Hetzel, 1997). Only in 1941 did the Census Bureau design a manual on procedures for delayed registration, which were then adopted by a large number of states (Hetzel, 1997). The absence of functioning delayed registration implies that if a child was not registered at birth, or shortly after, there was a high likelihood that their birth remained unregistered, until the early 1940s.¹⁰ Differences in registration rates remained with respect to race and urban versus rural location for some time. Estimates in 1940 showed that while 94 percent of white births were estimated to be registered, the corresponding figure was 81.5 percent for black births. There was also an urban-rural differential of 9.5 percent in favor of urban, likely to be driven by the lower rates of hospital births in rural areas (see Shapiro, 1950).

States may have had some practices for recording births prior to the state birth registration laws that made registration mandatory, and provided for certificates of birth. Registration may have been carried out at the level of counties, or in certain cities, but the coverage was generally weak (see Nichols, 1980 and Eichholz, 2004).¹¹ In a discussion on early attempts of registration in the 17th and 18th centuries, Hetzel (1997, p. 45) notes that “although a few cities and towns maintained active registration, for many years not a single State could be said to have a system covering its entire area”.

Table 1 shows the year in which the laws that established mandatory birth registration at the state-level were passed and the year in which the state was incorporated into the National Birth Registration area.¹² Figure 1 presents a histogram of the timing of the birth registration laws. The data sources and the determination of the timing of the laws are discussed in detail in Appendix 1, which also includes a map of the timing. Appendix 1 also discusses the correspondence between the years in Table 1 and the year from which onwards the State Office of Vital Statistics currently holds records of births (Table A1).

8 See Landrum (2010a) for a discussion on how the requirement of the war industry to employ U.S. citizens led to a dramatic increase in the demand for delayed birth certificates by adults in early 1940s.

9 The total US population in 1940, including foreign born individuals, was 132,164,569. Source: 1990 Census of Population and Housing, "1990 Population and Housing Unit Counts: United States", (CPH-2).

10 As an example of the complexities of delayed registration, Landrum (2010a) describes the case of California, where delayed registration was only possible through a complicated court proceeding with fees high enough to discourage most ordinary workers. As an indication of the lack of birth certificates and thus a functioning delayed registration system prior to the 1940s, Landrum refers for instance to the case Illinois, where over half a million applications for delayed certificates were processed between 1941-1943. Even if some children might have received delayed birth certificates prior to the 1940s, these would have been based on alternative proof of age, or parental testimonials, and were thus potentially unreliable.

11 Any existing records may also have been destroyed by the time a state law came into place, making it impossible to obtain copies (see e.g. Clopper, 1918 for the case of Alabama).

12 Analysis excludes Alaska, District of Columbia and Hawaii. Alaska and Hawaii were not states at the time and District of Columbia is excluded due to its special nature.

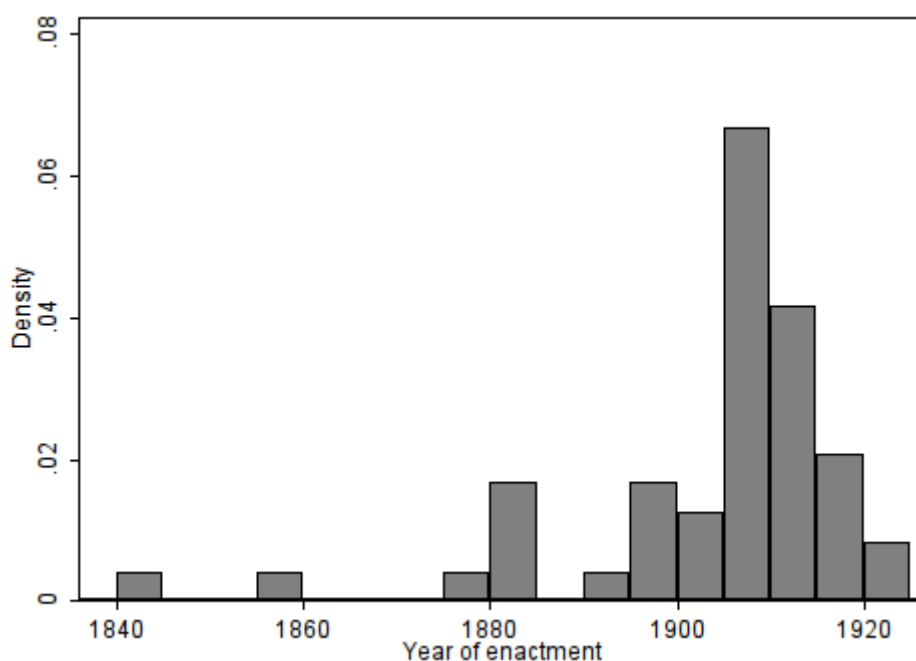
Table 1 Timing of the state laws on birth registration across U.S. states

State	Year of birth registration law	Part of birth registration area	State	Year of birth registration law	Part of birth registration area
Alabama	1908	1927	Nebraska	1904	1920
Arizona	1909	1926	Nevada	1911	1929
Arkansas	1914	1927	New Hampshire	1883	1915
California	1905	1919	New Jersey	1878	1921
Colorado	1907	1928	New Mexico	1920	1929
Connecticut	1897	1915	New York	1880	1915
Delaware	1881	1921	North Carolina	1914	1917
Florida	1899	1924	North Dakota	1907	1924
Georgia	1919	1928	Ohio	1909	1917
Idaho	1911	1926	Oklahoma	1917	1928
Illinois	1916	1922	Oregon	1903	1919
Indiana	1908	1917	Pennsylvania	1906	1915
Iowa	1880	1924	Rhode Island	1896	1915
Kansas	1911	1917	South Carolina	1915	1919
Kentucky	1911	1917	South Dakota	1905	1932
Louisiana	1918	1927	Tennessee	1914	1927
Maine	1892	1915	Texas	1903	1933
Maryland	1898	1916	Utah	1905	1917
Massachusetts	1841	1915	Vermont	*1857	1915
Michigan	1906	1915	Virginia	1912	1917
Minnesota	1908	1915	Washington	1907	1917
Mississippi	1912	1921	West Virginia	1925	1925
Missouri	1910	1927	Wisconsin	1908	1917
Montana	1907	1922	Wyoming	1909	1922

Source: Dates for birth registration laws are from Nichols (1980). See Appendix 1 for discussion. Dates for the incorporation into the national birth registration area come from Hetzel (1997, Table 1.01, Appendix 2).

* Information comes from a section of Eichholz (2004) that discusses state vital records.

Figure 1 Histogram: Timing of the enactment of state birth registration laws across U.S. states.



In 75 percent of the states, the law was passed after 1900. The years in Table 1 indicate that it took

longer for some states than others to reach close to full registration coverage since the enactment of the law. Nevertheless, as the discussion above implies, the state laws on registration can be regarded as instrumental for advancing birth registration, and eventually achieving close to full coverage. Therefore, this study assumes that birth registration could function effectively, and provide individuals with accurate birth certificates on a large-scale, only once state-level laws on compulsory registration were enacted and state-level procedures established. The determinants of the timing of the laws could also be analyzed empirically, and the results of a state-level regression analysis are discussed in Appendix 2 and will be referred to further below.

3 Compulsory schooling laws and child labor laws in the U.S.

Connection between laws, child labor and schooling

Economists have tended to analyze child labor in the context of family welfare optimization, considering returns from child work as opposed to adult work, or returns from schooling as opposed to work (see e.g. Edmonds and Pavcnik, 2005 and Edmonds, 2008 for detailed surveys). Most of the existing empirical research on the effects of child labor laws has focused on the USA, where in the late 19th and early 20th centuries, these laws varied across U.S. states.¹³ Compulsory schooling laws have been used more broadly to study, not just the direct effect on schooling, but the economic and social effects of additional education in different contexts (see e.g. Card, 2001 and Lochner, 2011).

Given the breadth of the literature on child labor and compulsory schooling in general, only key empirical research on the effects of child labor laws and compulsory schooling law on education and child employment in the context of the USA, is discussed here. As decisions to work and attend school are closely connected, so are the two types of laws.

Starting with a few studies on compulsory schooling laws, an influential one by Angrist and Krueger (1991) demonstrates how due to compulsory education laws, the quarter of an individual's birth affects educational attainment and school enrollment for children born between 1930s and 1960s. The authors then use the quarter of birth as an instrumental variable for education to study the income effects of education. Margo and Finegan (1996) introduced child labor laws as an additional component to the study of the effects of compulsory schooling laws on school enrollment. They rely on a sample of the 1900 U.S. population census and find that compulsory schooling laws were more effective in six states that combined them with a law on minimum working age.

Earlier research on child labor suggested that factors such as technological change, immigration, demography and wealth explained the decline in child labor in late 19th and early 20th centuries (see e.g. Osterman, 1979, Goldin, 1979 and Brown et al., 1992). Moehling (1999) then studied the effect of the

13 The Fair Labor Standards Act, a federal child labor law, was only enacted in 1938 (see e.g. Moehling, 1999).

minimum age limit for manufacturing employment between 1880-1910 using a difference in differences estimation framework. She concludes that the minimum working age limit did not reduce the likelihood of child employment in manufacturing, or any occupation, between 1880 and 1900. It may have been somewhat more effective between 1900 and 1910. She shows that significant progress was made in the enactment of child labor legislation only in the first decade of the 20th century.

Lleras-Muney (2002) extends the analysis in earlier studies by considering a range of indicators for child labor and schooling laws, including not just the age requirements, but also legal requirements on the minimum years of schooling to be completed and the presence of continuation laws. She focuses on laws in place between 1915-1939. With the use of a sample of the 1960 U.S. census, she finds that one additional required year of schooling raised educational attainment by about 0.05 years. However, the impact was confined to whites and depended on the legal indicator used.¹⁴

Manacorda (2006) finds that there is a connection between child labor laws and child employment using a sample of the 1920 U.S. census. His study investigates primarily the impact of a child's employment on the labor supply of parents and siblings, but relies on a child labor law indicator to construct an instrumental variable for child labor. Simple OLS estimates show that in 1920 for 10-16 year old children, minimum working age laws reduced child labor by approximately 5.5 percentage points.

Goldin and Katz (2008) use state-level data for 1910-1938 to analyze the impact of child labor laws and schooling laws on secondary school enrollment. Additionally, they study educational attainment with 1960 census data. They focus on requirements on the length of schooling, either for employment, or school drop-out, and the presence of continuation schooling laws. They find that together these laws did affect enrollment and attainment, but explain at most around 6-7 percent of the increase in either. The effect does depend to an extent on the model specification, and specific laws examined.

To conclude, the key empirical studies suggest that if child labor laws and compulsory schooling laws did have an effect on education, or child labor, these effects were not large. The literature has assumed that once a rigorous modeling strategy is adopted, the impact of child labor laws and compulsory schooling laws can be identified. This study relies on the same assumption. Lleras-Muney (2002) investigates the economic correlates of child labor and schooling law indicators at the state and cohort level. She finds a weak relationship between education levels and child labor laws, but in a further investigation on the timing of the laws, concludes that endogeneity is not a significant concern.

Child labor and compulsory schooling laws

The data used in this study on the schooling and child labor laws come from Goldin and Katz (2008). These data involve contributions from Schmidt (1996) and Lleras-Muney (2002) and have been used for instance in the study by Manacorda (2006). The source includes annual data on child labor and

¹⁴ An earlier unpublished dissertation by Schmidt (1996), analysing compulsory schooling laws over a similar period, also finds effects on high school graduation rates.

compulsory schooling laws between 1910-1939 for each U.S. State.¹⁵ In the data source, the values for each state represent those that applied to the majority of the population, as sometimes there were exemptions or differences between areas within a state. The source includes the minimum working age, or schooling requirement for each state and each year, but if a law was already in force, the starting date cannot be inferred.

Goldin and Katz (2008) provide a detailed discussion on the child labor and schooling laws and their evolution in the early 20th century U.S. The first compulsory schooling laws were enacted in the U.S. in the mid-nineteenth century. However, investments in education and enforcement, in particular at the secondary level, were still made in the early 20th century. This involved for instance defining standards for high school education, increases in expenditure, especially in poorer districts and more active involvement of truant officers (see e.g. Osterman, 1979, Lleras-Muney, 2002 and Goldin and Katz, 2008 for details). School censuses were carried out already in the early 20th century to record children who should be attending school and by 1928 this took place in each state (Goldin and Katz, 2008). By 1907, in a significant number of states, parents faced fines, or imprisonment for failing to send a child to school (Goldmark, 1907) .

In states with minimum working age laws, children required “working papers”, or a work permit, to be able to work and employers were responsible for holding these papers¹⁶ (see Goldin and Katz, 2008). Mechanisms to enforce child labor laws were also strengthened in the early 20th century. According to Ogburn (1912) (cited by Moehling, 1999), by 1909, 34 states had enacted provisions for special inspectors to enforce child labor laws.¹⁷ Goldmark (1907) suggests that in 1907, an even larger number of states had penalties in place for employers for the employment of under-aged children, and a significant number of states also had penalties for parents for allowing their children to work, generally in the form of fines or imprisonment. There were also penalties for obstructing the entry of factory inspectors.

Several of the studies discussed above have tended to focus on children in non-agricultural households as one might expect minimum working age legislation in particular to be less effective, or less well enforced, in rural areas, where a large share of children worked in agriculture, and on family farms. The relevance for agriculture is thus debatable, but can vary by state. Some states had exemptions for hardship, especially in the South (see Hindman, 2009, p. 483), or for children working in establishments owned by their parents (see e.g. Riney-Kehrberg, 2001, p. 59). As one concrete example, Riney-Kehrberg (2001, p. 58-59) notes that around 1920 in Illinois, under 14-year olds were prohibited from “any gainful occupation in, or in connection, with factories, canneries, stores, etc., at any time, or in any work for compensation during the school term.” According to Goldmark (1907), in 1907 there were several states

15 Data on compulsory schooling age requirements are available from 1900.

16 According to Goldmark (1907), at the time of publication the authority that issued “working papers” varied by state. She lists school officials, health officers, factory inspectors or judges as the options.

17 Goldmark (1907) also notes in many states, both truant officers and factory inspectors were authorized to “enter places of employment, to demand certificates of age or schooling...”.

where anyone below 14 years of age was prohibited from all employment during school hours.

For the child labor law, the core variable of interest is “the minimum legal age for obtaining a work permit for work during normal school hours” in the child's state of residence, which is available for 1910-1939. For compulsory schooling laws, the main indicators used relate to the legal school entry age and school leaving age in the child's state of residence (or birth), which are available for 1900-1939. Appendix 1 discusses the definitions of the indicators on child labor and schooling laws in more detail.

Often, the minimum school leaving age was higher than the minimum working age. States tended to waive the general requirements on compulsory schooling for working children who had reached the minimum working age; in some cases for a minimum educational requirement, in some for the ability to read, or write and in others, there were no such length of schooling requirements. As Goldin and Katz (2008) state, the binding constraint for work for much of the 1910-1939 period, was the age at which a youth could obtain a work permit, or the schooling requirement for employment if such was specified. In addition, many states exempted also non-working children from a maximum schooling age requirement if they had met a certain amount of schooling (in years). Although previous studies (such as Lleras-Muney, 2002 and Goldin and Katz, 2008) have exploited legal requirements on the years of schooling, with the exception of a robustness check, this study relies on the age requirements. The explanation for this is that only age requirements can be considered strictly relevant for studying the role of birth registration in the verification of age.¹⁸

Table 2 Minimum working age and compulsory schooling age across 48 states between 1910-1930, number of states.

Age	Minimum working age			School leaving age			Age	School entry age		
	1910	1920	1930	1910	1920	1930		1910	1920	1930
No age	8	2		7			No age	7		
12	7	4		2	1		6			2
13		1					7	16	21	29
14	33	36	41	18	8	5	8	24	26	17
15		4	5	4	4	1	9	1	1	
16		1	2	15	32	31				
17				1	2	6				
18				1	1	5				

Data source: Goldin and Katz (2008)

Table 2 shows the developments in the child labor and schooling age requirements for 1910, 1920 and 1930, corresponding to the census years used in the majority of the analysis. Across the years, the most common minimum working age was 14. In 1910, 8 states did not have a minimum working age law. In 1920, only 2 did not have one and by 1930 all states had such a law. Over the period, the school leaving age ranged between 12-18, with 14 being the most common age in 1910 and 16 the most common

¹⁸ The presence of continuation schooling laws, also analyzed in Lleras-Muney (2002) and Goldin and Katz (2008), are controlled for in the retrospective analysis on educational attainment in Section 6. They applied to working children below legal school leaving age and thus depend on employment.

age in 1920 and 1930. The school entry age ranged between 6-9, with 7 and 8 being the most common ages. In 1910, 7 states did not have a compulsory school leaving or entry age, but by 1920 all had one. The length of schooling requirements are not shown in the Table, but in 1910, the data on the schooling requirements for work were missing for 8 states, 18 states only required children to be able to read and write and 19 had no minimum education requirements. Such requirements became more common in 1920 and 1930, ranging between 4-8 years of schooling.

Finally, it could be asked whether the introduction of the minimum working age and compulsory schooling age legislation coincided closely with the enactment of birth registration laws? In a sample of state-level annual data for 48 states between 1910-1930, the correlation between whether the state had a birth registration law and a legal minimum working age was 0.22. For the same period, the correlation between whether the state had a legal school leaving age and a birth registration law was 0.34. In 1900, 32 states had a maximum legal schooling age, but only 12 had enacted a birth registration law. In 1910, there were 32 states out of 48 that had enacted a birth registration law, 40 states with a minimum working age law and 41 states with a legal school leaving age. The correlation between the enactment of a child labor and a compulsory schooling law and a birth registration law is not very strong. Laws on child labor and schooling were often introduced prior to a birth registration law. As discussed below, the latter may have been a reaction to the difficulties of enforcing child protection laws without formal records of birth.

4 Birth registration and age requirements: hypotheses

According to Shapiro (1950, p. 92), especially post World War I, “the birth record in some places became the primary document for verifying age in entering school and in obtaining work permits”. Discussion on the use of birth certificates in the enforcement of minimum working age legislation in the early 20th century can be found in historical writings. Birth registration could also affect schooling for several reasons, but information on the precise use of birth certificates in the enforcement of compulsory schooling age is not as easily available, in particular regarding the school entry process. Schooling laws and child labor laws were connected, but proof of age would not directly serve a purpose in the verification of years of schooling requirements, but only the age requirements. Given that the data source used does not capture regular school attendance well, the empirical analysis focuses more on the minimum working age legislation and child labor as the outcome of interest. This Section discusses the documentation and hypotheses on the relevance of birth registration separately for the minimum working age and compulsory schooling age laws.

Minimum working age and birth registration

The enforcement of minimum working age legislation took place through the issuance of work permits and inspections of work premises. In 1907, according to Goldmark, 17 states required

documentary proof of age for issuing a work permit, or employment certificate, 17 states required no proof of age and 14 accepted an affidavit by a parent regarding the age. When documentary evidence was required, birth certificates often had priority, but if a birth certificate was unavailable, a baptismal record, or a school (graduation) certificate, was generally demanded. That failing, a physical examination may have been carried out to establish physical fitness. In general, in 1907 proof of age was required to prove age within a certain range (often 14-16, or below 16).

Practical examples of the relevance of birth certificates in the process of granting work permits can be found in historical writings. In New York state, birth certificates were used in early 20th century as the primary proof of age for the purpose of granting work permits (Minor, 1910). In 1909, 75 percent of the 30,000 employment certificates in New York City were based on birth certificates as the proof of age. If a birth certificate could not be presented, the applicant was formally asked to convince the officers that the birth had not been recorded. In Wisconsin, already in 1903, laws listed birth certificates as the primary form of proof of age required for obtaining a work permit (McLogan, 1935). Lindenmeyer (1997, p. 120-121) describes how the lack of birth certificates was identified by the Children's Bureau as an obstacle to the enforcement of the unsuccessful federal child labor law between 1916-1918.¹⁹ Clopper (1918) describes similar problems in Alabama. The relevance of birth certificates as proof of age in the early 20th century U.S. has also recently been noted by Landrum (2009, 2011).

These examples suggest that for child labor laws requiring documentary proof of age to be effective, birth registration should be functioning at the state-level and copies of certificates should be accessible, preferably in a uniform format. This was unlikely without state laws on compulsory registration and can explain why states did not require documentary proof of age if there was no state registration law. Out of the states that Goldmark (1907) lists as requiring documentary proof of age for working papers, 71 percent had passed a state-level birth registration law by 1907. Out of the remainder that required no proof, or accepted a parent's affidavit, only 37 percent had passed such a law by 1907.

What is the expected effect of birth registration on the enforcement of minimum working age legislation? Working children could follow the official route and present an employer with an official work permit. When this happens, the responsibility of verifying the age is placed upon the officials granting permits. Alternatively, the employer may be willing to employ children without a permit, but risks punishment, especially if factory inspectors are able to demand convincing proof of age (birth certificates). Official proof of age might be expected to prove most useful in borderline situations, such as for 12-13 year olds when the minimum working age was 14, rather than for younger children (such as 8-

¹⁹ This refers to the Keyting-Owen Act, which was an attempt at a federal child labor law made in September 1916. It was declared unconstitutional shortly after (June 1918), and was in practice effective for less than a year (see e.g. Lindenmeyer, 1997, p. 91 and p. 121). Lindenmeyer mentions five states as examples of those where very few children seeking work permits had birth certificates around 1916 (North Carolina: 0.2 percent, South Carolina: 0.3 percent, Georgia: 1.4 percent, Mississippi: 1.8 percent and Virginia: 6 percent). These states enacted state birth registration laws between 1912-1918, but children nearing working age had been born before this period.

10 year olds), for whom under-aged status is less disputable.

If in a specific state, children hoping to work had been born with a birth registration law in place, those seeking a work permit could be expected to present a birth certificate as proof of age. Claims that a birth was not registered could be verified in the presence of central records and a repository of certificates. If birth certificates could generally be demanded as proof of age, officials could deny work permits from the under-aged. Employers willing to hire without a permit might not be willing to hire under-aged children in the knowledge that inspectors would be in a position to demand birth certificates.

If birth certificates did not exist, either in the state as a whole, or for the particular individual, alternative proof of age (such as affidavits and other documents with potential for falsification) would be relied upon, or the state might not require proof of age. In both cases, children visibly below the working age might be denied work. However, those closer to the working age, but still below, might be allowed to work, if they presented false proof of age, or were physically mistaken as work-eligible. Therefore, the general hypothesis is that under-aged children, in particular those in the borderline category, would be less likely to work if they had been born with a birth registration law in place than without such a law.

How about work-eligible children? If children had reached minimum working age, they would either be able to prove with a birth certificate that they are eligible, or in the absence of having had their births registered, would generally fall in the borderline category and be likely to be granted permits. If only birth certificates are accepted as proof of age, which is a strict enforcement environment, it is possible that some work-eligible children would be denied a work permit, or work by employers, if they could not produce a birth certificate. However, even in the strictest environment, if work-eligible children could prove that their birth was not registered, alternative proof may have been accepted. As mentioned above, proof of age was required generally up to a certain age. Thus, if the child appeared to have physically reached such an age, birth certificates might cease to be relevant.

Therefore, in conclusion, birth registration could be expected to reduce under-aged employment, but not necessarily directly affect the employment of work-eligible children, or do so to a considerably smaller degree. In the latter case, assuming that a lack of birth certificates did pose an impediment for work, the expected effect of birth registration would be to increase the employment of the work-eligible.

Compulsory schooling age and birth registration

In relation to compulsory schooling laws, reliable proof of age should identify school-aged children more accurately, both at the school entry stage, but also later in the detection of truants. According to Hindman (2009, p. 51), history suggests that in general it was easier to enforce school attendance laws with “good data, including school registers and birth registration”. In their study on the connection between secondary schooling and child labor and compulsory schooling laws, Goldin and Katz (2008) note that “changes in enforcement, not changes in the laws, may have mattered, and we (as

well as the others mentioned) have not yet secured a variable that captures enforcement expenditures and efforts for all states during the period of interest.” Birth registration could be considered a relevant enforcement dimension.

As mentioned above, birth certificates would not be directly relevant for the verification of years of schooling requirements, but only age requirements, so the discussion only concerns the latter. If schools could demand birth certificates to ascertain a child's age at the school entry stage, children would be more likely to enter school at the required age. Those below the schooling age would not be accepted. Those having reached this age might be less likely to ignore the law, if they would be expected to present official proof of age. Closer to school leaving age, truancy officers and schools could be expected to better identify under-aged truants with, rather than without, birth certificates. If school censuses were supported by birth certificates, they would also more accurately list school-aged children. In principle, if school censuses aided educational planning, school-aged children would have been identified more accurately, and as a consequence birth registration may even have had implications for school investments. If this were the case, we might see a connection between birth registration and schooling, independent of compulsory schooling and child labor laws.

In general, attendance rates could be expected to be higher for school-aged children born with than without birth registration laws. It might also be possible that due to the lack of a birth certificates, children entered school too early, or were not allowed to leave once they had reached the legal leaving age. The latter appears less realistic, but if this were the case, children outside the compulsory schooling age range would be less likely to be in school when born with than without a birth registration law, when other factors contributing to schooling decisions would be controlled for.

5 Birth registration laws and child labor

Data

The individual-level data in this section come from publicly available 1 percent samples of the U.S. population censuses for 1910, 1920 and 1930 in the Integrated Public Use Microdata Series (IPUMS-USA, Ruggles et al. 2010).²⁰ The variables used in the analysis can be considered more or less comparable between the censuses. Potential differences in relation to the dependent variable are discussed further below.

The choice of the census samples for these particular years depends on a number of factors. Methodological justifications for using all the three censuses are discussed below. The census of 1910 is the first census to be used, as data on child labor laws is available in the source used from 1910 onwards. While some states had enacted birth registration laws before 1900, the difference between the share of children of 6-18 years of age born with a registration law in place changed rather little between 1900 and

²⁰ The samples for these years are unweighted.

1910 (from an average of 0.16 to 0.20), but increased significantly between 1910 and 1930. Therefore it is of interest to carry out the analysis with more than one census. As will be seen in figures below, the share of children who reported an occupation also declined significantly between 1910 and 1930, in particular between 1910 and 1920. By 1940, the share of children who were employed was small and all the children in the age group studied would have been born with a birth registration law in place.²¹

The census does not include information on whether the birth of a child had been registered and neither do other available sources of individual-level data. The data on age at the time of the census and state of birth are used to define whether a child was born with a birth registration law in place. In most cases the month of the enactment of the law is not available in the data source used. The censuses for 1910-1930 do not include information on the year, or month of birth, and therefore the year of birth is calculated using the person's age. This introduces some unavoidable imprecision. The information on age in the census refers to age on the following days: 15 April, 1 January and 1 April for 1910, 1920 and 1930 respectively. Given that the reference point is early in a calendar year in all cases, the year of birth is calculated as follows: census year – age – 1. The analysis is restricted to children born in the USA as the state of birth determines whether the child was born with a birth registration law in place. If foreign passports and birth certificates were accepted as proof of age, a share of the children born outside the USA will have possessed reliable proof of age. As there is no information about birth registration status in the data set, foreign-born children have to be excluded from the analysis (3.2 percent of the 12-15 year old population between 1910-1930).

In this section, the dependent variable is whether the child is employed. Similarly to previous studies on child labor, such as Moehling (1999) and Manacorda (2006), employment is based on whether the child reports an occupation or not. In this study, occupational coding for the particular census year is used.²² This is considered to reflect occupation more precisely at the relevant point in time than

21 Work of children and women was also treated more explicitly in the 1910 than in the 1900 Census (see e.g. Moehling, 2004 for a discussion on the improvements in the 1910 census as opposed to the 1900 Census). This was also the case for the censuses for 1920 and 1930. The 1900 census was suspected of under-counting working children. It is possible that the 1910 census in turn somewhat over-counted working children in relation to the censuses for 1920 and 1930. These concerns relate mainly to farm labor. Regarding children working on farms, the instructions for the enumerators of the 1900 census, which included occupation for children aged 10 and above, were somewhat vague: “Enter the older children of a farmer (who works on the farm) as farm laborers, except when a father and son (or sons) jointly operate the farm for fixed shares of the product”. The instructions for the censuses for the following years included a more explicit section on children working on farms, and the treatment remained broadly similar between 1910 and 1930. The 1910 census instructions read: “In the case of children who work for their own parents on a farm, the entry in column 18 should be farm laborer and in column 19 home farm; but for children who work as farm laborers for others, the entry in column 19 should be working out..” However, for the 1920 and 1930 Censuses word “regularly” (for work) is included, which might imply that the 1910 Census could over-estimate working children somewhat in relation to the 1920 Census. Seasonality has been raised as another potential concern; the 1910 census was conducted in April and the 1920 census in January, which could affect the prevalence of reported agricultural employment by children (see e.g. Horowitz, 1928). The 1930 census was conducted again in April. Both the 1910 and 1920 censuses have been used in the previous studies on child labor discussed above.

22 1920 codes are used for 1910 and 1920 and 1930 codes for 1930. Those for whom the code is “blank” or “missing” are classified as not working. Those for whom the code was illegible, or inconsistent are excluded. Between 1910-1930, occupation was reported also by persons who were temporarily unemployed. According to the IPUMS data documentation: “the 1920 classification incorporates function as well as setting and sector, and is very detailed. By 1930, the census generally equated occupation with workers' functions, and relegated work setting and economic sector to a separate industry variable.”

occupation based on the 1950 classification, which is the other available alternative.²³ Precise occupational codes are not comparable between 1910-20 and 1930. However, the codes can be used for the purpose of identifying whether, or not, the child has an occupation. Everyone with an occupation code is assumed to be working, while those with “no occupation reported” are assumed not to be working.

This section focuses on children between the age of 12-15. There are several justifications for this. This is the age range for which there is most variation in the three censuses in the combination of the core variables: dummy variables for the minimum working age law (“child labor law”) and the registration law. The first panel in Table 3 illustrates this by cross-tabulating the two variables for the following age groups: 6-11, 12-15 and 16-18 for simplicity for the pooled sample for 1910-1930. The lack of variation in the combinations of these two laws for 6-11 year olds and 16-18 year olds implies that it is not meaningful to estimate models that include these age groups. Additionally, the share of children working in the age group of 6-11 is low (between 1-4 percent in different censuses), whereas the share of 12-15 year olds working in the regression sample varies between 6-23 percent for different censuses. Table 3 also includes a cross-tabulation of the compulsory schooling law and the registration law, which will be referred to further below.

Table 3 Cross-tabulation of laws across age groups and census samples (shares of children)

1910-1930			1910-1930		
Age: 6-11, N=383,612			Age: 6-11, N=383,612		
	Registration law			Registration law	
Child labor law	0	1	School law	0	1
0	0.04	0.01	0	0.13	0.17
1	0.30	0.65	1	0.21	0.49
Age: 12-15, N=240,081			Age: 12-15, N=240,081		
	Registration law			Registration law	
Child labor law	0	1	School law	0	1
0	0.30	0.22	0	0.15	0.04
1	0.19	0.29	1	0.34	0.47
Age: 16-18, N=172,066			Age: 16-18, N=172,066		
	Registration law			Registration law	
Child labor law	0	1	School law	0	1
0	0.59	0.41	0	0.59	0.38
1	0	0	1	0.01	0.02

Child labor law = Dummy variable that takes a value of 1 when child is below minimum working age. Registration law = Dummy variable that takes a value of 1 when the child was born during, or after, the year of the birth registration law. School law = Dummy variable that takes a value of 1 when the child falls within the legal schooling age range. See Appendix 1 for details. Sample includes all US-born children residing in 48 U.S. states.

Table 4 reports summary statistics for the variables used in the regression analysis separately for each census year. The figures show how the share of children born with a registration law in place increased from 18 percent in 1910 to 88 percent in 1930. They also show a significant decline in child

²³ There are a small number of cases who have been classified as not having an occupation code with the current classification, but having one with the 1950s classification. It should be noted that the choice of dependent variable would not affect the results of the analysis.

labor over the period studied, in particular between 1910 and 1920. Child labor was more prevalent in rural than in urban areas. A further analysis on occupations reveals that a significant share of children employed in rural areas in the 12-15 age group were working as unpaid laborers on the family farm (between 65-70% in 1910-1930).²⁴

Table 4 Summary statistics, means, children 12-15 years

Core variables	1910	1920	1930
Male*	0.51	0.50	0.50
Black*	0.136	0.121	0.105
Other non-white*	0.004	0.003	0.005
Reports an occupation*	0.23	0.11	0.06
Urban	0.13	0.09	0.03
Rural	0.28	0.13	0.09
Registration law applies*	0.18	0.36	0.88
Child labor law applies*	0.35	0.49	0.57
School law applies*	0.62	0.87	0.92
Obs.	69276	77469	91108
Additional controls			
Both parents foreign*	0.17	0.17	0.18
No mother*	0.10	0.09	0.08
No father*	0.16	0.14	0.14
Head literate*	0.88	0.90	0.92
Occupational score of head	19.88	20.64	21.68
Age of head	46.2	46.02	45.59
Female head*	0.10	0.09	0.09
Number of individuals in hh	6.74	6.61	6.37
Urban*	0.37	0.41	0.48
Obs.	68917	76991	90455

* Refers to a dummy variable. Sample is the one in the regression models in Table 5.

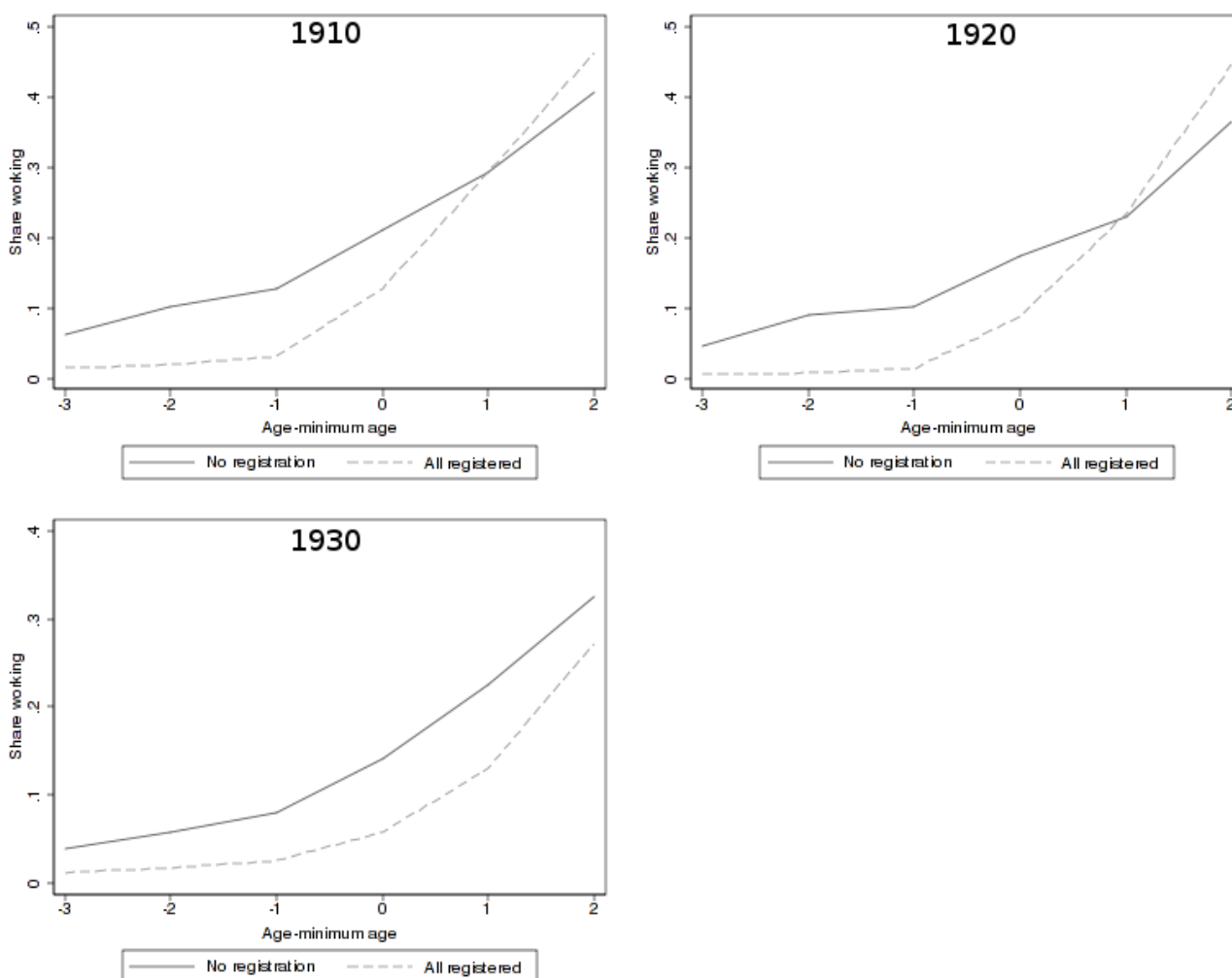
'Child labor law applies' = Dummy variable for whether child is below minimum working age. 'Registration law applies' = Dummy variable for whether the child was born during, or after, the year of the birth registration law. 'School law applies'=Dummy variable for whether the child has reached school entry age and is below maximum school leaving age'. 'Other non-white' includes all ethnicities other than black and white. The racial categories are based on the "Race" variable. Blacks include negroes and mulattos. 'Both parents foreign' refers to a case where the child is native born, but both parents are foreign-born. No mother/no father indicates that no link to a mother/father-figure (related or unrelated) is identified in the data. Head literate' refers to whether the head can both read and write. 'Number of individuals in hh', where 'hh' refers to household, excludes outlier values above 15. 'Occupational score' is available for individuals who have an occupation and takes a value up to 80. It is a variable that assigns the person's occupation a value that represents the median total income of all individuals with that occupation in 1950 (in hundreds of 1950 dollars). It includes values of zero for those without an occupation (the regression models control for this with a "missing dummy"). The urban area consists mostly of households in cities and incorporated places with 2,500+ inhabitants.

Figure 2 presents the employment rates of children separately for each census, for two types of states of birth; one where all children had been born with a birth registration law in place and another where all children had been born prior to the enactment of the registration law. The horizontal axis is the

²⁴ Based on 1950 occupation codes and calculated for U.S. born children.

child's age minus the minimum working age in the child's state of residence. In the census years, the lowest minimum working age was 12 and the highest 16, implying that the maximum age range covered in the graphs is 9-18 years. Children born with a registration law in place were less likely to be employed when they are under-aged (-3 to -1), than children born before the registration law was enacted. In 1910 and 1920, the difference in employment narrows down once children reach minimum working age (0-2). This provides initial support for a connection between the effectiveness of child labor law in prohibiting under-aged employment and birth registration laws. Here it must be noted that state, or cohort-specific factors, that might affect employment, are not controlled for. In 1930, the employment rate of children born before a registration law is constantly lower than the rate of those born after. However, there are only three states of birth where no one in the age group had been born before a registration law.

Figure 2 Share of working children below and above the minimum working age in two groups of birth states



Maximum age range: 9-18. Includes only states with a minimum working age law. 'No registration': states where no one had been born with a birth registration law in place. 'All registered': states where everyone had been born on, or after a birth registration law was enacted. "Age-minimum age" refers to the age of the child minus the minimum legal working age.

Identification and estimation

Identification of the effects of the birth registration laws relies on the differential timing of these laws across states and cohorts within a state. Since birth registration itself is not observed, but only the laws are, the analysis focuses on the effects of the birth registration laws. Complete registration coverage was not immediately achieved, possibly due to limited access to registration facilities, birth outside health care facilities, or parental ignorance, despite penalties. Therefore, under imperfect enforcement, the effect of full birth registration coverage ought to be larger than that induced by the birth registration law. This is a common feature of econometric studies on laws, when enforcement is not perfect.

The framework relies on variation in the registration laws (defined at the state of birth and cohort level) and child labor laws (defined at the state of residence and year level), after state of birth and residence and cohort effects have been controlled for. The historical account on the enactment of birth registration laws in Section 2 suggested that the process might have been affected by factors such as the state of health care, the degree of urbanization, or the “progressiveness” of the state. The inclusion of state effects in the models guarantees that the identification of the legal effects is not compromised by state-specific unobservable variables that are fixed over time, but possibly correlate with the timing of the registration law, or the coverage of the minimum working age law. However, unobservable state-specific trends in child employment, that may correlate with the enactment of the laws, could be a potential source of omitted variable bias. To assess the extent of this concern, state-specific linear cohort trends will be controlled for, and a number of robustness checks will be implemented. To further support the case for the identification strategy, a simple regression analysis in Appendix 2 shows that general socioeconomic characteristics across U.S. states do not correlate strongly with the timing of the birth registration laws.

Results will be reported for regression models estimated separately with each census sample and with a sample pooled across all three census years. However, the latter constitutes the main analysis, for one key reason; lack of variation. The regression sample includes all children between the age of 12 and 15 who have been born in one of the 48 US states. A share of them do not reside in their state of birth (14 percent). If census-specific regression models, that control for state of birth effects would be estimated, they would rely on very limited variation in the birth registration law dummy variable. The variation would derive from those few states where the registration law was timed so that a share of 12-15 years olds were born before and a share after the law. In the case of the 1910 census, there are only 2 such states of birth out of 48 states. This number rises to 9 out of 48 in 1920, but falls again to 3 for 1930. Therefore, the estimated census-specific models will not control for state of birth effects, but only state of residence effects, so that additional variation can be derived from children who have moved away from their state of birth. However, variation is still limited and comes from a selected group. By pooling the census samples for three years together, a broader range of birth cohorts, spanning 20 years, is covered, increasing the variation in the birth registration variable within state of birth. A pooled model with parameter

homogeneity does assume that the effects of control variables are homogeneous across the census years.

The full logit model specification with the pooled sample takes the form

$$(1) \text{ Prob}(W_i = 1 | \mathbf{X}_i) = F(\alpha_0 + \alpha_1 R_{bc} + \alpha_2 C_{say} + \alpha_3 R_{bc} C_{say} + \mathbf{Z}_i' \boldsymbol{\beta} + \delta_c + \gamma_b + \psi_s + \varepsilon_i)$$

where i refers to individual, b to state of birth, s to state of residence, c to birth cohort, a to age and y to census year. The dependent variable, W_i refers to whether, or not, the child reports an occupation. F is a logistic function. R_{bc} refers to a dummy variable, which takes a value of 1 if the child is born after, or during, the year when the birth registration law was enacted. C_{say} refers to a dummy variable for whether the child is too young to obtain a work permit (value 1) and $R_{bc}C_{say}$ is an interaction term between the dummy variables for the minimum working age and the registration law. R_{bc} varies between birth states and between cohorts within a state. For a specific census year, C_{say} varies between states of residence and between age groups within states of residence. In the pooled sample it also varies by census year, as minimum age laws changed over time. \mathbf{Z}_i refers to a vector of control variables.

The coefficients γ_b and ψ_s refer to a set of dummy variables for the child's state of birth and state of residence respectively and δ_c to a set of dummy variables for the child's birth cohort, which control for factors that are specific to the year of birth. There is no need to control for age separately since all individual cohorts are observed only in one particular census. Thus, the cohort effects also account for age effects. Census year effects are also redundant in this framework, as they too are controlled for completely by the cohort effects. Specifications that control for linear cohort trends separately for each state of birth, are also estimated with the pooled sample. Standard errors in all models are clustered at the state of birth \times cohort level, given that this is the level at which the registration laws are defined.

The core models are deliberately maintained simple as far as control variables are concerned to reduce concerns with endogeneity. However, in a robustness check, a set of control variables is included.

The interpretation of the coefficients on the legal variables merits some discussion. Theoretically, birth registration laws could have the following effects:

a) Similar effect on under-aged and work-eligible children:

$$\alpha_1 \neq 0, \alpha_3 = 0$$

b) Effects only on under-aged children:

$$\alpha_1 = 0, \alpha_3 \neq 0$$

c) Effects only on work-eligible children:

$$\alpha_1 \neq 0, \alpha_1 + \alpha_3 = 0$$

d) Effects on both, but differentially:

$$\text{General case: } \alpha_1 \neq 0 \text{ and } \alpha_3 \neq 0 \text{ and } \alpha_1 + \alpha_3 \neq 0$$

Opposite effects:

- i) $\alpha_1 > 0$ and $\alpha_1 + \alpha_3 < 0$
- ii) $\alpha_1 < 0$ and $\alpha_1 + \alpha_3 > 0$

The expected effect based on the hypotheses discussed in Section 4 is b) with $\alpha_3 < 0$. However, d.i) was also mentioned as a possibility if birth registration laws increase the likelihood that the under-aged are denied work permits, but also facilitate the granting of work permits to the work-eligible. a) would seem a more plausible hypothesis if registration affected employment through some other mechanism than the granting of work permits. c) and d.ii) appear unlikely, or counter-intuitive.

The α_2 coefficient in equation (1) reflects the effect of the minimum working age legislation on the employment of the under-aged in relation to work-eligible children, for children born before a registration law. The coefficient α_3 captures how this difference in employment between the under-aged and work-eligible changes when the under-aged are born with a birth registration law. It should be noted that this difference may not simply be driven by effects on the under-aged. A reduction in under-aged employment may change the demand for work-eligible children, for instance if the two are close substitutes.²⁵

If a reduction in the employment of the under-aged due to the minimum working age law would generate a demand effect on the work-eligible, this would be reflected in the coefficients α_2 and α_3 . If birth registration laws improve enforcement and reduce under-aged employment further, any demand effect on the work-eligible could be expected to be magnified with birth registration laws. However, it is reasonable to assume that the ratio, α_3/α_2 , which measures the relative improvement in legal enforcement due to birth registration laws, remains unaffected by any labor market effects on the work-eligible.

Finally, two issues should be noted in connection with the interpretation of the coefficients of the Logit model. Most of the explanatory variables are dummy variables. It is logical in this situation to estimate average marginal effects rather than marginal effects at the means. Secondly, the models include the estimation of an interaction effect, for which the average marginal effect and its standard error have to be calculated using the delta method (see Ai and Norton, 2003 for details).

Results of core models

Table 5 shows the results of basic census-specific models. Each model includes dummy variables for age, gender, race and state of residence. As the variation in the birth registration law variable within state of residence is limited, the models are estimated primarily for an indication of the potential differences in the effects of interest across census years. The results for two specifications are shown for each year. The first one (1) includes separate dummy variables for the minimum working age law (child labor law) and the birth registration law. The second model (2) also includes an interaction term for the

²⁵ For a general theoretical contribution on how the welfare effects of bans on child labor depend on labor market effects, see e.g. Basu and Van (1998), which discusses the distinction between adult and child labor. Bugni (2011) also suggests that a difference in differences approach may underestimate the effects of child labor laws on under-aged employment if the resulting increase in adult labor leads to a decline also in the employment of work-eligible children.

two legal dummy variables.

Table 5 Likelihood that child reports an occupation, census-specific Logit estimates

	1910		1920		1930	
	(1)	(2)	(1)	(2)	(1)	(2)
Registration law	-.027 [.017]	.012 [.023]	-.018 [.010]	.031 [.012]**	.007 [.004]*	.008 [.004]*
Child labor law	-.100 [.015]**	-.077 [.016]**	-.058 [.009]**	-.034 [.009]**	-.001 [.007]	.003 [.008]
Child labor law × Registration law		-.116 [.026]**		-.090 [.014]**		-.005 [.005]
Male	.158 [.006]**	.159 [.006]**	.080 [.003]**	.080 [.003]**	.048 [.003]**	.048 [.003]**
Black	.125 [.007]**	.124 [.007]**	.075 [.005]**	.073 [.005]**	.051 [.003]**	.051 [.003]**
Other non-white	-.036 [.028]	-.035 [.027]	-.022 [.024]	-.022 [.024]	.042 [.020]*	.042 [.020]*
Obs.	69276	69276	77469	77469	91065	91065
Log-likelihood	-29177	-29062	-22809	-22636	-17041	-17041

Notes: **, * significant at the 1 and 5 percent levels respectively. Reported coefficients are average marginal effects. The sample includes US-born individuals aged 12-15. It excludes individuals who are institutional inmates and thus not available for work. All models include cohort dummies and state of residence dummies. Standard errors (in brackets) are clustered at state of birth × cohort level. A Wald test is used to test for statistical significance. Due to multicollinearity, the 1930 estimation drops individuals residing in Nevada (43 observations).

Starting with 1910, the results in the first column show that children below the minimum working age were 10 percentage points less likely to work than work-eligible children. Whether children were born with the registration law in place, or not, does not matter at the 5 percent significance level. This would imply that the registration law did not have a common, independent effect on all children. However, in the second column, the interaction term between the child labor law and birth registration law is statistically significantly negative, while the coefficient on the registration law remains statistically insignificant, although changes sign. This result supports hypothesis b) above with $\alpha_3 < 0$; that the birth registration law reduced the likelihood of employment of legally under-aged children in relation to the work-eligible. Under-aged children born before the registration law were around 8 percentage points less likely to work than work-eligible children. However, under-aged children born with a registration law in place were around 19 percentage points less likely to work than work-eligible children. The birth registration law more than doubled the effectiveness of the minimum working age legislation in reducing under-aged employment. It did not have a statistically significant independent effect on the employment of work-eligible children in 1910, implying that hypotheses d.i) in Section 4 might not hold.

The models for 1920 broadly support the conclusions for 1910, although the effects are smaller. Under-aged children born before the registration law were 3.4 percentage points less likely to work than the work-eligible children. Under-aged children born with a registration law in place were 12.4

percentage points less likely to work than the work-eligible. However, a part of this difference stems from the fact that the registration law also has a statistically significant direct positive effect on work-eligible children, suggesting that the birth registration law may have facilitated the employment of the work-eligible. Work-eligible children born with a registration law were around 3 percentage points more likely to work than work-eligible children born without a registration law.

The results for 1930 are rather different. Children below minimum working age are no longer less likely to work than work-eligible children. In both models 1 and 2, the birth registration law alone has a statistically significant positive effect on the likelihood of everyone's employment. It should be noted, that there is still some, but less, variation in the child labor law dummy variable. By this time, the incidence of child labor itself had also fallen to low levels and 88 percent of children had been born with a birth registration law in place.

The results indicate that the minimum working age legislation reduced the likelihood of under-aged employment in 1910 and 1920. The birth registration laws also made the minimum working age law more effective in reducing under-aged employment, but possibly also facilitated the employment of work-eligible children. These results no longer hold for 1930 when child employment had fallen to a low level and the minimum working age law had ceased to make a difference for the employment for 12-15 year olds. It should be stressed that the results must be considered in light of the limitations of the census-specific approach discussed above.

The next step is to estimate a set of models with a pooled data set consisting of all three survey samples, for 1910, 1920 and 1930. The results of a set of such models are shown in Table 6.

The first column in Table 6 shows the coefficients for the legal variables of interest in a model that excludes the interaction term. This suggests that the birth registration law did not have a common statistically significant effect on the likelihood of employment of all children. Children below the minimum working age were 5 percentage points less likely to work than the work-eligible children.

In model 2, which includes the interaction term, the coefficients on both the child labor law variable and the interaction term are statistically significantly negative. The coefficient on the registration law remains statistically insignificant. When born before the registration law, children below the minimum age were 3.6 percentage points less likely to work than work-eligible children. However, when born with a birth registration law in place, those below the minimum age were 9 percentage points less likely to work than the work-eligible. Again, these results imply that a birth registration law more than doubled the effectiveness of the minimum working age legislation in reducing the employment of the under-aged in relation to the work-eligible. Some of the difference between the employment of the under-aged and work-eligible could result from demand effects on the work-eligible. The results suggest that the birth registration law did not have an independent effect on the employment of work-eligible children, implying that proof of age did not directly facilitate their employment.

Table 6 Likelihood that child reports an occupation, pooled Logit estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Registration law	-.007 [.007]	.011 [.010]	.005 [.014]	.005 [.014]	.005 [.014]	.017 [.015]	.005 [.015]	-.003 [.015]
Child labor law	-.048 [.007]**	-.036 [.008]**	-.039 [.008]**	-.038 [.008]**	-.034 [.008]**	-.038 [.008]**	-.037 [.009]**	-.037 [.008]**
Child labor law × Registration law		-.053 [.012]**	-.050 [.013]**	-.050 [.013]**	-.046 [.013]**	-.052 [.014]**	-.052 [.014]**	-.051 [.014]**
School law								.005 [.008]
School law × Registration law								.013 [.013]
Obs.	237853	237853	237853	236363	237853	237853	237853	237853
State of birth trends (based on birth year)			YES	YES	YES	YES	YES	YES
Log-likelihood	-69446	-69285	-69169	-66599	-69189	-69185	-69161	-69156

Notes: **, * significant at the 1 and 5 percent levels respectively. Reported coefficients are average marginal effects. The sample includes US-born individuals aged 12-15. It excludes individuals who are institutional inmates and thus not available for work. All models include dummy variables for year of birth, race (black and other non-white), gender as well as state of birth and state of residence. Standard errors (in brackets) are clustered at the state of birth × cohort level. A Wald test is used to test for statistical significance. Model (4) equals (3) with a range of control variables: dummy variables for both parents foreign, no mother, no father, literate head of household, female head of household, urban location and variables on the occupational score of the head of household (including missing dummy for those without occupation), number of individuals in the household, age of head. Model (5) relies on an alternative child labor law indicator instead of that in the previous models (See Appendix 1). The average value for this indicator in the regression sample is 0.36 in 1910, 0.54 in 1920 and 0.65 in 1930. In Model (6) the registration law is assumed to have been implemented a year later in each state. In Model (7) the registration law dummy variable is based on the year from which the state Office of Vital Statistics holds birth records (Table A1). Model (8) is similar to Model (3) with the addition of the 'school law' dummy.

Model 3 includes cohort trends for each state of birth. The results change little, which supports the identifying assumption that the enactment of registration laws was not correlated with unobservable state-specific trends in child employment. Model 4 demonstrates that the results are not sensitive to the inclusion of a range of control variables (listed in the notes to Table 6).

Model 5 relies on an alternative indicator on whether the child is below minimum working age. The indicator is defined precisely in Appendix 1, and it incorporates the length of education requirement for receiving a work permit in the state of residence if such was specified. The conclusion regarding the effects of the laws remain unchanged.

Models 6 and 7 rely on alternative ways of defining the timing of the birth registration law. Since the month of year when the law became effective is generally not defined in the source used, not all children born in that year will have been affected by the law. Firstly, an alternative specification is estimated, where the birth registration law is assumed to have become effective in the year after the implementation year for all states (model 6). Again, the coefficients of interest change little. In model 7, instead of the year of the birth registration law, the year from which the states' Offices of Vital Statistics (Table A1, Appendix 1) hold birth records, is used to construct a dummy variable for whether state-level

registration existed at the time the child was born.²⁶ Again, the conclusions hold.

So far the analysis has focused exclusively on the minimum working age legislation. The last model (8) in Table 6 incorporates a dummy variable for whether the child is within the compulsory schooling age range (“school law”), and its interaction with the registration law dummy. However, neither the schooling law nor its interaction with the registration law are statistically significantly connected with the likelihood of an occupation.²⁷ The coefficients on the child labor law dummy and its interaction with the registration law change little. The result supports the claim that for the age group concerned, the binding constraint for work was the minimum working age and not the compulsory schooling age.

Overall, the results remain robust to the way in which the birth registration and child labor law variables are defined and to the inclusion of an additional indicator on compulsory schooling laws. The results demonstrate that minimum working age legislation was more effective in reducing the likelihood of under-aged employment in relation to the work-eligible when children had been born with a registration law in place. In none of the pooled models has the birth registration law had a statistically significant independent effect on the employment of work-eligible children, although there was some indication of this in the census-specific models. Overall, support for the hypothesis d.i), that registration laws may have directly facilitated the employment of the work-eligible, is weak.

Additional robustness checks

The identification of the effect of the birth registration law relies on the assumption that the timing of the enactment of the registration law is not correlated with unobservable state trends in child labor. Table 7 reports the results of a 'falsification' test, which is performed to analyze the sensitivity of the results to the year of the birth registration law.

The falsification test focuses on whether the estimated effect could be capturing a “pre-enactment” trend in child employment. The sample is restricted to individuals born before the birth registration law was enacted. This guarantees that there are no individuals in the sample who in reality were already affected by the registration law. It is then assumed that the birth registration law in each state in the sample was enacted three, four, five, or six years before its actual date. These years were chosen to be sufficiently, but not too close, to the actual year, so that a sufficient share of individuals can be considered affected by the false registration law. The main regression specification is then estimated for this sample of the pooled data set for 1910-1930. Unless the registration law dummy captures a “pre-enactment” trend for the cohorts, one would expect no meaningful results for the registration law nor its interaction effect.

²⁶ If several years are listed in Table A1, the earliest one is used. If the records start from late in the year, the following year is assumed as the year from which records are available.

²⁷ Had the child labor law dummy and its interaction with the registration law dummy been omitted, the interaction term for the schooling law would be statistically insignificant. However, the coefficient on the schooling law itself would be statistically significantly positive, which is unexpected and again suggests that for the particular age group concerned, the schooling law did not constrain employment decisions.

This is largely confirmed. Neither the coefficient on the registration law, nor on the interaction term, is statistically significant, with one exception in the last column.

Table 7 Falsification test: Likelihood that child reports an occupation, pooled sample

	Early implementation			
	3 years	4 years	5 years	6 years
Registration law	.021 [.021]	.028 [.024]	.033 [.025]	.039 [.018]*
Child labor law	-.038 [.008]**	-.051 [.010]**	-.049 [.010]**	-.048 [.010]**
Child labor law × Registration law	-.016 [.018]	-.018 [.022]	-.024 [.019]	-.017 [.017]
Obs.	117239	117239	117239	117239
State of birth trends (based on birth year)	YES	YES	YES	YES
Share born with “false” registration law	0.21	0.26	0.30	0.33

Notes: **, * significant at the 1 and 5 percent levels respectively. Reported coefficients are average marginal effects. The sample includes US-born individuals aged 12-15. It excludes individuals who are institutional inmates and thus not available for work. All models include dummy variables for year of birth, race (black and other non-white), gender as well as state of birth and state of residence. Standard errors (in brackets) are clustered at state of birth × cohort level. A Wald test is used to test for statistical significance. The sample includes all those children in the original regression sample who have been born prior to the enactment of the birth registration law.

Some of the previous studies on child labor in the U.S. have restricted attention to non-agricultural households or urban households. As discussed earlier, child labor laws may not have been applicable to agricultural activities, or cases where the child was employed by parents, although the coverage did vary across states. In rural areas and agricultural households, children may have worked on the family farm, and would not be expected to have work permits, or were not visited by factory inspectors. Thus, the focus on the use of birth certificates as a proof of age for obtaining work permits, may not be relevant.

The first two columns in Table 8 report the results of the core model specification for the pooled sample separately for urban and rural individuals. There are no significant differences between the results of the urban and rural samples. In urban areas, under-aged children born before the registration laws were 2.7 percentage points less likely to work, and in rural areas, 2.6 percentage points less likely to work than work-eligible children. However, the under-aged were around 6 percentage points less likely to work in both rural and urban areas when they had been born with a birth registration law. It should be noted that by dividing the sample into two, the coefficients for the control variables (such as cohort effects) are allowed to vary, which can explain why the effect of the minimum age limit is smaller in the models in Table 8 than in the models in Table 6. The similarities in urban and rural areas may appear surprising given that the minimum age limit was assumed to be less well enforced, or irrelevant for agricultural work. However, firstly it is important to recognize that between 1910-30, the average share of children

working in rural areas (17 percent) was over twice the share in urban areas (7 percent), which implies that the relative effect of the minimum age law was larger in urban areas. Secondly, it should be emphasized that farm labor was not the only gainful activity that children could engage in in rural areas. In some areas in particular, children worked for instance in cotton mills or fruit canneries.

Table 8 Urban-rural and racial differences: Likelihood that child reports an occupation, pooled sample

	Urban	Rural	Agr. counties	Non-agr. counties	White	Black
Registration law	.012 [.008]	-.003 [.010]	.001 [.008]	.012 [.008]	.009 [.010]	-.004 [.012]
Child labor law	-.027 [.007]**	-.026 [.006]**	-.016 [.006]**	-.029 [.006]**	-.037 [.008]**	-.007 [.012]
Child labor law × Registration law	-.030 [.007]**	-.033 [.010]**	-.014 [.010]	-.034 [.008]**	-.044 [.010]**	.017 [.019]
Obs.	101272	136581	85015	152823	208643	28240
State of birth trends (based on birth year)	YES	YES	YES	YES		

Notes: **, * significant at the 1 and 5 percent levels respectively. Reported coefficients are average marginal effects. The sample includes US-born individuals aged 12-15. It excludes individuals who are institutional inmates and thus not available for work. All models include dummy variables for year of birth, race (black and other non-white), gender as well as state of birth and state of residence. Standard errors (in brackets) are clustered at the state of birth × cohort level. A Wald test is used to test for statistical significance. The urban area consists mostly of households in cities and incorporated places with 2,500+ inhabitants. Agricultural (Agr.) counties are those where the share of individuals working in agriculture was above 50 percent in 1910 and non-agricultural (Non-agr.) those where the share of individuals working in agriculture was equal or below 50 percent in 1910.

In order to investigate the relevance of child labor laws and birth registration laws for agricultural areas further, the sample is divided in two depending on the average share of all employed individuals who worked in agriculture in the child's county of residence in 1910.²⁸ The model is then re-estimated for these samples. “Agricultural counties” are those where the share of individuals (of all ages) working in agriculture is above 50 percent, and the remainder are classified as “non-agricultural” counties. In the former category, between 1910-1930, on average 22 percent of the children in the regression sample were employed and 71 percent of these children worked as “unpaid family workers on farms”. In non-agricultural counties, 8 percent of the children in the regression sample were employed and only 19 percent worked as unpaid family workers on farms. Columns 3 and 4 show that the minimum age limit affected employment in agricultural counties somewhat less than in non-agricultural counties. Neither the interaction term, nor the birth registration law dummy are statistically significant in agricultural counties, implying that the registration law did not affect the likelihood of employment. In non-agricultural counties, children below the minimum age limit were 3 percentage points less likely to work than the work-eligible if they were born without a birth registration law, but over 6 percentage points less likely to work if they were born with birth registration laws.

²⁸ Based on 1950 industry codes.

The distinction between children in agricultural and non-agricultural counties supports the explanation that birth registration laws improved the enforcement of minimum working age legislation through the provision of official proof of age, when employment certificates were applicable. In counties where agriculture was a dominant activity, children were far more likely to be employed in agriculture and family farms, where work permits were typically not relevant. Birth registration was less relevant for the minimum working age legislation, and the latter was less connected to employment decisions.

Black children worked predominantly in agriculture, and may in general have been neglected in law enforcement, or due to weaker of access to health care, were less likely to be registered. The last two columns in Table 8 show that the minimum age limit had no effect on the employment of black children, regardless of registration laws.²⁹ The minimum age limit did affect the employment of white children, and was more effective for white children born with a birth registration law.

Given that the census focuses on households, it may appear tempting to estimate household fixed effects models as these control more specifically for household specific factors that would affect the likelihood of employment. However, there are limitations. Within household variation is limited with respect to the birth registration law. It would be derived from households with multiple children between 12-15 years of age, who either were born in one of the few states where the timing leads to variation within this age group, or where the siblings had been born in different states. Secondly, the minimum working age may affect intra-household labor market decisions and the employment of work-eligible siblings. However, to provide some indication of the implications of household fixed effects, the results of a few linear probability household fixed effects specifications are shown in Table A4 in Appendix 3. With a few exceptions, the conclusions remain broadly similar to the ones from the above analysis.

To end with, Appendix 3 also discusses the possibility that the age of those individuals born prior to a birth registration law would be misreported in the census, and the potential implications.

6 Birth registration laws and education

The analysis so far has focused on child labor as the outcome of interest, given that this is the direct target of minimum working age legislation. However, it would be of interest to know whether the reduced likelihood of under-aged employment translates into an increased likelihood of school attendance, with the potential for increased educational attainment. This could have longer term welfare implications. Secondly, the ability to confirm age with birth certificates may have improved, not just the enforcement of the minimum working age law, but also the enforcement of compulsory schooling age laws. This Section begins by analyzing school attendance as the outcome with the 1910-1930 sample and then discusses the results of a retrospective analysis on educational attainment with the 1960 census.

²⁹ The models do not include state trends as they could not be estimated with such for the black sub-sample.

School attendance and birth registration

The only variable available in the 1910-1930 censuses on the schooling of children is whether they attended school, or were enrolled in school, any time since September in the previous year. Since the census dates varied, the reference time varies from within past 4 months to within past 7.5 months in the three Census samples. As acknowledged for instance by Moehling (2004), who compares figures on reported attendance and school enrollment, this variable does not capture regular attendance well, and the figures are closer to enrollment. In the sample of 12-15 year olds used in Section 5, the reported school attendance rates were 0.87, 0.90 and 0.91 for 1910, 1920 and 1930 respectively. A significant share of children who reported having an occupation in the pooled data, also reported having attended school (60-66 percent), which implies that children either attended school irregularly, or worked outside school hours.³⁰ Data on months of school attended are not available in these censuses.³¹ The analysis relies on a dummy variable for reported school attendance as the dependent variable in the regression analysis.

In order to assess whether the connection between the birth registration law and the minimum working legislation had implications for schooling, a regression model with school attendance as the dependent variable is estimated for 12-15 year olds with the pooled 1910-1930 sample. The model is otherwise identical to the core model specification in Table 6. The results, shown in the first column of Table 9, confirm that the minimum working age law affected the likelihood of school attendance and the positive effect was larger with registration laws. Children below the minimum age who were born before the registration law, were 3.8 percentage points more likely to attend school than the work-eligible. Those born with a birth registration law were 6.4 percentage points more likely to attend school.

To analyze the relevance of birth registration for compulsory schooling laws, a few additional models are estimated. To keep the presentation concise, only pooled models are estimated. As a direct comparison with the results of model 1 on the minimum working age, the same model specification for 12-15 year olds is estimated with the compulsory schooling law dummy variable as opposed to the child labor law variable. Again the schooling law dummy is based on the legal age of school entry and exit rather than the length of schooling requirements for school exit or work, given that birth certificates as such would not prove directly useful in the verification of the latter. Model 2 indicates that school-aged children were 2.2 more likely to attend school than those outside the compulsory age range when they had been born with a registration law in place. The registration law did not have an independent effect on the attendance of children outside the compulsory schooling range.

A comparison of the results in models 1 and 2 implies that for the 12-15 age range, the minimum working age was a more relevant constraint than the legal school leaving age, as suggested for instance by Goldin and Katz (2008). This is confirmed by model 3, which includes both the schooling and child labor

30 Or attended a continuation school (see Section on educational attainment below for details).

31 In principle, the 1950 occupational classification includes a category for “student”, but there are next to no entries in this occupational category in the 1910-1930 censuses.

law variables and interaction terms with the registration law variable. Only the coefficients for the child labor law dummy and its interaction term are statistically significant and resemble those in column 1.³²

Table 9 Likelihood that child attends school, pooled Logit estimates

	(1)	(2)	(3)	(4)
		Age: 12-15		Age: 6-11
Registration law	.006 [.008]	-.004 [.009]	-.002 [.009]	-.007 [.007]
Child labor law	.038 [.008]**		.040 [.008]**	
Child labor law × Registration law	.026 [.008]**		.025 [.009]**	
School law		-.012 [.007]	-.001 [.008]	-.006 [.007]
School law × Registration law		.022 [.009]*	.012 [.010]	.025 [.006]**
Obs.	238399	238399	238399	381398
State of birth trends (based on birth year)	YES	YES	YES	YES
Log-likelihood	-68782	-68998	-68777	-105093

**, * significant at the 1 and 5 percent levels respectively. Estimated coefficients are average marginal effects. The sample includes US-born individuals. The logit models include dummies for gender, race (black and other non-white), birth cohort, state of birth and state of residence. Standard errors (in brackets) are clustered at the state of birth × cohort level. A Wald test is used to test for statistical significance.

Model 4 is estimated for an age range for which the variation in the schooling law dummy relates to the legal school entry age (6-11 year olds). As discussed above, the variation in the combination of the registration law and the child labor law dummy variable is very low for the 6-11 age group, so it is only meaningful to focus on the schooling law (see Table 3). The share of U.S. born children in the 6-11 age group who are of compulsory schooling age is 0.58, 0.71 and 0.78 for 1910, 1920 and 1930 respectively. The share of children in this age group who report attending school is 0.86, 0.91 and 0.88 percent for 1910, 1920 and 1930 respectively. The results show that in the 6-11 year age group, only when children had been born with a registration law in place, were school-aged children more likely to attend school than those outside the compulsory schooling age range. The estimated effect corresponds to a 2.5 percentage point difference in the likelihood of school attendance, which suggests that the age requirements for younger children were somewhat better enforced with official proof of age.

Overall, there is some evidence that birth registration laws improved the enforcement of compulsory schooling age laws, in particular regarding the school entry age. For the 12-15 year age group, the minimum working age appears to have been a more relevant factor for school attendance than the school leaving age. The effects of the schooling laws may appear weak, or small, since the reported

³² The conclusions would remain similar with an alternative indicator for the compulsory schooling age, that utilizes the requirement on years of education to be completed for an exemption (similar to alternative child labor law indicator).

attendance rates are fairly high, although they are unlikely to capture regular attendance accurately.

Educational attainment and birth registration

The variable on school attendance is not without limitations. It is uncertain whether increases in reported attendance translated into increases in total years of education. Some of the research on the effects of child labor and compulsory schooling laws on education in the U.S. has taken a retrospective approach by analyzing the contribution of the laws to educational attainment of adults with a later census. Lleras-Muney (2002) and Goldin and Katz (2008) both use the 1960 census. This section utilizes a similar estimation framework, incorporating birth registration laws as an additional dimension. It also relies on the 1 percent sample of the 1960 U.S. census (IPUMS-USA, Ruggles et al. 2010).

The 1960 census includes data on the quarter of birth and age, which are used to calculate the birth year of a child, and determine whether the individual was born with a birth registration law in place or not. As was the practice in Lleras-Muney (2002), with respect to the legal minimum working age and school leaving age, the laws that applied in the state of birth when the child was 14, is used. With respect to the school entry age, the law that applied in the state of birth when the child was 7, is used (similar to Goldin and Katz, 2008). The data on child labor laws is available from 1910. Those who were 14 in 1910, were born in 1896. The data on the schooling and child labor laws ends in 1939, when those born in 1925 would have been 14 years olds. Given that delayed registration became more common in the 1940s, the analysis focuses on individuals who had reached compulsory schooling age by the 1940s. Therefore, as in Goldin and Katz (2008), the models rely on a sample of individuals born between 1896-1925. Again, the analysis relies on age rather than length of schooling requirements. Birth certificates should only be directly relevant for the former, and the use of age requirements allows for a separation between the effects of the legal school entry and legal leaving age, or working age.³³

Controlling for the legal entry age, we would expect a higher school leaving age, or minimum working age, to lead to higher educational attainment. Vice versa, controlling for the leaving age, we would expect a higher legal entry age to reduce educational attainment. In comparison with those born before a birth registration law, individuals born with a birth registration law could be expected to be more likely to enter school at the required age and to stay in school until the minimum legal leaving age (either based on the working age or schooling age, depending on which was the true binding constraint). It is realistic to assume that overall better enforcement of the age requirements would lengthen the time spent in school. The results earlier indicated that registration laws largely did not facilitate the employment of children above the minimum working age, or lower attendance of children below the school entry age.

³³ Goldin and Katz (2008) used the minimum age requirements together with the length of schooling requirements for work, or an exemption from schooling, to construct indicators on the number of years an individual born in a certain year was required to spend in school. Separate indicators were calculated for required “child labor school years” and “compulsory school years”, which correlate highly with each other. It can be noted that had such indicators been included in the regression models (to be described below) instead of the legal age requirements, the conclusions on the effects of birth registration laws would hold.

In the sample of individuals born in the U.S. between 1896-1925, only 2 percent lived in a state without a legal minimum working age, or a school leaving age when they were 14, and 7 percent in a state without a legal school entry age when they were 7. Therefore, there is a very limited group of individuals without legal age requirements (value 0) as opposed to those with such requirements. In order to simplify interpretation, the analysis is restricted to individuals with a non-zero value for all the legal age requirements.

It is likely that regardless of the age requirement, children reluctant to attend school would be able to falsify their age by a fairly fixed margin, not larger than a few years. Children beyond this margin would be physically identifiable as over, or under-aged. The effect of the birth registration law on educational attainment would not be expected to vary significantly depending on the legal age requirement. It would not be appropriately captured with an interaction term with the legal age requirements, but could rather be expected to be a positive constant across the age requirements. This is the assumption used in the estimated regression models. The limitation is that it cannot be confirmed whether any effect of birth registration laws on attainment would be the result of improved enforcement of the age requirements, or another factor, such as improved educational planning.

The following OLS model is estimated for the sample of individual to whom the age laws applied:

$$(2) \quad ED_i = \alpha_0 + \alpha_1 R_{bc} + \alpha_2 C_{bc} + \alpha_3 S_{bc} + \alpha_4 CN_{bc} + \mathbf{Z}_i' \boldsymbol{\beta} + \delta_c + \gamma_b + \varepsilon_i$$

where i refers to an individual, b to the state of birth and c to the birth cohort. ED_i refers to the years of education completed, C_{bc} is either the minimum working age or school leaving age, and S_{bc} the school entry age, R_{bc} refers to a dummy variable for whether the child is born with a registration law in place. The coefficient γ_b relates to state of birth effects and δ_c to cohort effects. \mathbf{Z}_i refers to a vector of control variables, which for simplicity only includes dummy variables for gender and race. The models now also include a dummy variable for whether the state of birth had a continuation schooling law when the individual was 14 years old (CN_{bc}), given that this has been studied in previous research and could affect attainment. These laws required working children who had a work permit, but were below the legal school leaving age, to attend school, generally for four to eight hours per week (see Goldin and Katz, 2008). In the sample, for the 1896 cohort, no birth states had such a law, but the prevalence increased steadily over time, covering 64 percent of the 1925 birth cohort.

For simplicity, the models are estimated across the entire educational distribution. As a robustness check, a model with cohort effects for each census region of birth is also estimated, to control for the possibility that developments in educational attainment varied by region (as in Lleras-Muney, 2002). There are four census regions (Northeast, Midwest, South and West). The summary statistics for the variables of interest are reported in Table 10. The results of the regression models are shown in Table 11.

Table 10 Summary statistics for the 1960 sample (birth cohorts: 1896-1925)

	Obs. 507,808	
	Mean	St.dev
Education in years	10.23	3.37
White	0.92	0.28
Black	0.08	0.27
Other non-white	0.003	0.06
Female	0.51	0.50
Minimum working age ¹	14.29	0.68
School entry age ²	7.47	0.55
School leaving age ¹	15.81	1.00
Continuation schooling law dummy ¹	0.50	0.50
Born with registration law	0.73	0.44

¹ legal age at the age of 14 in the state of birth, ² legal age at the age of 7 in the state of birth. The sample excludes individuals whose state of birth did not have a legal working age, or schooling age when the individual was 14 or 7. Only U.S. born individuals, in the 48 states for which the date of the registration law is defined, are included.

Table 11 Years of Education in 1960 (birth cohorts: 1896-1925), OLS

	(1)	(2)	(3)	(4)	(5)	(6)	3 years (7)	5 years (8)
Registration law	.061 [.023]**	.068 [.023]**	.088 [.023]**	.061 [.023]**	.097 [.023]**	.073 [.023]**	-.017 [.028]	.026 [.029]
School entry age		-.004 [.020]	.000 [.019]	-.013 [.021]	-.013 [.019]	-.029 [.019]		
Minimum working age		.085 [.016]**	.078 [.016]**			.042 [.014]**		
School leaving age				.006 [.015]	-.007 [.015]			
Continuation school		.058 [.028]*	.112 [.027]**	.044 [.028]	.105 [.027]**			
Obs.	507808	507808	507808	507808	507808	545424	136425	136425
Region of birth × cohort dummies			YES		YES	YES		
R ²	0.12	0.12	0.12	0.12	0.13	0.15	0.10	0.10

**, * significant at the 1 and 5 percent levels respectively. Sample: Table 10. Standard errors (brackets) are clustered at the state of birth × cohort level. All models include dummies for gender, race (black, other non-white), birth cohort and state of birth. In models 3 and 5, birth cohort dummies are specific to region of birth. In model 6, the sample also includes individuals for whom one, or more of the working and schooling age requirements did not exist (value 0). 'Missing dummies' are included to control for this. In models 7 and 8, the sample is restricted to individuals born before a registration law. The registration law is assumed to have been enacted 3 or 5 years earlier.

Model 1 includes only the registration law dummy as an explanatory legal variable. The results indicate that the birth registration law was related to educational attainment; those born with the law in place had on average 0.06 more years of education.

The next models include the legal minimum working age and schooling age variables, mainly to analyze whether this changes the effect of the birth registration laws significantly. Both the legal entry age and exit age are controlled for in the same model, in order to estimate the effect of the entry age controlling for the exit age and vice versa. However, given the high correlation between the school

leaving age and the minimum working age (0.82 across sample), separate models are estimated including the school leaving and the minimum working age. All models include the continuation schooling dummy.

Models 2 and 4 are identical to Model 1, with the addition of the legal variables. The coefficients on the birth registration dummy remain significant and change little in magnitude. The school entry and leaving age are statistically insignificant. A one year higher minimum working age is found to raise attainment by around 0.085 years and the continuation schooling law by 0.06 years. Models 3 and 5 include cohort effects that are specific to each census region of birth. The effect of the birth registration law increases in magnitude, and remains statistically significant. Although Goldin and Katz (2008) relied on length of schooling requirements, the conclusions with respect to the child labor and schooling law variables are rather similar. The contribution here relates to the inclusion of the birth registration laws.

So far the sample has been restricted to individuals for whom the working or schooling age laws applied. Since this is a selected sample, Model 6 also includes those individuals with a value of zero for any of the legal age requirements.³⁴ The model is otherwise similar to Model 3. The coefficients are not shown, but dummy variables for the absence of each legal age requirement are included. The birth registration law variable remains statistically significant with a slightly smaller coefficient. This is not surprising as the sample now includes individuals for whom there were no age laws to enforce.

The last two columns show the results of a falsification test similar to that in Table 7. The model specification is similar to Model 1 (Table 11), but the estimation relies only on individuals born before a registration law. The registration law is assumed to have been implemented either three, or five years earlier. If the implementation of the registration law correlates with pre-enactment trends in schooling, the coefficient on the birth registration law variable would be statistically significant. This is not the case.

To conclude, there is evidence that birth registration laws raised educational attainment by 0.06-0.1 years. The results in Table 11 do not definitively identify the channel, but based on all the evidence, the likely explanation is the improved enforcement of the legal age requirements. For individuals born in the U.S. between 1896-1925, the average educational attainment increased from 8.7 to 11 years. A 0.1 year increase in attainment due to the birth registration laws would explain 4 percent of this increase.

7 Conclusions

Birth registration has been a little explored topic by economists and a neglected aspect in the study of the effects of legislation that specifies age limits or age requirements. This study has shown that state-level laws on birth registration improved the enforcement of minimum working age legislation and to some extent also compulsory schooling legislation in early 20th century USA. The suggested channel of effect is the use of birth certificates as formal proof of age. It is also shown that birth registration laws had long-term implications by raising educational attainment.

³⁴ In this full sample, the mean for the registration law variable is 0.69.

The identification of the legal effects has relied on a framework that controls for state and birth cohort effects. Therefore, any time invariant, state-specific and cohort-specific characteristics that might correlate with the timing of the birth registration laws, have been controlled for. Most models also control for state of birth specific trends. A state-level regression analysis on the timing of the birth registration laws suggests that “pre-enactment” levels, or trends, in core socioeconomic variables are mostly not associated with the timing. Given that birth registration coverage was not complete from the enactment of the registration laws, it is possible that the study still underestimates the effect of birth registration.

The results of the pooled models with a sample of 12-15 year olds for 1910-1930 show that the minimum working age legislation was more effective in reducing the likelihood of under-aged employment when children had been born with a birth registration law in place. On aggregate, between 1910 and 1930, under-aged children born with a registration law in place were around 9 percentage points less likely to work than work-eligible children. When they had been born prior to a birth registration law, under-aged children were around 3-4 percentage points less likely to work than work-eligible children. Therefore, birth registration doubled the effectiveness of minimum working age legislation. Census-specific estimations suggest that the results are driven by the 1910 and 1920 censuses. By 1930, the incidence of child labor had fallen to a low level, and minimum working age legislation was less relevant.

A further investigation suggests that the impact of birth registration laws on the enforcement of minimum age legislation was limited to children residing in counties, where the majority of individuals worked outside agriculture. In such counties, working children were also much more likely to engage in non-agricultural activities, where work permits were required. This supports the conclusion that the channel of effect was the use of birth certificates to ascertain a child's true age in the process of granting work permits. The minimum working age limit did not affect the likelihood of employment of black children, irrespective of birth registration laws. Birth registration laws did enhance the effectiveness of the minimum working age legislation for white children.

The results also confirm that the connection between the birth registration law and the minimum working age legislation had implications for school attendance of 12-15 year olds between 1910-1930. Children below the minimum working age were generally more likely to report attending school than work-eligible children, but even more likely to do so when born with a birth registration law.

With respect to compulsory schooling requirements, the findings indicate that between 1910-1930 the school leaving age was not necessarily a relevant constraint for decisions on schooling and employment for the 12-15 year age group, irrespective of birth registration laws. However, in a sample of younger children (6-11), those within the compulsory schooling age range were 2.5 percentage points more likely to attend school than those outside the compulsory schooling range, but only when children had been born with a birth registration law in place. The data on school attendance does not capture full-time attendance well and the reported school attendance rates were rather high. Nevertheless, the result

for younger children indicates that the schooling age requirements were more strictly adhered to when children had official proof of age. Most of the results suggest that registration laws had implications for the employment, and to an extent the school attendance of the under-aged, but did not have an independent effect on the work-eligible, or those who had reached the school leaving age.

The retrospective analysis finds that individuals born with a birth registration law in place had 0.06-0.1 more years of education than those born without. In this case, the models estimate the general effect of birth registration laws. Considering all the evidence together, this is likely to be explained by the improved enforcement of the minimum working age and compulsory schooling age laws.

Overall, the results imply that legislation that sets age requirements is more likely to be enforced with a functioning birth registration system in place. The findings indicate that the neglect of birth registration as an enforcement institution can affect estimates on the significance of minimum working age, or compulsory schooling age laws, as well as other laws that specify age requirements. This could explain why some of the previous studies have found relatively small effects of such laws on child labor or educational attainment. Although this study focuses on a historical period, the results remain relevant for today's developing countries. Child labor and the implementation of compulsory schooling continue to be timely issues (see e.g. Fyfe, 2005). Many developing countries also have far from complete birth registration coverage, and new birth registration laws, or amendments to old ones have been implemented recently (see e.g. Cody, 2009).

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Appendix 1 Data and variables

Birth registration laws

The dates for birth registration laws in each states are obtained from an article by Elizabeth Nichols (1980), in *Everton's Genealogical Helper*. The article can be accessed electronically from World Vital Records databases (<http://www.worldvitalrecords.com>) or as a reprint from <http://www.progenealogists.com/unitedstatesvitalrecords.htm> (last accessed 1 February 2012). The dates refer to the year when a state-wide law making birth registration mandatory at the state-level became effective. In most cases, simply the year is included. A few cases include the month of the year.

The National Center for Health Statistics publishes an on-line report titled “*Where to Write for Vital Records*”³⁵. For most states this includes a date since when the state office of vital statistics holds records of births and other events. These dates are shown in Table A1. In many cases, the month of the year is also reported.³⁶ This is not necessarily the date when a state-level birth registration law came into force. In some cases, some records are available from a period before registration at the state level began (generally county records, or records from specific cities). For the majority of the states, the year mentioned coincides with the year reported in Nichols for when birth registration was required by a state law (see Table 1). In a few cases the date is unavailable in “*Where to Write for Vital Records*”, or the report implies that earlier records are available in state archives, but the date is missing. The data are then supplemented with information from Eichholz (2004), which contains state-specific entries discussing the history of vital records in each state. In most cases, the information on laws in Eichholz corresponds with that in Nichols (1980), although Nichols focuses more specifically on the state laws and when they became effective. The years in Table A1 are used to construct an alternative indicator for the birth registration law and used in a robustness check in Table 6 (Model 5).

35 <http://www.cdc.gov/nchs/w2w.htm> (last accessed 1 February 2012)

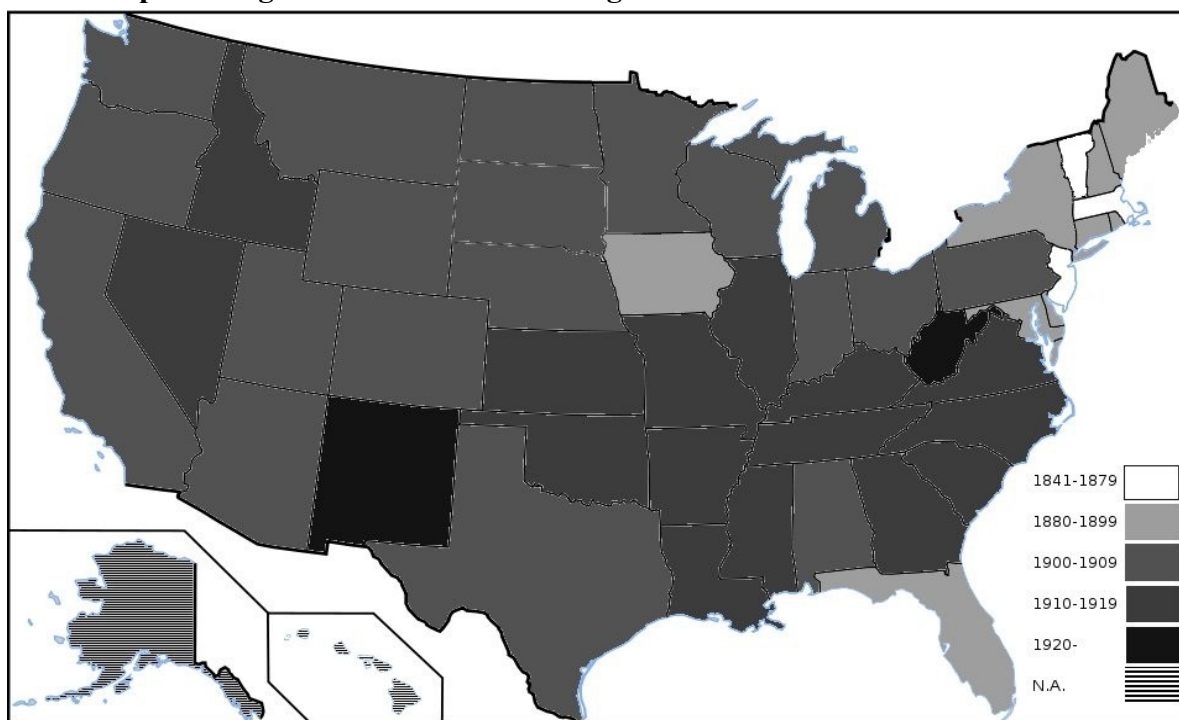
36 However, even if this information could be used to construct an alternative indicator for the beginning of birth registration at the state level, data on the month, or quarter, of birth are not available in the 1910-1930 censuses.

Table A1 Date from which birth records are available at the State Vital Statistics Office.

State	Date	State	Date
Alabama	January 1908	Nebraska	Late 1904
Arizona	July 1909	Nevada	July 1911
Arkansas	February 1914	New Hampshire	1640
California	July 1905	New Jersey	1848 (1848-1900 in state archives)
Colorado	1910	New Mexico	1920
Connecticut	* 1897	New York	1881
Delaware	*Records in state archive mainly start from 1913, although some earlier.	North Carolina	October 1913
Florida	January 1917 (some since 1865)	North Dakota	1870 (incomplete over 1870-1920)
Georgia	January 1919	Ohio	20 December 1908
Idaho	July 1911 (some from 1907)	Oklahoma	October 1908
Illinois	January 1916	Oregon	1903
Indiana	October 1907	Pennsylvania	January 1906
Iowa	July 1880	Rhode Island	* 1853
Kansas	July 1911	South Carolina	January 1915
Kentucky	January 1911	South Dakota	July 1905
Louisiana	*Majority from 1914	Tennessee	January 1914
Maine	1923 (from 1892 in state archive)	Texas	1903
Maryland	August 1898	Utah	1905
Massachusetts	* 1841	Vermont	* 1857
Michigan	1906 (some from 1867)	Virginia	June 1912 (some from 1853-1896)
Minnesota	January 1900	Washington	July 1907
Mississippi	November 1912	West Virginia	January 1917
Missouri	January 1910	Wisconsin	October 1907 (earlier incomplete)
Montana	Late 1907	Wyoming	1909

Source: National Center for Health Statistics (2011), but in a few cases the information is missing, or the starting date ambiguous in this reference. In such cases, denoted with *, sections of Eichholz (2004) that discuss state vital records are used.

Figure A1 Map: Timing of enactment of birth registration law across U.S. states



Source of map: Wikimedia Commons. GNU Free Documentation Licence.

Nichols presents the years for birth registration laws for each state in a table, but also includes a discussion separately for each state. She reports the year from which registration was considered to have become effective. Some states had enacted laws earlier than the year reported in the table, but these laws were not considered effective. There are some cases, discussed below, where instead of the year in Nichols' table, the discussion in Nichols (and Eichholz (2004) in a few cases) is used to determine the timing of the birth registration law as opposed to using the date in the table.³⁷

In the case of Delaware, Nichols provides three separate years. The first law was enacted in 1861, but repealed after two years. The next law was enacted in 1881, but was not considered very effective. Finally, 1913 is listed as the year when the Bureau of Vital Statistics was created and a corresponding law enacted. The 1881 law is reported by Nichols to have succeeded in registering about 50 percent of the population, which is far from complete registration, but enough to be considered a change. Therefore, 1881 is chosen as the year of the law.

In the state of New York, the state procedures did not cover New York City, or Albany, Buffalo and Yonkers prior to 1914, which had their own registration procedures. However, as the census data do not include information on the place of birth, other than the state, this aspect cannot be considered. The table in Nichols shows 1915 as the year when birth registration was required by law at the state-level. However, the discussion states that a state-level registration law was enacted in 1880, but it did not include penalties for non-compliance. However, here it seems appropriate to use 1880, which Eichholz (2004) also mentions as the year of the law. Records of birth are available in the state office since 1881.

For South Dakota, the table in Nichols shows 1920 as the year when birth registration was required by law at the state-level. However, the discussion notes that a state law was also passed in 1905, but it did not include penalties for non-compliance. As in the case of New York, 1905 is used as the relevant year in this study. This is again the year from which records are available in the state office.

Vermont is described by Nichols as a state where state-wide records of births and deaths were reasonably complete already by 1800, but the year of the mandatory state law is unclear. According to Eichholz (2004) (and confirmed by information on the website of the Vermont Department of Health), registration at the state-level began in 1857, which is the year used in this study.

Several other states require a mention. In Idaho, since 1907 midwives and physicians were required to report births to county recorders, which explains why some records are available from 1907. Since 1911, births had to be reported directly to the state, and this is considered the year of enactment of the state law (also the year in Nichols' table).

In Michigan, the first Vital Statistics registration law was enacted in 1867, but the information was collected in the form of an annual census and according to Eichholz (2004), the law was not effective. The year provided in Nichols' table, which is 1906, is used.

³⁷ It should be noted that the results in this study would not change had the year of the birth registration law always taken to be the one in Nichols' table. The results are not shown.

For Minnesota, the table in Nichols shows 1908 as the year when birth registration was required by law at the state-level. However, the further discussion on Minnesota suggests that the first law was passed already in 1872, but that it was not effective. Therefore, 1908 is chosen as the year of the law. Records are available in the state office from 1900.

According to Nichols, New Hampshire passed the first registration law already in 1714, but it was not well enforced. The 1883 law was considered instrumental for achieving more complete registration, and it is therefore chosen as the year, as recorded in Nichols' table.

In the case of North Dakota, the discussion in Nichols (and Eichholz, 2004) suggests that a state registration law was passed in 1893, but it is unclear whether any certificates as such were issued. The date coded in the Nichols' table is 1907, when North Dakota passed the Model Vital Statistics Act, which requires individual birth certificates to be issued. This is the year used in this study.

Nichols reports that in New Jersey, registration of births began in 1878, but that a state law was passed earlier, and records of births are reported to be available from 1848. For the purposes of the regression analysis in Section 5 and 6, it is irrelevant which year is chosen, as all children in the sample would have been born with a birth registration law in any case. The year in Nichols' table (1878) is used.

In the case of Nebraska, it is somewhat unclear whether any type of birth certificates were issued prior to 1912. The discussion implies that such birth records may not have included the child's name, but sex and parent's name(s). The state office is reported to have records from late 1904. This study uses 1904 as the year, which is the year in Nichols' table.

A state law on the registration of vital events in Oklahoma was passed in 1917, and therefore this year is used. However, according to Eichholz (2004), recording of vital events began in 1908, which explains why state records are available from 1908 (Table A1).

Virginia had a birth registration law between 1853-1896, but according to Nichols, reporting was incomplete and many of the records were destroyed during the Civil War. The law ended in 1896, and a new one was not enacted prior to 1912, which is considered as the year of the law for this study.

State registration of births started in West Virginia in 1917, but was not compulsory by law prior to 1925, which is the year recorded in Nichol's table and used in this study.

Indiana, North Carolina, Ohio and Wisconsin are among the few states for which Nichols' table includes a month for the law. In these four states, the law became active from late in the year (October-December). In these cases, it is assumed that the law became effective in the following year.

Child labor and compulsory schooling laws

These data are from Goldin and Katz (2008) and can be accessed through Goldin's website (<http://www.economics.harvard.edu/faculty/goldin/data>, version of data from July 2011). The values for each state represent those that applied to the majority of the population, as sometimes there were

exemptions or differences between areas in a state. These data are available for 1910-1939 for the majority of the legal indicators, but start from 1900 for variables on the legal school entry and leaving age. The data set excludes Alaska, Hawaii and District of Columbia. For the regression analysis with the 1910-1930 census data, the child labor and schooling laws refer to those in place in the child's state of residence. Section 6 includes an analysis of educational attainment with the 1960 census data. In this case, these laws refer to those in place in the individual's state of birth.

The main child labor law indicator in this study is based on the “Age at which youth can obtain a work permit for work during normal school hours”. The 'child labor law' variable in the regression models is a dummy variable that takes a value of 1 when the child is below minimum working age, and 0 otherwise. When the minimum working age is coded as zero, it is assumed that there is no required minimum working age. The 'school law’ variable is a dummy variable that takes a value of 1 when the child falls within the compulsory schooling age range; that is when the child has reached the minimum entry age and is below the leaving age. This relies on the following indicators:

- 1) Minimum required school entrance age,
- 2) Maximum compulsory schooling age (minimum school leaving age) .

If the required school leaving age and school entry age are coded as zeros, it is assumed that there is no compulsory schooling age. In the data set, if one takes a value of zero, so does the other.

The data also include indicators on length of schooling requirements. An alternative version of the minimum working age indicator would take into account the minimum years of education required for a work permit (similar to Goldin and Katz (2008) and Manacorda (2006)). In the analysis for 1910-1930 in Section 5, a robustness check (Table 6, Model 5) is conducted with a child labor law dummy variable that is based on the following alternative indicator for the minimum working age:

Max{minimum age for work permit; minimum school entrance age + years of education required for obtaining a work permit}

The value for the school entrance age is the prevailing legal age in the child's current state of residence when the child was 7 years old. If there was no minimum schooling requirement for a work permit, the minimum age for a work permit is used (if such existed). A “read and write” requirement is considered as equivalent of to four years of schooling, as in Goldin and Katz (2008).

Appendix 2 Timing of the birth registration laws

A state-level OLS model is estimated to analyze whether the timing of the birth registration law correlates with the levels, and trends, of core economic and social indicators. The analysis relies on a state-level data set constructed using 1 percent samples from the U.S. Population censuses for 1870 and 1900. Core variables that depict the socioeconomic status are chosen as explanatory variables: share of black population, share of adult workforce in manufacturing, share of literate adults, degree of urbanization, share of immigrants, average age and the average occupation score of the household head.³⁸ The last one proxies for income, given that data on incomes are not yet available in these census samples. Summary statistics for the variables can be found in Table A2, which also includes variable definitions.

Table A2 Summary statistics for states

	1870 levels	1870-1900
	Mean	Mean change
Share urban	0.18 (0.16)	0.14 (0.11)
Share of adult workforce in manufacturing	0.11 (0.10)	0.03 (0.04)
Share black	0.12 (0.18)	-0.006 (0.02)
Share of literate adults	0.77 (0.20)	0.10 (0.12)
Share born outside USA	0.25 (0.20)	-0.05 (0.11)
Mean occupational score for adult workers	17.91 (2.84)	1.71 (1.25)
Mean age	23.77 (2.87)	2.02 (2.14)

“Share of literate adults” and “share born outside USA” include everyone above 15 years. “Adults workers” are those between 15 and 60 years of age. Occupational score is available for individuals who have an occupation and takes a value up to 80. Standard deviations are in parentheses. The sample includes 47 states and excludes Alaska, Hawaii, District of Columbia, and Oklahoma (the last one did not have data for 1870) and the others are excluded in the regression analysis.

The results of the regression analysis are shown in Table A3. Firstly, a model is estimated using the 1870 census, with the year when the birth registration law came into force as the dependent variable. For nearly all of the states, 1870 corresponds to a “pre-registration law” year. This is followed by a model that includes changes in the core variables between 1870 and 1900 as explanatory variables. The degree of correlation between the levels of the explanatory variables is relatively high, whereas the correlation between the trends in the variables between 1870-1900 is not.

Most explanatory variables are mostly statistically insignificant. The only statistically significant coefficient in the analysis with 1870 levels is the one on the share of urban population. The standard deviation for the share of urban population variable is 0.16. For one standard deviation higher share of urbanization, the birth registration law would have been enacted around 6.9 years earlier. Although this might appear large at first instance, it must be remembered that the enactment of the law was spread over

38 The last one is a variable that assigns the person's occupation a value that represents the median total income of all individuals with that occupation in 1950 (in hundreds of 1950 dollars).

more than 80 years. The changes in the chosen variables between 1870-1900 are not associated with the timing of the law, with the exception of the share of literate adults, which is weakly statistically significant and positively associated with the timing. States with faster growth in literacy rates, enacted the laws later. The results in Table A3 imply that the changes in core socioeconomic circumstances in the pre-registration period largely did not coincide with the enactment of the registration laws.

Table A3 Timing of birth registration laws
 Dependent variable: Year when birth registration required by law, OLS.

Variables	(1)	(2)
	1870 Levels	Δ 1870-1900
Share urban	-43.31 [16.97]*	3.80 [23.06]
Share of adult workforce in manufacturing	-15.18 [36.44]	-54.41 [67.37]
Share black	8.99 [14.84]	-10.55 [75.72]
Share of literate adults	-20.71 [14.23]	47.33 [23.94]+
Share born outside USA	5.68 [11.26]	-29.62 [32.02]
Mean occupational score for adult workers	2.11 [1.63]	-.43 [1.79]
Mean age	-2.04 [1.25]	.35 [.74]
Constant	1936.46 [15.73]**	1897.95 [9.65]**
Obs.	47	47
R ²	0.44	0.20

** , * , + significant at 1, 5 and 10 percent levels respectively. Robust standard errors in brackets.

Appendix 3 Additional estimations and discussion

Household fixed effects

The results of linear probability household fixed effects models with child employment as the dependent variable are shown in Table A4. The first two columns rely on the pooled sample and the remaining three columns show the results of census-specific models. The sample is somewhat smaller than the one in Tables 5 and 6 (by 3-5% depending on census), since it excludes households where individuals belong to more than one family, and individuals who are not related to the head of household. Therefore, the fixed effect can be considered family-specific. The models also exclude the two dummy variables for race, as there is very little variation within household in these indicators.

Starting with the pooled sample, the results correspond with those of the core models in Table 6, although the estimated coefficients are somewhat smaller in size. The birth registration law doubled the effectiveness of the minimum working age law in reducing the employment of the under-aged in relation to the work-eligible. It did not have an independent effect on the employment of work-eligible children. However, the census-specific fixed effects models confirm this result strongly only for 1910. Although the results for 1920 resemble those for the Logit model for 1920 (Table 5), the magnitude of the coefficients indicates that the registration law directly raised the employment of the work-eligible, but had a relatively small effect on the employment of the under-aged [.043-.057=-.014]. The results for 1930 contradict with those obtained with the logit model for 1930 (Table 5). However, the fixed effects models have to be interpreted with caution due to the limited sources of within-family variation in the registration law status. The results of the pooled fixed effects models support those of the pooled logit models.

Table A4 Likelihood that child reports an occupation, household fixed effects, linear probability

	Pooled sample		1910	1920	1930
	(1)	(2)	(3)	(4)	(5)
Registration law	.010 [.006]	.011 [.006]	-.057 [.031]	.043 [.010]**	-.010 [.008]
Child labor law	-.025 [.005]**	-.025 [.005]**	-.026 [.008]**	-.020 [.007]**	-.052 [.009]**
Child labor law × Registration law	-.034 [.005]**	-.034 [.005]**	-.073 [.011]**	-.057 [.008]**	.022 [.009]*
Obs.	229623	229623	65928	75094	88601
R ² (within)	0.13	0.13	0.18	0.14	0.08

Notes: **, * significant at the 1 and 5 percent levels respectively. The sample includes US-born individuals aged 12-15, but excludes children who reside in households with more than one family, or individuals who are unrelated to the household head. Model (1) with the pooled sample includes dummy variables for year of birth and gender. Model (2) includes additionally dummies for the state of birth. The census-specific models include dummy variables for gender and age. Robust standard errors are in brackets.

Misreporting of age

Given that the age in the census is self-reported, there is a possibility of misreporting.³⁹ The census staff were not instructed to ask for proof of age and thus those who felt that it was in their interest to misreport age, might have done so. In particular, children just below the minimum working age with an occupation may have been reported to be of an age that makes them legally eligible to work. This concern is likely to be valid for any study on age limits that relies on self-reported data on age. Of particular interest here is that there may be a connection between the lack of a birth certificate and the tendency to overstate age. This could happen because the lack of a birth certificate raises the tendency of under-aged children to work. Secondly, although children did not have to present proof of age, those with an official record of birth may have been less tempted to misreport age, as in principle their age could be verified.

If misreporting was connected to birth registration, we would expect the number of work-eligible children to be overstated and the number of under-aged children to be understated for children born without a birth registration law in relation to those born with a registration law. This would imply a larger difference in the employment rates of the under-aged and the work-eligible for those born without a birth registration law. If the employment rate of under-aged children was below that of the work-eligible, such misreporting would lead to a negative bias on the coefficient α_2 (equation 1) and a positive bias on the coefficient α_3 (equation 1). If birth registration raised the effectiveness of the minimum working age law in reducing under-aged employment, this effect would be underestimated with misreporting of age.

For an indication of this possibility, Table A5 below shows the age distribution for 12-16 year old U.S. born children, for two types of birth states: those where everyone in this age range is born with a birth registration law and those where no one in this age range is born with birth registration law. The sample is restricted to individuals in states with a minimum working age of 14.

Table A5 Age distribution for individuals in birth states with a minimum working age of 14

	1910			1920			1930		
	Registered	Unregistered	diff. z-stat.	Registered	Unregistered	diff. z-stat.	Registered	Unregistered	diff. z-stat.
Age									
12	0.2093	0.2050	1.13	0.2239	0.2178	1.66	0.2083	0.2170	-1.81
13	0.1964	0.1929	0.94	0.2085	0.1994	2.55*	0.1979	0.1937	0.89
14	0.1982	0.2041	-1.56	0.1950	0.2063	-3.17**	0.2033	0.2005	0.59
15	0.1962	0.1918	1.19	0.1880	0.1838	1.25	0.1918	0.1935	-0.37
16	0.1999	0.2063	-1.69	0.1845	0.1927	-2.30*	0.1988	0.1953	0.74
Obs.	15125	45042		18540	40489		65931	8024	

Notes: 'Registered' = States of birth where everyone is born with a birth registration law, 'Unregistered' = States of birth where everyone is born before the registration law. The reported z-statistics relate to a test for the difference between the proportions of children of a specific age in the "registered" versus "unregistered" category. **, * significant at the 1 and 5 percent levels respectively.

39 See for example Oppenheim Mason and Cope (1986) for a discussion on the sources of misreporting of age and date of birth in the 1900 U.S. census.

Assuming that on average age distributions are similar across the two types of states, we would expect the proportions of individuals in each age group to be similar across the two groups of states. Table A5 reports the results of a test for the differences in proportions of children in each age group. Given that the figures relate to states with a minimum working age of 14, the focus of interest should be on the differences in the shares of 13 and 14 year olds for children born with and without the registration law. There are no statistically significant differences in the 1910 and 1930 censuses. However, in the 1920 census, the share of 14 year olds is statistically significantly higher and the share of 13 year olds statistically significantly lower for children born without rather than with a birth registration law. This indicates that misreporting might have taken place in 1920. If misreporting was connected to under-aged employment, in the case of 1920, the difference between the employment of under-aged children born with and without a birth registration law could be underestimated. This would imply that in reality the enforcement effect of the birth registration law would be even stronger than the current estimates suggest.