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## INCOMPLETE REGISTRATION OF BIRTHS IN CIVIL SYSTEMS: The Example of Ontario, Canada, 1900-1960

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FOREWORD

Although incomplete registration of births and deaths is generally found today only in the systems of developing countries, this deficiency of the civil registration system was fairly common among the industrialized nations in the not too distant past. Professor Emery has carefully examined the completeness of birth registration in the Province of Ontario, Canada for the period 1900-1960, making excellent use of the available information on delayed registrations. As he points out that although "the research findings for Ontario cannot be generalized...the documentary source and methodology are pertinent to any jurisdiction whose vital events are documented primarily through civil registration."

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# Incomplete Registration of Births in Civil Systems:

The Example of Ontario, Canada,  
1900–1960

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Birth registrations, the basis for published vital statistics, commonly underreport births for historical periods.<sup>1</sup> In Ontario, Canada, for example, the compulsory civil registration of births dated from the province's Vital Statistics Act of 1869, but the law was widely ignored for some years. In 1930, the eminent demographer Robert R. Kuczynski cited the 1865–1895 period of birth registrations as a “thirty year's war against passive indifference” and the 1896–1920 period as one of “slow progress.”<sup>2</sup> He estimated that provincial birth registrations were only two-thirds complete for the 1875–1895 period and a maximum of 85 percent complete for any year in the 1896–1919 period.

Kuczynski also judged that registration was “more complete from 1913 on” and “at least 90 percent” complete by 1920. Two other studies found high levels of completeness through comparison of enumerated census populations with birth registrations for months corresponding to the enumeration years. In 1927, E. S. MacPhail, superintendent of the Dominion Bureau of Statistics, estimated that Ontario birth registration was 100 percent complete for 1921.<sup>3</sup> In a 1931 census monograph, W. R. Tracey estimated a maximum completeness of 100 percent for the 1927–1931 period and a minimum completeness of 96 percent for 1931.<sup>4</sup> Like MacPhail, Tracey used published (aggregate) data for his maximum estimate, but his minimum estimate was based upon tracing individuals in the census manuscript to a birth registration.

Building on the earlier studies, this paper elaborates on the completeness of Ontario birth registration by analyzing evidence from delayed registrations of birth. It reviews the histories of birth registration and delayed birth registration in the province. It then analyzes information about the delayed registrations to estimate actual numbers of live births for selected cohorts and when published birth statistics for Ontario become re-

liable. Because the historical coverage of birth registration varies among jurisdictions, the research findings for Ontario cannot be generalized. However, the documentary source and methodology are pertinent to any jurisdiction whose vital events are documented primarily through civil registration.

## THE HISTORICAL CONTEXT

The Ontario Vital Statistics Acts of 1869 and 1896 provided most of the legislative framework for birth registration in the 1900–1960 study period. The 1869 act required the father, mother, or person representing the parents and the medical attendant to report a birth, and it also provided penalties for willful noncompliance. Although an amendment in 1869 removed the medical attendant's responsibility, the 1896 act restored it, requiring the attendant to report a birth forthwith and providing penalties for *any* noncompliance.

However, the provincial inspector of Vital Statistics guessed that the returns for 1898 were only 80 percent complete, and he blamed medical attendants as the principal culprits. Physicians in the city of London, for example, made “scarcely any pretence of registering births, and few of them even obtain the cards necessary for this purpose from the Division Registrar.” In the city of Stratford, his canvas of the physicians found “at least 90 more” than the 159 births reported.

To promote better compliance with the Vital Statistics Act, the inspector placed newspaper notices, circularized physicians, and started court actions. Thus in December, 1899, he noted:

Several of the leading citizens of the “Forest City” [London] were arraigned before the magistrate there and ordered to pay a fine of one dollar and costs, and subsequently four of five physicians also found the Registration Act was not entirely a myth, as under one of its provisions they were

ordered to pay a fine into the city treasury. The result in that city has also been most beneficial, and the Division Registrar is now kept busy recording entries that should have been made months ago.

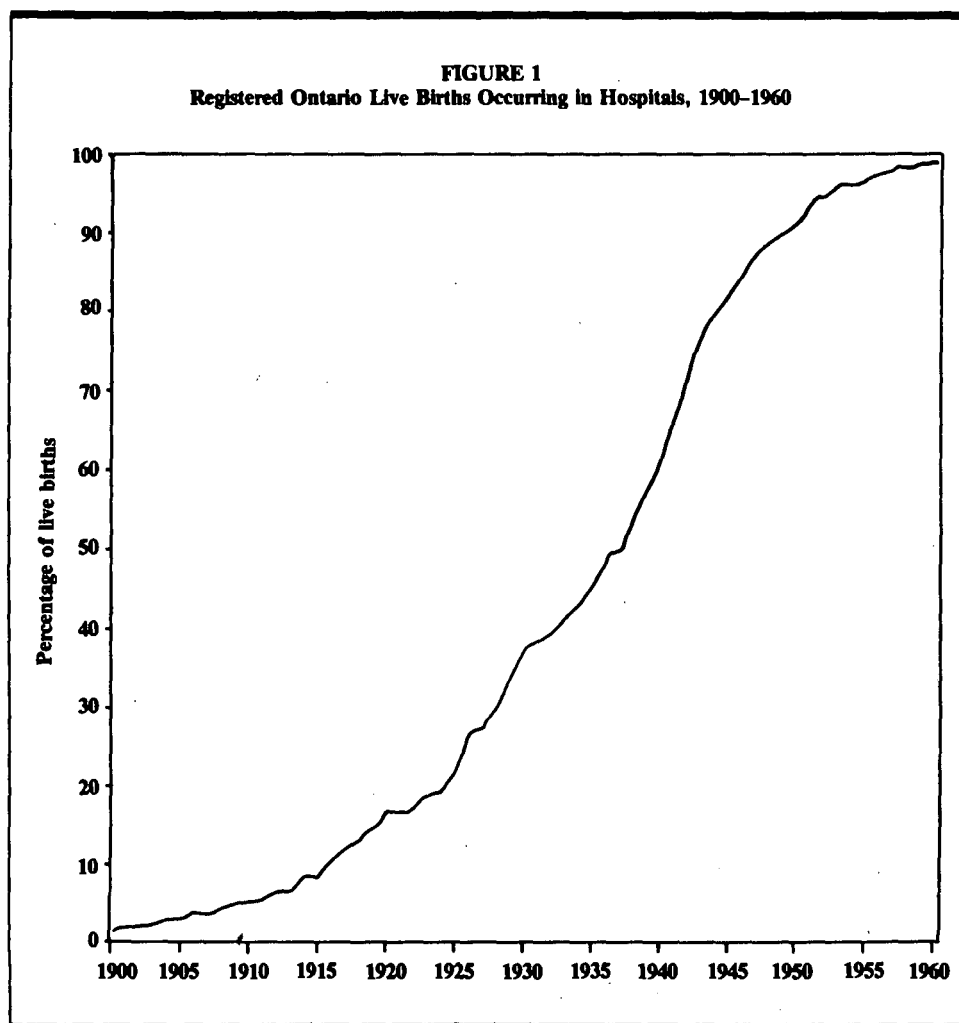
To aid prosecution, he urged the removal of a "weakness" in the 1896 act that exempted the medical attendant from penalty if a parent had reported the birth.<sup>5</sup> His reports for 1903 and 1904 also urged "drastic measures"—the use of a "member of the Provincial detective force" to gather evidence—followed by prosecution "at unequal intervals."

Beginning in 1905, the registrar-general's *Annual Report* omits the inspector's report and is uninformative about the completeness of birth registration. Four types of circumstantial evidence, however, point to increasingly complete returns.

First, new vital statistics acts tightened the requirements for medical attendants. A 1908 act made the attendant liable to penalty for not reporting a birth regardless of whether a parent had registered it, and a 1919 act required him to report a birth within 48 hours instead of the indefinite forthwith.<sup>6</sup>

Second, as shown in figure 1, the proportion of Ontario's registered live births occurring in hospitals increased dramatically from 2 percent in 1900 to 16 percent in 1920, 37 percent in 1930, 62 percent in 1940, and 98 percent in 1960.<sup>7</sup> Here one may surmise that hospital records of the births, required for the provincial hospital inspector, helped both medical attendants and local registrars to report them.

Third, an increase of age-related regulatory and welfare legislation enacted during the study period made birth registration increasingly useful for proof of age or citizenship. The Ontario Insurance Act of 1913, for example, made proof of the age stated in a policy a condition for payment of the benefit.<sup>8</sup> In 1917, the Military Service Act made males eighteen to fifty-nine eligible for service, established a selective draft by age category (twenty to thirty-four, thirty-five to forty-one, and forty-two to fifty-nine) and by marital status within age categories, and placed the burden of proof on the person drafted to show that he was not in the draft category to which he was assigned.<sup>9</sup> Also in 1917, provincial statutes made women twenty-one years of age or older



**TABLE 1**  
**Searches, Certificates Issued, and Birth Certificates Issued According to Scattered Evidence in the Annual Reports of the Registrar-General and the Provincial Board**

Year	Searches	Certificates issued	Birth certificates
1903	1,272	693	307 (44%)
1904	1,516	810	324 (40%)
1911	2,854	1,219	676 (56%)
1912	2,646	1,311	689 (53%)
1913	3,159	1,750	1,019 (58%)
1918	96,500	60,000*	No data
1925	No data	30,000*	No data
1926	114,521*	56,521	No data
1927	50,000*	42,573	No data
1928	50,000*	41,048	No data
1929	75,000*	43,700	No data
1930	57,000*	27,000	No data
1931	38,185*	18,185	No data

Note: Birth certificates as a proportion of all certificates shown in parentheses.

\* = registrar-general's estimate.

eligible for the voter's list and public office.<sup>10</sup> In 1919, two provincial school attendance acts increased the age of compulsory full-time attendance from fourteen to sixteen and prohibited the employment of a person under seventeen during school hours.<sup>11</sup> In 1920, the Ontario Mother's Allowance Act provided help to mothers who lacked spousal support and had two or more dependents under the age of fourteen (amended to sixteen in 1921).<sup>12</sup> In 1927, Ontario's Liquor Control Act repealed prohibition but forbade selling or supplying liquor to a person under twenty-one.<sup>13</sup> In the same year, Canada's Old Age Pension Act introduced pensions for persons aged seventy or older.<sup>14</sup>

The proliferation of motor vehicles in Ontario also led to age-related regulation. Following a 1903 law that required vehicle licenses, the number of licensed vehicles per 1,000 persons in Ontario increased from 2 in 1910 to 69 in 1920, 121 in 1925, and 186 in 1930.<sup>15</sup> During this time, a 1908 law required a commercial driver to have a chauffeur's license and prohibited persons under seventeen from driving on public roads; a 1917 law prohibited persons under sixteen from driving and required chauffeur's licenses for drivers aged sixteen to eighteen; a 1922 law prohibited anyone from permitting a minor to drive or hiring a person aged sixteen to eighteen who did not have a chauffeur's license; and finally, a 1925 law required all drivers not having a chauffeur's license to obtain an operator's license, which they were to keep on their persons when driving and produce for a constable on demand.<sup>16</sup> Thus, amidst the growing popularity of motor vehicles, one had to be licensed to drive and meet an age requirement in order to be licensed.

For various statutes, proof of Ontario birth registra-

tion met citizenship requirements. The American Immigration Act of 1924, for example, allowed Canadian-born persons to apply for immigration visas that permitted them to work in the United States for up to four months, but it also placed the burden of proof on applicants to show that they were Canadian born and not in a restricted class.<sup>17</sup> Other statutes with citizenship requirements included the Ontario Adoption Act of 1927, which restricted issuance of an adoption order to British subjects; and the Canada Pension and Ontario Mother's Allowance Acts, which limited benefits to British subjects.<sup>18</sup> Lastly, as registraion officials noted, proof of Canadian birth was required by the Federal Immigration Department and all federal government departments paying benefits to "returned soldiers, athletic associations, [and] associations carrying benefit funds."<sup>19</sup>

The temporal increase of age and citizenship requirements in Ontario caused a corresponding increase of applications for "official certificates of registration" and "letter forms certifying to registrations on file."<sup>20</sup> As shown in table 1, the number of birth certificates issued rose by 48 percent between 1912 and 1913, probably in reaction to the 1913 Ontario Insurance Act. The registrar-general did not report the numbers of birth certificates for later years. However, the number of certificates issued for all vital events (births, marriages, and deaths) increased sharply after 1918, and in 1929, an official noted that these were "principally of birth records."<sup>21</sup>

The registrar-general's *Annual Report* for 1918 explained the record activity for that year:

During the early part of the year the Military Service Act became operative in Canada, which made it necessary for practically all men from sixteen or seventeen years of age or

upwards to carry certificates of births and, in some cases, certificates of marriage. Never before in the History of the Department has the demand been so great for documentary evidence relating to births and marriages on the part of the public. So great, indeed, was the demand that it became necessary to increase the staff by about three hundred percent, and work twenty-four hours a day, seven days a week, in eight hour shifts. It is estimated that there were some 60,000 certificates issued during the year, and some 89,000 searches made, for which fees were received. During the same period some 7,000 searches were made and certificates issued free of charge to soldiers or their families.

During depressed economic conditions of the 1926-1930 period, the "emigration of Canadian-born citizens going to the U.S.A. for the purpose of obtaining employment" accounted for 61 percent of the official certificates issued in 1926 and "two-thirds" of the certificates issued for 1928. As shown in table 2 for 1926, however, the emigration purpose is less dominant if "letter forms certifying to registrations" were also considered.

To summarize, the study period witnessed a proliferation of age-related government regulation and increased popular usage of birth registrations for proof of age or citizenship. By the 1920s, therefore, parents and physicians were likely to have become more careful about registering births than was the case in earlier years.

A fourth type of evidence of improved registration which Kuczynski used, is the birth rate calculated from the registration data.<sup>23</sup> As shown in figure 2, brief surges in the rate during 1896-1897 and 1908 may reflect short-term impacts of the 1896 and 1908 Vital Statistics Acts. The gradual rise in the rate between 1899 and 1912, and the sharp rise between 1912 and 1915, apparently informs Kuczynski's judgment that the returns show "slow progress" for the 1896-1920 period and are "more complete from 1913 on."

The *calculated* birth rates, however, may show change in the *actual* rate rather than the reporting of births. Indeed, Kuczynski implicitly interprets the post-1915 drop in the calculated rate as a decline in the birth rate, not as evidence of less-complete registration. Plainly con-

ceding the ambiguity of his evidence, he allowed "no possibility of ascertaining the actual number of births."

In conclusion, circumstantial evidence supports Kuczynski's view that Ontario birth registration became increasingly complete during the early twentieth century. The evidence includes the tightening and vigorous enforcement of requirements in the Vital Statistics Act, the trend toward hospital births, the proliferation of age-related government regulation with age and citizenship requirements, a growing popular use of birth registration for proof of age or citizenship, and the rise in the birth rate calculated from published statistics. To test and elaborate the overview, the paper turns now to evidence in delayed registrations of birth, a source that Kuczynski "neglected as not essential" in order "to save space."<sup>24</sup>

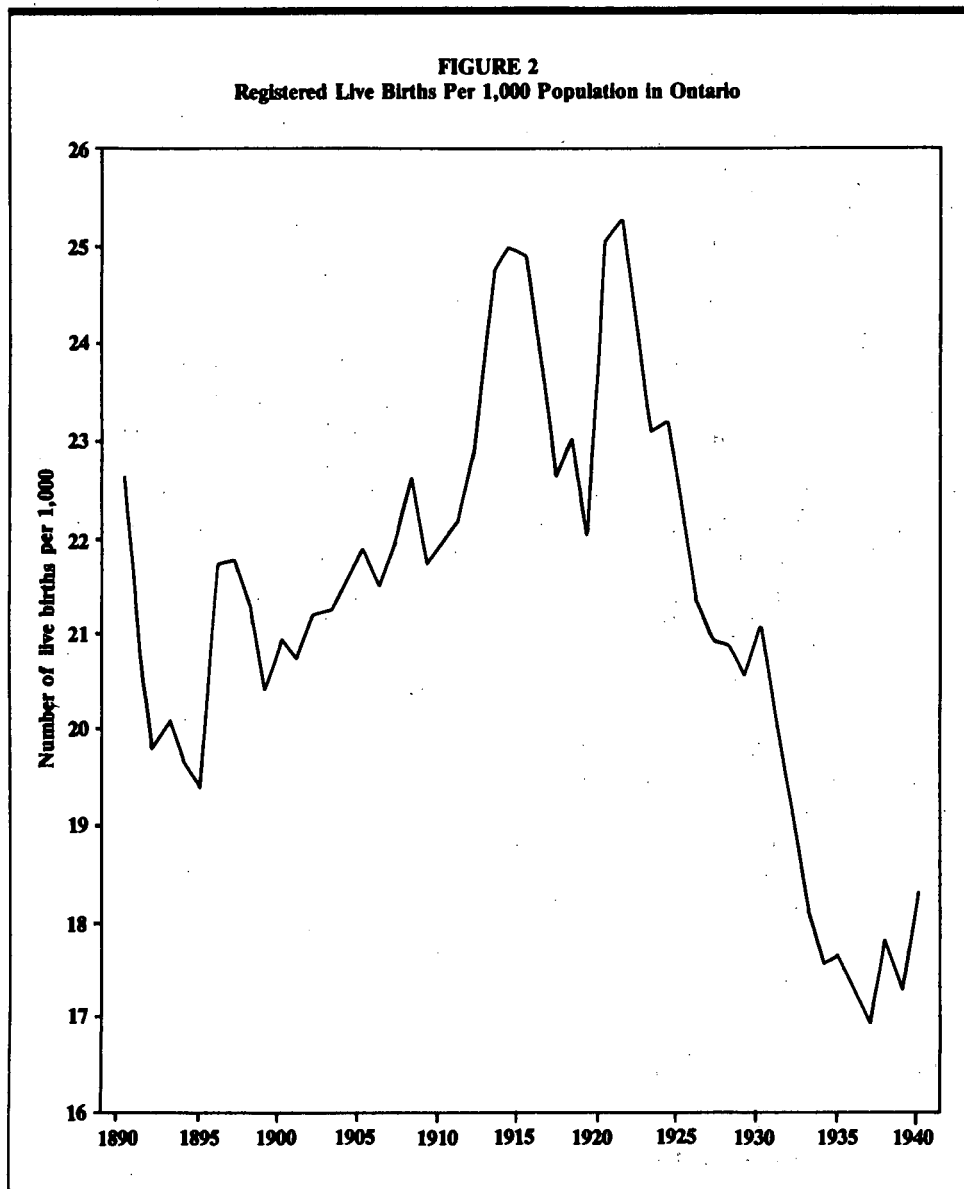
### DELAYED REGISTRATIONS OF BIRTHS: A Historical Description

Local registrars (municipal clerks) could not register a birth if more than a year had elapsed since the birth date. In such a case, the provincial registrar-general could grant delayed registration, on receipt of appropriate evidence and at his discretion. Between 1915 and 1986, for example, his office issued delayed registrations for 3,886 births in the 1900 cohort. However, he submitted his *Annual Report* for 1900 on December 31, 1901, well before he had issued any of the delayed registrations. In this fashion, birth statistics published in his *Annual Reports* exclude delayed registrations and are manifestly incomplete.

Each birth group gathers delayed registrations throughout its life course as certain of its members request birth certificates for proof of age and discover that their births are not registered. Table 3 shows the number of delayed registrations for selected cohorts according to period of issuance. Table 4 converts the table 3 subtotals into cohort age categories that correspond to the periods of issuance. For convenience, values referenced in discussion are shown in boldface type.

TABLE 2  
Purposes Reported for Searches of Vital Records During 1926<sup>22</sup>

Certificates		
Emigration to the United States:	34,850	(30.4%)
Other purposes:	22,691	(19.8%)
Letter Forms		
"Insurance, athletics, etc.":	40,100	(35.0%)
Mother's Allowance:	4,200	( 3.6%)
Adoption:	750	( 0.7%)
Federal Immigration Department:	700	( 0.6%)
Soldier's Benefits:	450	( 0.4%)
Local Police Requests and Unrecorded:	11,800	( 9.4%)
Total	114,521	(99.9%)



Both *historic* and *life-course* events influence cohort accumulation rates. As the data in table 4 show, for example, the numbers of delayed registrations issued to cohorts 1900 through 1920 increase as each group approaches sixty-five, the age of pension eligibility. In table 3, the numbers for the 1900, 1905, and 1910 cohorts increase for the 1925–1929 period. Here probable influences include the new American immigration requirements (1924); the introduction of automobile driver's licenses (1925); and the repeal of prohibition (1927), each with provisions excluding minors. Similarly, wartime legislation to mobilize manpower in 1917 and 1940 caused a rise in the numbers for cohorts whose males were in or approaching the ages of military service.<sup>25</sup> After noting the huge increase in the number of searches and certificates requested following the implementation of the Military Service Act in 1918, the registrar-general continued:

Such huge amount of searching revealed the fact that in the earlier days registration of vital statistics was not nearly so well observed as it is at present. A large number of births and marriages was found not to be registered, and, in all cases where it was possible, the Department gave the privilege of registering, and in this way, some 5,000 births were registered. A larger number would have been registered had the Department not been obliged to refuse many the privilege because there was no person available who was qualified to bring sufficient evidence to make the registration.

Because historic events exert an age-selected influence, cohorts differ in their accumulations of delayed registrations of birth. As the data in table 3 show, the Military Service Act increased the number of delayed registrations issued to the 1900 cohort, age eighteen in 1918, but did not affect the number for the 1905 cohort, then age thirteen. Similarly, the 1940 conscription legislation increased the numbers for cohorts 1905 through 1925, whose ages that year ranged from fifteen to thirty-

five, but did not affect the numbers for cohorts older or younger.

Given such differences, certain cohorts more than others receive large numbers of delayed registrations as they pass through the younger age categories, when comparatively few of their members have died. Relative to the others, therefore, these cohorts produce fewer applicants as they encounter critical life-course events at later ages. Similarly, younger cohorts are likely to have more complete birth registration than the older cohorts, which gives them smaller pools of potential applicants for delayed registration.

### The Requirements for Delayed Registration

Although the requirements for delayed registration affect the numbers issued, provincial statutes state little about them. Until 1948, for example, the legislation merely refers to "the required information in the prescribed form."<sup>26</sup> For details, one must consult the instructions that accompanied the application form for the period concerned.

Under the 1931 instructions, for example, one applied for delayed registration of a birth by submitting a fee and a notarized statutory declaration of the birth by someone in a position to know about it. The declaration was to come from a parent, or, if neither parent was alive, a person old enough to know about the birth. Examples of such a person, in order of preference, were (1) an older sibling who could remember the birth, or who,

while too young to remember the birth, could remember the mother "sick in bed with a young infant with whom I grew up and always recognized"; (2) an aunt or uncle present at birth, or who saw the child within three days of birth and was then informed of the child's birth date; (3) a near neighbor; and (4) a physician or nurse who had attended the birth. As stated on the reverse of the form, entries in family Bibles or baptismal certificates could not substitute for the statutory declaration and effectively were discounted as evidence.

Circumstantial evidence indicates that the requirements became more stringent about 1945. First, the registrar-general stores delayed registrations issued after 1945 separately from those issued up to 1944, and the staff who manage the records believe that documents in the second set are more reliable. Second, the provincial Vital Statistics Act of 1948 is more specific than earlier legislation about the requirements.<sup>27</sup> Henceforth, these included (1) the fee; (2) a statement of birth by (in order of preference) the mother, father, a person representing the parents, the occupier of the house if he had knowledge of the birth, or the nurse in attendance; (3) a statutory declaration by the applicant or another person; and (4) "such other evidence as may be prescribed by the regulations."

The instruction sheet that accompanies the application form used in 1979 serves to elaborate the "other evidence . . . prescribed" for the post-1945 period. As detailed below, the key innovation is an insistence upon documentary evidence.

TABLE 3  
Delayed Registrations for Selected Cohorts by Period When Registration Was Granted

Period	Cohort birth year										
	1900	1905	1910	1915	1920	1925	1930	1935	1940	1950	1960
1900-04	0	-	-	-	-	-	-	-	-	-	-
1905-09	0	0	-	-	-	-	-	-	-	-	-
1910-14	0	0	5	-	-	-	-	-	-	-	-
1915-19	647	87	128	106	-	-	-	-	-	-	-
1920-24	119	199	366	244	147	-	-	-	-	-	-
1925-29	681	1,010	1,035	609	355	163	-	-	-	-	-
1930-34	217	256	320	662	416	224	120	-	-	-	-
1935-39	166	217	302	302	355	164	170	110	-	-	-
1940-44	293	369	426	689	502	388	193	188	217	-	-
1945-49	191	191	280	297	195	125	263	239	176	-	-
1950-54	296	263	289	265	179	99	114	85	47	139	-
1955-59	339	292	319	310	165	83	86	97	88	107	-
1960-64	400	358	356	290	174	86	68	62	82	50	339
1965-69	437	502	335	308	191	69	65	32	34	76	152
1970-74	58	290	891	587	313	142	116	68	42	58	87
1975-79	33	81	412	832	441	212	174	118	68	39	86
1980-84	7	16	38	209	357	134	98	51	48	17	19
1985-86	2	5	16	20	128	62	48	36	21	4	0
Total	3,886	4,136	5,498	5,730	3,918	1,951	1,515	1,086	823	490	683



**TABLE 4**  
**Delayed Registrations for Select Birth Groups by Age Category**

Age Category	Cohort birth year										
	1900	1905	1910	1915	1920	1925	1930	1935	1940	1950	1960
0-4	0	0	5	106	147	163	120	110	217	139	339
5-9	0	0	128	244	355	224	170	188	176	107	152
10-14	0	87	366	609	416	164	193	239	47	50	87
15-19	647	199	1,035	662	355	388	263	85	88	76	86
20-24	119	1,010	320	302	502	125	114	97	82	58	19
25-29	681	256	302	689	195	99	86	62	34	39	0*
30-34	217	217	426	297	179	83	68	32	42	17	
35-39	166	369	280	265	165	86	65	68	68	4*	
40-44	293	191	289	310	174	69	116	118	48		
45-49	191	263	319	290	191	142	174	51	21*		
50-54	296	292	336	308	313	212	98	36*			
55-59	339	358	335	587	441	134	48*				
60-64	400	502	891	832	357	62*					
65-69	437	290	412	209	128*						
70-74	58	81	38	20*							
75-79	33	16	16*								
80-84	7	5*									
85-86	2										
Total	3,886	4,136	5,498	5,730	3,918	1,951	1,515	1,086	823	490	683

Note: \* = first two years of category only.

**Acceptable Evidence**

At least one item of the following is acceptable if the record was made within four years of date of birth:

1. Baptismal Certificate or other Church Records such as a Cradle Roll
2. Hospital Record of Birth
3. Doctor's Office Record of Birth
4. Newspaper Notice
5. Insurance Policy
6. Certified Copy of any record of a Child Welfare Organization

If not available at least *two* items of the following:

1. A School Record
2. Bible Record
3. Census Records
4. Marriage Records
5. Baby or Birthday Book
6. Letters or Telegrams re-birth
7. A record of Baptism after the age of four years
8. Other documentary evidence made at the time of birth

Note: A delayed registration of birth cannot be effected in this office unless the name, date, place of birth and parentage are clearly established by documentary evidence. The responsibility for supplying such proof rests with the person applying for the registration.

Note: The original copy of documentary evidence, *not* a photocopy, is to be submitted. Personal documents will be returned after they have served their purpose.

The difference between the pre-1945 and post-1945 requirements prompts two important observations about delayed registrations for the different cohorts. First, the insistence upon documentary evidence in the

second period increased the possibility (noted above for 1918) that legitimate applicants were refused delayed registration because they could not provide enough proof. Second, it decreased the risk that delayed registration might be granted to persons actually born outside the province. Although the writer found no statistics for refused applications, table 5 elaborates cohort exposures to the differences in risk between the two periods. For example, 68 percent of the delayed registrations for the 1930 cohort were issued under the more stringent post-1945 requirements, as compared with only 45 percent for the 1900 cohort.

**ESTIMATING ACTUAL NUMBERS OF ONTARIO LIVE BIRTHS**

In a four-step procedure, this section uses information in published statistics and delayed registrations of births to estimate the numbers of live births for selected cohorts. The procedure entails three assumptions that are later relaxed for discussion: (1) that all delayed registrations issued were for bona fide applicants, namely, persons whose births were not registered but had occurred in Ontario in the year for which delayed registration was granted; (2) that all bona fide applications for delayed registration were successful; and (3) that the dead, had they not died, would have applied for delayed registrations in the same proportions as the living.

### Step 1

Table 3 reports the distribution of the delayed registrations for each cohort by five-year periods of issuance. Table 4 then reports the subtotals for cohort age categories that correspond with the periods of issuance.<sup>28</sup>

### Step 2

As the data in table 4 show, the 1900 birth group accumulated delayed registrations throughout its life course, from age fifteen through age eighty-six. As the group aged, however, a growing number of its members died and, therefore, did not experience historic and life-course pressures that prodded the survivors to apply for delayed registration. To allow for the influence of mortality on the number of delayed registrations issued to a cohort, step 2 of the procedure assumes that the dead would have received delayed registrations in the same proportions as the living, had nobody in the cohort died.

Only 71 percent of the 1900 birth group, for example, were alive as the group entered the age category forty to forty-four, during which time 293 delayed registrations were granted to group members. Fewer than 71 percent obtained the 293 delayed registrations, however, because the cohort experienced some deaths while passing through the ages forty through forty-four. To allow for this added group attrition, the estimate is based upon the proportion alive at the midpoint of the age category forty to forty-four.<sup>29</sup> Thus, 69.8 percent of the cohort obtained the 293 delayed registrations. Had 100 percent of its members been alive at age forty-four, the group would have received 415 delayed registrations  $([293/69.8]*100)$ .

Generation life tables are used to calculate the proportions alive at different ages. Because such tables have not been published for Ontario, tables for Canada were used for the 1900, 1910, 1920, and 1930 cohorts.<sup>30</sup> For the 1905, 1915, and 1925 cohorts, calculations were based on the means of the values in tables for the cohorts immediately preceding and following each of the three cohorts.

Although the accuracy of the Canada-generation life tables for Ontario survival rates is unknown, abridged life tables published for the period 1921-1981 show little

difference between Canada and Ontario in expectation of life at birth for both sexes.<sup>31</sup> In any event, the estimates are not very sensitive to variations in overall survival. As shown in table 6, the estimated incompleteness of birth registrations for the 1900 cohort changes by less than one percent if either the 1891 (higher mortality) or 1911 (lower mortality) tables are substituted for the 1901 table.

### Step 3

By 1986, the last year for which the writer examined delayed registrations, the younger cohorts had yet to pass through some of the age categories that the 1900 cohort had completed. For example, the 1900 cohort was eighty-six an age the 1930 cohort will not reach until the year 2015. Thus, to apply step 2 of the procedure to all age categories for each cohort, one must estimate the numbers of delayed registrations the younger cohorts will receive during age categories they have yet to pass through. Table 7 shows where such estimates are needed for the 1905 and 1930 birth groups.

To predict how many delayed registrations a cohort will receive during a future age category, step 3 uses the preceding cohort's experience for the category, while allowing for historic differences between the cohorts. In table 7, for example, the number of delayed registrations the 1905 cohort receives for the age category eighty to eighty-four cannot be known until 1990. The first part of the step 3 prediction assumes (for want of contrary evidence) that the 1900 and 1905 cohorts experience the same life-course influences for the age category (e.g., relatively few survivors whose critical life-course events are largely over). For prediction, one calculates the 1900 cohort's number for the age category (twenty-four) as a proportion of its birth registrations (45,549), which yields the statistic .000524. Assuming the same proportion for the 1905 cohort, it will receive .000524 of its 50,808 birth registrations, or 26.6 delayed registrations (the life-course statistic) as it passes through the age category.

The second part of step 3 is to adjust the life-course statistic to allow for historic differences between the cohorts in their respective accumulations of delayed regis-

TABLE 5  
Proportions by Cohort of Delayed Registrations Granted by 1986 Issued Before 1945 (Calculated from Table 3 Data)

Cohort	1900	1905	1910	1915	1920	1925	1930	1935	1940
1986 <i>N</i>	3,886	4,136	5,498	5,730	3,918	1,951	1,515	1,086	823
% pre-1945	55	52	47	46	45	48	32	27	26
% post-1945	45	48	53	54	55	52	68	73	74

**TABLE 6**  
**Estimates of Incompleteness in Birth Registrations for the 1900 Cohort, Assuming Different Survival Rates**

Life table selected	S(x)	D(0)	E(0)	Est. % births missed	Difference
1891	100,000	15,433	45.20	12.45	+0.91
1901	100,000	13,381	48.67	11.54	
1911	100,000	11,259	52.55	10.72	-0.82

Note: 1. S(x) = number of life births for the cohort.  
 2. D(0) = number dying before age 1.  
 3. E(0) = expectation of life at birth.

**TABLE 7**  
**Estimates of Unregistered Births (Delayed Registrations and Births Never Registered) for the 1900, 1905, and 1930 Cohorts as of 1986**

Cohort age	Grant period 1900 c.	Unregistered births 1900 c.	Grant period 1905 c.	Unregistered births 1905 c.	Grant period 1930 c.	Unregistered births 1930 c.
55-59	1955-59	527	1960-64	530	1985-89	60*
60-64	1960-64	659	1965-69	786	1990-94	?
65-69	1965-69	789	1970-74	496	1995-99	?
70-74	1970-74	119	1975-79	158	2000-04	?
75-79	1975-79	83	1980-84	38	2005-09	?
80-84	1980-84	24	1985-89	16*	2010-14	?
85-86	1985-86	11	1990-91	?	2015-16	?

Note: \* = two years (1985-86) only.

trations. For example, if birth registration for one cohort is more complete than for the cohort preceding, then proportionately fewer of its members will require delayed registration as they encounter life-course events. If, on the other hand, historic events cause proportionately more members in the preceding cohort to obtain delayed registration in the younger age categories, when relatively few cohort members have died, then proportionately more members in the second cohort will seek delayed registration as they encounter critical life-course events in later years.

To allow for historic differences between two cohorts, the step 3 method keys on the net differences at entry into the age category for which prediction is required. For each cohort, one calculates the delayed registrations for all previous age categories as a proportion of its birth registrations. The proportion for the second cohort, which requires the prediction, is then divided by the proportion for the cohort preceding to obtain the history statistic. The history statistic multiplied by the life-

course statistic yields the complete step 3 prediction for the age category.

To return to the above example, the life-course part of the prediction was that the 1905 cohort would receive 26.6 delayed registrations as it passed through the age category eighty to eighty-four. As the 1905 cohort reached age eighty, however, its delayed registrations as a proportion of its birth registrations were equal to only .91 of the corresponding figure for the 1900 cohort. Thus, the completed step 3 prediction is that the 1905 cohort will receive .91 of 26.6, or 24.12 delayed registrations of birth as it passes through the age category eighty to eighty-four.

The accuracy of the predictions for future years (1987+) is problematic. As shown in table 8, the step 3 method poorly predicts the known numbers of delayed registrations for pre-1986 age categories of the 1905, 1910, and 1915 cohorts. As shown below in table 9, however, the step 3 predictions involve small numbers and cause little change in cohort birth estimates. Thus,

the author accepts the predicted values for the number of delayed registrations the cohorts will receive after 1986, and these values, in turn, serve to estimate the number that the cohorts would have received from 100 percent of their members (see step 2 above).

#### Step 4

The percentage incompleteness in cohort birth registrations is obtained by dividing the estimate (obtained through steps 1-3) by the number of unregistered births (the estimate minus the number of registrations). In figure 3, the trend line shows continuous increase in the completeness of birth registrations between 1910 and 1930. Contrary to expectation, however, it shows that registration was more complete in 1900 and 1905 than in 1910.

The statistics for 1900 and 1905 are not plausible and require adjustment. First, they go against Kuczynski's impression of "slow progress" for the 1896-1920 period. Second, on the basis of circumstantial evidence—the provincial inspector's vigorous effort to enforce the Vital Statistics Act, the tightening of the requirements in the act in 1908 and 1919, and the small increase in the proportion of births occurring in hospitals—one might expect a slight increase in the completeness of birth reg-

istration between 1900 and 1910. Third, an implicit assumption in steps 2 and 3—that all persons whose births were missed by civil registration eventually would have applied for delayed registration, had nobody in the cohort died—is problematic for the older birth groups. Notwithstanding the effects of the Military Service Act on the 1900 cohort, age-related government regulation possibly had less influence on life courses for the older cohorts than for those of the younger.

The step 4 adjustment to the figures for 1900 and 1905 makes two assumptions. One is that the cohort with the highest estimated incompleteness (1910) is the first for which the step 3 estimates are reliable. The other is that the completeness of the returns rose more slowly before 1910 than after, in keeping with Kuczynski's description of the data ("slow progress" for the 1896-1920 period, with an accelerated improvement in the returns beginning about 1913). Thus, the author arbitrarily assumes a one percent increase for each of the intervals 1900-1905 and 1905-1910, which is about half the 2.1 percent increase estimated for the period 1910-1915.

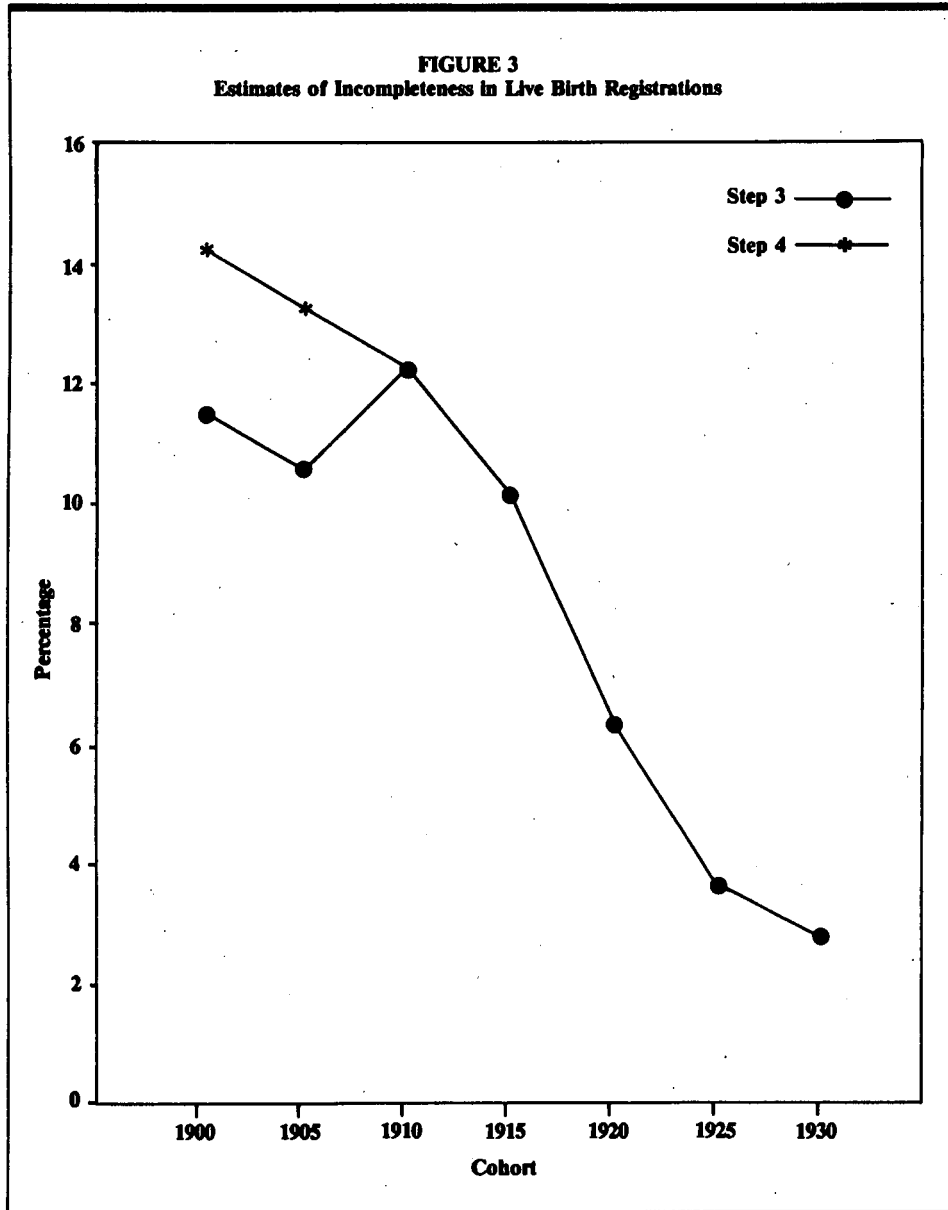
Figure 3 shows the effect of the step 4 revisions, and table 10 shows the final estimates of cohort birth numbers.

TABLE 8  
Accuracy of Step 3 Estimates for Predicting Known Values for Previous Age Categories

Age category	Delayed registrations 1905	% prediction error	Delayed registrations 1910	% prediction error	Delayed registrations 1915	% prediction error
40-44	191	+79	289	-12	310	+3
45-49	263	-20	319	+12	290	+22
50-54	292	+14	356	+10	308	+26
55-59	358	+5	335	+42	587	-39
60-64	502	-12	891	-28	832	+20
65-69	290	+68	412	-5	209	+115
70-74	81	-24	38	+189		
75-79	16	+120				

TABLE 9  
Cases Added in Step 3 as Percentages of Birth Registrations and Estimated Birth Totals

	1905	1910	1915	1920	1925	1930
Stage 3 estimates, N:	45	101	162	309	427	332
% birth registrations	0.1	0.2	0.2	0.4	0.6	0.5
% estimate	0.1	0.2	0.2	0.4	0.6	0.5



The step 4 estimates are higher than Kuczynski's posited 85 percent maximum completeness for any year before 1920. Here two assumptions of the estimation procedure may inflate the estimates. The first—that all persons whose births were missed by civil registration would eventually have applied for delayed registration had nobody died—may be tenuous for more than the 1900 and 1905 cohorts.

The second—that all persons missed by civil registration could have obtained registration of their births—also is problematic. As noted in the registrar-general's *Annual Report* for 1918, many applications were refused for want of acceptable evidence, and the standards of evidence became more rigorous in 1945. A possible offsetting influence was the issuance of delayed registration to persons actually born outside the jurisdiction. Even

so, the actual completeness of the birth returns probably is less than the step 4 estimates indicate.

On the other hand, comparison of the step 4 estimate for 1930 (97.3 per cent) with Tracey's minimum estimate for the 1931 census enumeration year (96 percent completeness) testifies to the accuracy of the step 4 estimate for the end of the study period. For this estimate Tracey drew a systematic sample of 5,763 infants from the 1931 manuscript census for Ontario. He then matched 89 percent of his sample population to birth registrations for months corresponding to the enumeration year, in each case limiting his search to birth registrations for the infant's county of residence (census). After experimentation, he adjusted the total for matched cases to 92 percent to allow for births which were registered outside the census county of residence. Finally,

he considered other influences which deflated the total for matched cases: the frequent occurrence of American immigrants reporting a Canadian birthplace for children "whose age indicates that they were born previous to the date of migration;" the difficulty of tracing illegitimate children and adopted children "subsequent to registration and before the census;" the misspelling of names by census enumerators; and "incomplete searches by clerks seeking to match the transcripts."<sup>32</sup> To allow for these influences, he "put the deficiency of birth registrations at not over half the percentage unmatched." Thus, for Ontario, one-half of the adjusted total for unmatched cases (8 percent) yields the estimate of 4 percent incompleteness in birth registrations for the enumeration year.

### BIASED INCOMPLETENESS IN LIVE BIRTH REGISTRATIONS

Did chance alone determine which births Ontario's civil registration missed, or were systematic influences at work? To elucidate bias in Ontario birth registration, the following section compares information in delayed registrations for the 1920 cohort with corresponding information about the cohort's registered live births. The information about the 3,918 delayed registrations comes from a random sample of birth registrations; information about the 72,511 live births comes from published statistics or, where these are lacking, from a random sample of birth registrations. Each of the random samples holds 384 cases; assuming maximum variability in the distribution for any attribute, this sample size allows a confidence interval of .10 and a confidence level of .05 (i.e., for any attribute, one can be 95 percent confident that the sample distribution is within 5 percent of the population distribution).<sup>33</sup>

#### Geographical Bias

If no geographical bias existed in birth registrations, then published birth statistics and delayed registrations would have similar geographical distributions. To test

for this possibility, the author compared *actual* distributions in the delayed-registrations sample with the distributions *predicted* on the assumption that the distributions for registered births and delayed registrations were identical. As shown in table 11, no statistically significant difference exists between the predicted and actual distributions for the geographical aggregates of cities, towns, and counties (exclusive of towns and cities). Apparently, the completeness of birth registrations did not differ between rural and urban populations. However, the city of Toronto and the Northern Ontario region account for disproportionate numbers of delayed registrations, a sign that their respective birth registrations are exceptionally incomplete.

Interestingly, Toronto persons missed by civil registrations acted more quickly than other such persons to obtain delayed registration of births (see figure 4); more than 79 percent of Toronto delayed registrations granted by 1986 were issued before 1950, compared with 53 percent of delayed registrations for the province. Residence in the provincial capital evidently provided greater stimulus than elsewhere to possess a birth certificate for proof of age; alternately, it provided easier access to the registrar-general, whose offices were located in the city.

#### Sex Bias

Females account for 55 percent of the cases in the delayed-registration sample, but only 49 percent of the published total for live births. The difference is suggestive but inconclusive about sex bias in birth registration. Sample error may inflate (or deflate) the proportion of females in the delayed registrations. Second, some of the female surplus in the delayed registrations comes from the greater longevity for females; more females than males survive to experience life-course events in older age categories, which prompts applications for delayed registration.

On the other hand, the female surplus exists despite a male bias in certain of the life-course events (e.g., obtaining an automobile driver's license, responding to

TABLE 10  
Ontario Live Births: Published Totals (Registrations) and Step 4 Estimates

	1900	1905	1910	1915	1920	1925	1930
Registrations	45,549	50,808	54,755	67,032	72,511	70,122	71,263
Delayed registrations	3,886	4,136	5,518	5,730	3,918	1,951	1,515
Never registered (estimated)	2,600	2,591	1,184	1,067	715	594	438
Estimated births	52,035	57,535	61,457	73,829	77,144	72,667	73,216
% underregistered	14.2	13.2	12.2	10.1	6.4	3.6	2.7
% completeness	85.8	86.8	87.8	89.9	93.6	96.4	97.3

**TABLE 11**  
**Predicted (from the Distributions Shown in Published Statistics for Live Births) and**  
**Actual Numbers of Delayed Registrations of Births in the Sample**

	Predicted number	Actual number	Percentage/ difference
<b>Rural-urban</b>			
Cities	184	185	0
Towns	30	26	-13
Counties (rural)	170	173	+2
Chi-square = 0.315663; <i>df</i> = 2 Not statistically significant at the .05 level			
<b>Region</b>			
Eastern Ontario	94	77	-16
Southwest Ontario	153	122	-31
Northern Ontario	49	88	+39
Toronto-York County	88	97	+9
Chi-square = 16.72463; <i>df</i> = 3 Statistically significant at the .01 level			
<b>Selected municipalities</b>			
Toronto (city)	72	92	
Sudbury (county)	5	24	
Fort William (city)	7	11	
Windsor (city)	6	12	
Temiskaming (county)	6	12	
Renfrew (county)	5	11	
Bruce (county)	4	9	
Ottawa (city)	18	4	
York (county)	16	5	
Hamilton (city)	17	12	
Carleton (county)	5	1	
St. Catharines (city)	4	1	
Muskoka (county)	3	0	

wartime military service regulations) that promoted cohort members to apply for delayed registration. Moreover, evidence on sex ratios suggests an anti-female bias in Ontario birth registration until the 1930s. During the 1880-1940 period, the actual ratio of male to female live births probably rises irregularly because of sex-selective reductions in prenatal mortality.<sup>34</sup> Figure 5 shows this pattern for England and Wales, whose birth registration was quite complete for the period.<sup>35</sup> The ratios calculated from published Ontario data, however, show a declining pattern and are notably higher than English-Welsh ratios for the 1880-1920 period. The likely explanation is that biased incomplete registration masks a rising trend until the 1920s, when more complete registration attenuates the bias. For the same reason, the Ontario ratios began to mimic the English-Welsh ratios during the 1920s and closely match them during the 1930s

### Social Class Bias

Father's occupation is the only available proxy for the social class status of a newborn's family. Both birth reg-

istrations and delayed registrations report this information, although for illegitimate births they usually report only the mother's occupation, if she has one. Occupations are categorized in a three-stage process in order to test for social class differences. First, they are separated into farm and nonfarm categories; nonfarm occupations are then placed in the categories of manual and nonmanual; last, occupations in each of these categories are classified as simple or complex according to the complexities of the work task involved.<sup>36</sup> Table 12 summarizes results of the classification. The *manual/simple* category, and to a lesser extent the *nonmanual/simple* category may be taken as crude indicators of low social standing. From this standpoint, the table 12 data for delayed registrations show a slight overrepresentation of lower-class parents, and therefore a slight bias against them in birth registration. Although suggestive, the evidence of class bias is inconclusive. Occupation is a notoriously ambiguous indicator of social class, the difference between the two distributions is small, and the use of two samples doubles the potential of distortion through sample error.

**Ethnic Bias**

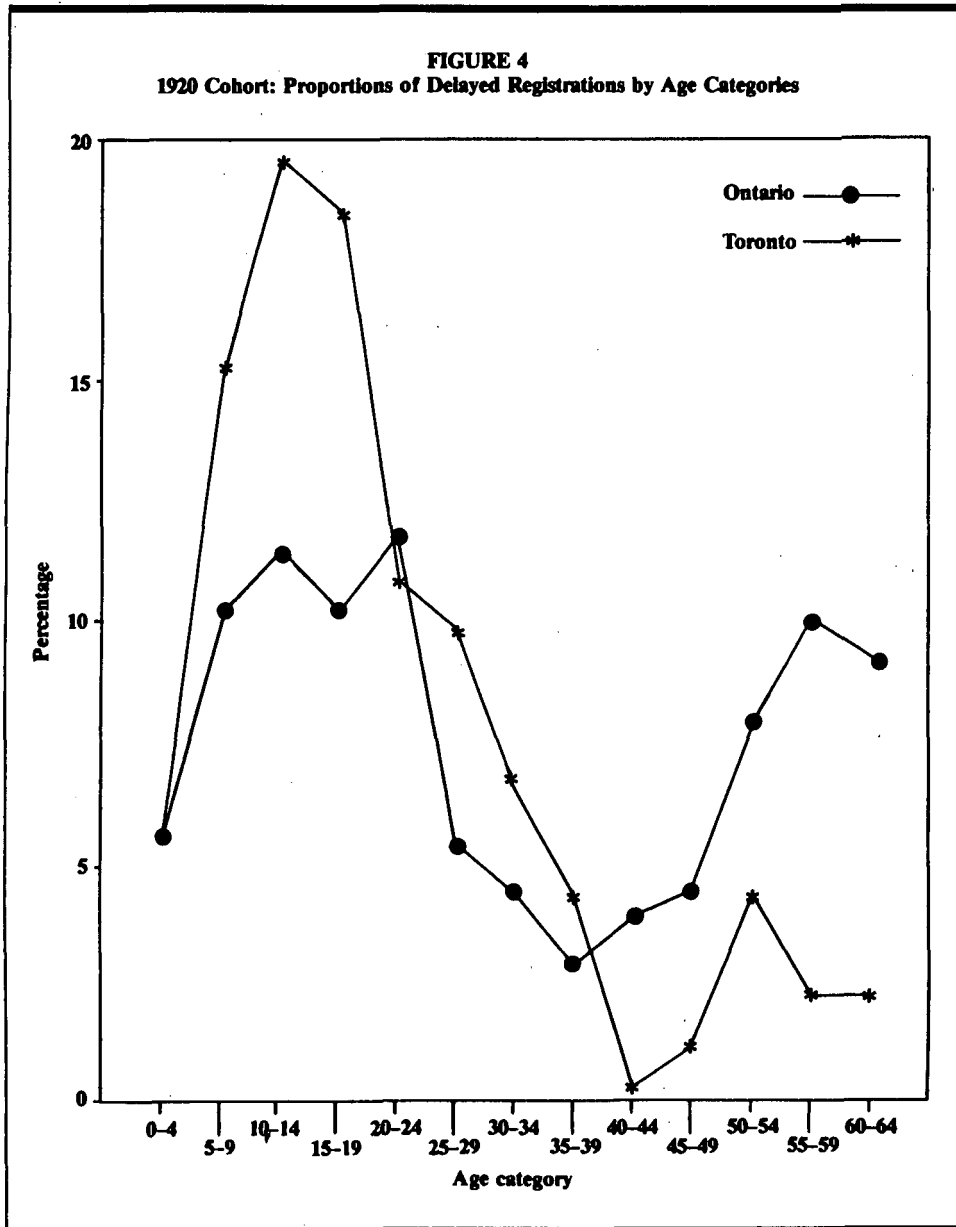
Although birth registrations report "race" and place of birth for both parents, the forms used for delayed registration solicit this information for the period 1945-1959 only, which accounts for just 49 cases in the sample. The number is small, and its ethnic composition may differ from that for cases involving earlier or later years of issuance for delayed registration.

Although limited as evidence, the partial data suggest two important ethnic biases in Ontario birth registrations for 1920. The first is a disproportionate underreporting of births for continental European ethnic groups. These groups account for only 6 percent of cases in the birth registration sample, but for 35 percent (17 cases) of the 49 delayed registrations. The second is

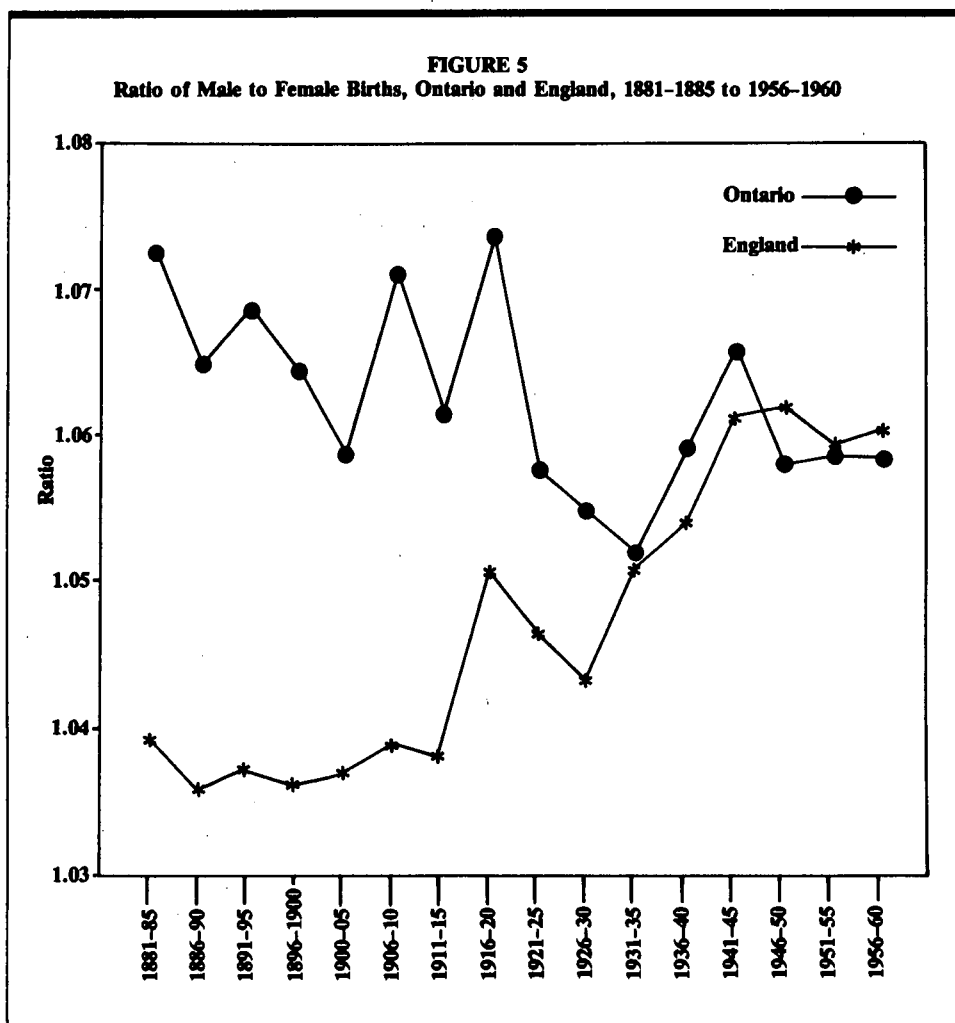
an unusually complete reporting of French Canadian births; franco-Ontarians account for 13 percent of cases in the birth registration sample but receive only 8 percent (4 cases) of the 49 delayed registrations.

The findings for French Canadians accord with viewpoints expressed in the 1898 and 1910 *Annual Reports*. The report for 1910 also gives a partial explanation:

In most of the counties settled by the French people of Ontario, a great many of the births are registered by the priests of the parishes. The people being Roman Catholics generally, are anxious to have their children baptized as soon after birth as possible, and in this manner the priests get their names and register them, although there is no provision in the Vital Statistics Act giving them this power, yet, if these clergymen did not make the registrations, very many, indeed most of them, would go unregistered, as it is impossible for the Division Registrar to know where births take place.







The full explanation is that the priests were continuing a practice begun in Quebec, where civil registration law required clergy to compile lists of births, marriages, and deaths from information in church parish registers. The parish registers, in turn, provided nearly complete coverage of vital events for French Canadian and other Roman Catholic populations.<sup>37</sup>

**CONCLUSION**

In 1905, Ontario’s inspector of vital statistics recognized that provincial birth statistics were unreliable. Similarly, Kuczynski’s 1930 monograph described “birth statistics for English-speaking Canada up to 1920” as “utterly inadequate.” Although useful, these early views were general, largely intuitive, and gave little historical context. By using evidence from delayed registrations, this paper strengthens the empirical basis for such judgments and gives more precise information about the incompleteness and biases of birth registration and illustrates when it becomes reliable. Second, it uses circumstantial evidence—the secular hospitalization of bir-

ths, the proliferation of government, age, and citizenship requirements, and a tightening of the legislation and enforcement for civil registration—to elaborate the historical context.

The principal research finding shows that Ontario birth registrations moved from 86 to 97 percent completeness between 1900 and 1930. This supports Kuczynski’s estimate of “at least 90 percent” completeness for the 1920s and also Tracey’s minimum estimate for 1931. On the other hand, it describes higher levels of completeness than Kuczynski’s 85 percent maximum allowed for the years prior to 1920. Here the study estimates may be high due to assumptions made in the estimation technique.

A second finding is that Ontario birth registration was biased against certain population groups as long as it remained incomplete. As shown by analysis of the delayed registrations issued to members of the 1920 cohort, birth registration was unusually complete for French Canadians, but disproportionately incomplete for Toronto and Northern Ontario regions, females, and continental European ethnic groups.

TABLE 12  
Percentages of Fathers' Occupation in Different Occupational Categories, Differences between Birth Registrations  
(N = 376) and Delayed Registrations (N = 325) for 1920

Sample	Non-manual/ complex (%)	Non-manual/ simple (%)	Manual/ complex (%)	Manual/ simple (%)	Farm (%)
Birth registrations	11	11	32	19	26
Delayed registrations	7	15	29	26	21
Difference	-4	+4	-3	+7	-5

## NOTES

I wish to thank the two anonymous reviewers for their comments, and also Kevin McQuillan, Jack Blocker, Peter Neary, and Jill Fraser.

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- Kuczynski, R. R. 1930. *Birth registration and birth statistics in Canada*. Washington, D.C., The Brookings Institution, chap. IV; see also Emery, G. 1983. Ontario's Civil Registration of Vital Statistics, 1869-1926: The evolution of an administrative system. *Canadian Historical Review* 64 (4):468-93.
- MacPhail, E.S. 1927. Infant mortality as shown by Canadian Vital Statistics. *American Journal of Public Health* 17:476-84.
- Tracey, W. R. 1942. *Fertility of the population of Canada*. Seventh Census of Canada, 1931. Vol. XII. Ottawa: King's Printer, chap. 1. See also Appendix A in Charles, E. 1948. *The changing size of the family in Canada*. Eighth Census of Canada, 1941, Census Monograph No. 1, Ottawa: King's Printer, 1948.
- Section 28 of the act states: "(2) if a return required by this act to be made by more than one person is made by any one of such persons, the others shall not be liable to the penalty." Ontario, *Statutes*. 1896, chap. 17.
- Ontario. *Statutes*. 1908, chap. 28; 1919, chap. 23. Section 31 of the 1908 act states that the exemption "shall not apply to a return required to be made by a duly qualified medical practitioner."
- Data Source: Ontario. *Annual reports of the inspector of hospitals and charitable institutions, 1900-1925; Annual reports of the registrar-general, 1926-1960*. The hospital inspector's statistics are for the twelve months ending 30 September.
- Ontario. *Statutes*. 1912, chap. 33, s. 166; 1913, chap. 35, s. 8. Except for industrial insurance, commercial insurance companies and registered friendly societies were to advise insured persons of the requirement, in writing, at specified intervals until they secured proof of age. Failure to comply with this requirement was deemed to be acceptance of the age stated in the contract.
- Canada. *Statutes*. 1917, chap. 19; 1940, chap. 13.
- Ontario. *Statutes*. 1917, chap. 5, 6, and 43; 1918, chap. 3; 1919, chap. 8, 47.
- Ontario. *Statutes*. chap. 77, 78. The new legislation also compelled township school boards to appoint school attendance (truant) officers, a requirement hitherto limited to urban boards. If a child or adolescent's work was needed for maintenance of a family, the officer could issue a certificate to grant partial exemption from the attendance requirements.
- Ontario. *Statutes*. 1920, chap. 89; 1921, chap. 79.
- Ontario. *Statutes*. 1916, chap. 50; 1925, chap. 67; 1927, chap. 70. The drinking age was twenty-one in 1916, eighteen in 1925, and twenty-one in 1927.
- In 1951, Canada's Old Age Assistance Act provided assistance for needy persons aged sixty-five or more, and in 1965, the Canada Pension Plan Act made the age of pension eligibility sixty-five for retired persons. Canada. *Statutes*. 1927, chap. 35; 1951, chap. 18, 55; 1964-65, chap. 51.
- Data Source: 1983. *Historical statistics of Canada*, edited by F. H. Leacy. Ottawa: Statistics Canada, Series A8, T171-3.
- Ontario. *Statutes*. 1903, chap. 27; 1906, chap. 46; 1908, chap. 53; 1912, chap. 48; 1917, chap. 49; 1922, chap. 80; 1923, chap. 48; 1925, chap. 65.
- United States. *Statutes*. 1924, chap. 190, vol. 43, pp. 153-69. The earlier 1917 Immigration Act empowered the Commissioner of Immigration to set the rules for the admission of aliens from Canada. See *ibid.*, 1917, chap. 29, vol. 39, I, p. 883.
- Ontario. *Statutes*. 1920, chap. 89 and 1927, chap. 53; Canada. *Statutes*. 1927, chap. 35.
- Ontario. *Annual reports of the Provincial Board of Health, Reports of the registrar-general's branch, 1926-1930*.
- The fee for a search was twenty-five cents until 1925 and then fifty cents; the fee for a certificate was fifty cents until 1925 and then one dollar. The fees were waived in certain cases (e.g., soldiers and their families during World War I; returned soldiers and mother's allowances applicants in 1925). See Ontario. *Annual reports of the registrar-general, 1900-1940*.
- Ontario. *Annual report of the Provincial Health Board for 1919*, p. 54.
- Ontario. *Annual reports of the Provincial Health Board, Reports of the registrar-general's branch, 1926-1930*.
- Stillbirths are removed from published totals for 1911 and earlier years. Kuczynski's birth totals and birth rates for 1897 and 1910 (p. 113) are incorrect.
- Kuczynski, *Birth registration in Canada*. p. 28. In 1930, cohort accumulations of delayed registrations were still too incomplete to be useful.
- Canada. *Statutes*. 1917, chap. 19; 1940, chap. 13. Without specifying particulars about age, the National Resources Mobilization Act of 1940 empowered the Governor-in-Council to mobilize males for service within Canada.
- Ontario. *Revised statutes*. 1937, chap. 88.
- Ontario. *Statutes*. 1948, chap. 97.
- The procedure is time-consuming for the pre-1945 period, because records are filed by alphabetical order of family name rather than by year of issuance.
- To approximate the additional number who had died by the mid-point of the age category, the author uses 50 percent of the deaths estimated for the category.
- Bourbeau R., and J. Légaré. 1982. *Évolution de la mortalité au Canada et au Québec 1831-1931, essai de mesure par génération*.

- Montréal: Les Presses de l'Université de Montréal. The tables are for 1901, 1911, 1921, and 1931.
31. Nagnur, D. 1986. *Longevity and historical life tables, 1921-1981 (Abridged), Canada and the Provinces*. Ottawa, Statistics Canada. The abridged tables for Canada and Ontario show a close correspondence in expectation of life at birth  $E(0)$  for both sexes. The  $E(0)$  statistics for Canada and Ontario are respectively 59.73 and 59.29 for the 1920-1922 period; 61.00 and 62.48 for the 1930-1932 period; 64.58 and 66.40 for the 1940-1942 period; and 68.51 and 69.24 for the 1950-1952 period.
  32. As Tracey notes, the deputy registrar-general of Quebec linked 151 (30 percent) of the 499 cases that Tracey's clerks failed to match. Similarly, the deputy registrar-general of Alberta showed that 15 of the 21 unmatched cases for Edmonton involved misspelled names or adopted children.
  33. Schofield, R. S. 1972. Sampling in Historical Research. In *Nineteenth-century society, essays in the use of quantitative methods for the study of social data*, edited by E. A. Wrigley. Cambridge: Cambridge University Press, pp. 146-90. Sample distributions are accurate to within 2 percent of the attribute distributions reported in published statistics. The birth registration sample includes stillbirths and is stratified by the geographic units in the published sources (individual cities and towns and counties exclusive of towns and cities). The strata are weighted by each unit's proportion of the province's registered live births; thus 72 cases, 18.8 percent of sample, were drawn randomly from Toronto registrations, which were 18.8 percent of the provincial total.
  34. Parkes, A. S. 1963. The sex ratio in human populations. In *Man and his future*, edited by Wolstenholme, G. Boston: Little, Brown, pp. 91-99; Teitelbaum, M. S. 1972. Factors associated with the sex ratio in human populations. In *The structure of human populations*, edited by Harrison G. A. and A. J. Boyce. London: Clarendon Press, pp. 90-109; Robinson, H. L. 1947. Rates of stillbirths in Canada. *Canadian Journal of Public Health*, 38 (7):168-81. McKeown, T., and C. R. Lowe. 1951. The sex ratio of stillbirths related to cause and duration of gestation. *Human Biology*, 23 (1):41-60.
  35. Data source for England and Wales: Mitchell, B. R. 1971. *Abstract of British historical statistics*. Cambridge: Cambridge University Press. The data for 1920 appear to be incorrect (they yield an improbable sex ratio of 1.009) and are adjusted.
  36. This is a modification of the classification system proposed by Bouchard G. and C. Pouyez. 1985. Les catégories socioprofessionnelles: une nouvelle grille de classement. *Labour/LeTravail* 15:145-63. Hershberg, T., and R. Dockhorn. 1976. *Historical Methods Newsletter* 9:59-98, elaborates work-task complexities for various occupations for the nineteenth century.
  37. Kuczynski, *Birth registration*, pp. 30-68.

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