General Education versus Vocational Training: Evidence from an Economy in Transition

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Abstract

Vocational training and general education are the two predominant forms of secondary schooling around the world. Most studies that compare the effect of vocational and general education on labor market outcomes in the cross-section suffer from selection bias since less able students are more likely to enroll in vocational programs. To avoid the bias caused by non-random selection, this paper exploits a 1973 educational reform in Romania that shifted a large proportion of students from vocational training to general education while keeping total years of schooling unchanged. Using data from the 1992 Census and the 1995-2000 LSMS, we analyze the effect of this policy in the context of a transition economy that experienced a decline in manufacturing and a reallocation of labor to new jobs. We find that men in cohorts affected by the policy were significantly less likely to work in manual or craft-related occupations but showed no differences in unemployment, nonemployment, family income or wages as compared to their counterparts who were not affected by the policy. However, there is evidence that men affected by the policy were more likely to marry and less likely to remain single or divorce. We therefore conclude that the cross-sectional differences in labor market returns between graduates of vocational and general schools are largely driven by selection but that there are returns to general education in the marriage market.

1 Introduction

Most educational systems around the world contain both a general and a vocational component of secondary schooling. But there is remarkable diversity in the emphasis on general versus vocational education across different countries and a long-standing debate about the relative benefits of these different types of education.[1] In the United States, President Bush's 2006 proposed budget included substantial reductions in funding for vocational education. Moreover, in recent years, the World Bank has adopted a policy that supports general education rather than school-based vocational training (IBRD, 1991, 1995). This policy, which affects funding for vocational programs in many developing nations, is based on a large number of international case studies. However, cross-sectional comparisons across individuals with general and vocational education are plagued by selection bias since admission into different types of educational tracks is usually based on ability. In this paper, we address the problem of selection bias by considering an educational reform in Romania that shifted a large proportion of students from vocational training to general education in 1973. We examine the labor market returns as well as returns on the marriage market for cohorts affected by the policy in the context of a transition economy that experienced major technological and institutional change.

The debate about the relative benefits of general versus vocational education is often framed by the contrast between the American and European systems of education. Whereas the United States emphasizes formal general education in secondary schools, much of Europe relies on vocational training and apprenticeships to prepare its workforce for the labor market. Goldin (2000, p. 277) notes the essential trade-off between these different approaches: "Formal, school based education enabled American youths to change occupations over their lifetimes and to respond rapidly to technological change. Apprenticeships and highly specific training were more cost effective for individuals who expected to spend their lives in the same place and in the same industry and occupation." Thus, Germany's impressive growth following World War II may have been due to its highly qualified workforce trained in vocational schools while the superior performance of the US economy in the 1980s and 1990s during a time of rapid technological change may be testimony to the flexible nature of its general education. Krueger and Kumar (2002, 2003) have recently applied this logic to explain the trends in relative growth between the US and Europe over the

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[1] Appendix Table 1 highlights the wide range of vocational education enrollment across a selection of countries. Zymelman's (1976) review of the evidence on rates of return to general and specific secondary schooling reveals contradictory findings from different studies. Psacharapolous (1987) argues in favor of general secondary education but more recent evidence from Neuman and Ziderman (1991, 1999) suggests that vocational education may be beneficial when there is a match between the type of training and the occupation.

previous half-century. The rate of technological change is therefore an essential factor in determining the dominance of one form of education over another.[2] More generally, Acemoglu and Pischke (1999) argue that more empirical research is needed to understand the optimal mix between general schooling and industry specific training in order to better evaluate the relative advantages and disadvantages of the US and German system, which rely to a different extent on general purpose education and vocational training.

A particularly dramatic instance of technological and institutional change occurred after the fall of Communism in the countries of Central and Eastern Europe, which suffered significant declines in their industrial sectors and a gradual reorientation of their economic activities towards services. A series of studies have examined whether the winners and losers of the transition process differ in terms of their education, training and experience. Brainerd (1998) shows that young educated men were able to take advantage of the new profit making opportunities in Russia's early transition, while Barberis, Boycko, Shleifer and Tsukanova (1996) provide evidence on the important role of new human capital for restructuring during the transition. Given the profound transformation of these old centralized sectors which relied heavily on vocational and technical training, we might expect the relative advantages of general education over vocational training to become apparent during the transition period.

Romania's experience was no different from other transition economies. Industrial employment fell from almost 45 percent of total employment in 1989 to only about 30 percent in 1995. (Earle, 1997) Registered unemployment rose from essentially no unemployment in 1990 to over 10 percent in 1993 and remained at a high level throughout the mid-1990s.[3] (Earle and Pauna, 1996, 1998) Indeed, an OECD (2000) report on Romania argues that some of the blame for its disappointing economic performance during the transition period rests with the inflexibility of vocational training: "Under an emerging democratic and competitive market system, the state enterprises have had to adapt to changing demand and new competition. This adaptation has been hindered by a workforce trained in narrow specializations with little ability to adjust to changing skill demand." (p. 109)

So how have individuals with vocational training fared during transition compared to individuals with general education? The existing empirical evidence, based on cross-sectional comparisons, indicates that individuals with vocational training had worse labor market outcomes than those with general education. In particular, Earle (1997) finds that individuals with a general education

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[2]Another important factor is the likelihood of making a mistake (relative to an individual's own specific abilities) by selecting students into specific educational tracks at such an early age. Malamud (2005) explores the effect of academic specialization when individuals are uncertain of their match quality to specific occupational fields.

[3]More information about the unemployment rate in Romania from 1991-2003 is described in Section 5.2 which details these changes over time.

were more likely to find jobs in the service sector and less likely to end up in agriculture or out of the labor force than their counterparts with vocational training. Similar findings emerge from other countries during their transition from Communism to a market-based economy. (Nesporova, 2001) However, one of the main problems with the interpretation of these results is that selection into different types of educational tracks is not random. Admission into general and vocational schools is usually determined by a competitive examination so that less able students are more likely to enroll in vocational programs.[4] Indeed, this problem affects most studies examining the relative benefits of vocational training and, as Bennel notes, "sample selection bias...is a pervasive weakness of almost all the...studies utilized in the 1993 [World Bank] global update." (1996, p.238).[5]

This paper exploits an unusual educational reform in Romania to avoid the problem of selection bias. The reform, which occurred in 1973, prevented students from entering vocational schools after only 8 years of schooling and, instead, required them to receive an additional two years of general education. As a result of this policy change, secondary school cohorts born after January 1, 1959 were treated with more general education and less vocational training than cohorts born immediately before this date. For the most part, these students remained in similar peer groups before and after the policy change. Furthermore, empirical evidence indicates that total years of schooling across these cohorts did not change as a result of the educational reform.[6] Assuming that these adjacent cohorts were otherwise similar in unobserved characteristics, we can identify an unbiased estimate for the effect of shifting students from vocational training to general education. We can estimate the reduced-form effect of the policy and derive the effect of a year of vocational versus general education.

Using data from the Romanian Census of 1992 and the LSMS from 1995-2000, we examine both labor market and marriage market returns for men some 20 years after the 1973 educational reform. Although most of our results also hold for women, we focus our analysis on men since they were the ones most affected by the policy change.[7] The timing of the education reform provides an excellent setting for understanding the effect of vocational education at a time of technological

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[4]Certainly, this is the case in Romania and most European countries that have a separate track for vocational education. Even in countries such as England and the United States that do not administer a competitive examination, there is a large degree of self-selection into vocational courses.

[5]Lechner (2000) represents one attempt to address this issue by using propensity score methods to evaluate a public sector vocational training programs in East Germany and finds no evidence of any positive effects on employment probabilities and earnings.

[6]This contrasts with other educational reforms in Europe which served to increase years of schooling. For example, Meghir and Palme (2006) show that a Swedish reform which abolished selection into academic and non-academic streams also led to large increases in years of schooling.

[7]In a earlier version of the paper, we also examined women and found similar results for most labor market outcomes.

change: cohorts born around 1959 were in their mid-thirties during the early part of a transition period which may have begun to make their previously acquired skills obsolete. We find that men in cohorts born immediately before and after January 1, 1959 received *very different* types of secondary education and consequently experienced quite different occupational outcomes, but had *very similar* rates of labor market participation and earnings in 1992. While the drastic short-term expansion in general education may have introduced some crowding resource constraints, we provide evidence that this factor is unlikely to explain why men who completed general education secondary schools do not perform better.

Among men that were employed in 1992, those in cohorts affected by the policy were significantly less likely to be engaged in manual and craft occupations, indicating that the policy did alter the occupational composition of workers. The incidence of unemployment and nonemployment, however, was not significantly different between cohorts that were affected and those unaffected by the educational reform. Changes in labor demand for occupations associated with vocational training do not explain these findings since these differences remain insignificant even after controlling for detailed indicators of previous occupation. Differences in family income and wages from the period 1995-2000 were also insignificant between these cohorts. However, we do find that men in cohorts affected by the policy were more likely to be married and less likely to remain single or divorce by 1992. The results on divorce suggest that general education may also provide skills that help couples succeed in marriage or increase the quality of a marital match. We interpret these results as evidence that the large cross sectional differences in most labor market outcomes between graduates of vocational and general secondary schools are driven mainly by selection but that there are significant returns to general education in the marriage market.

The paper is organized as follows. Section 2 provides a background of the Romanian educational system and the 1973 educational reform. Section 3 describes the data and the relevant samples. Section 4 explains the empirical strategy used to identify the reduced-form effect of the policy and derive the effect associated with a year of general education versus vocational training. Section 5 presents the results, and Section 6 concludes.

2   Background

2.1   The Development of the Romanian Educational System

The educational system in Romania experienced several major reforms following the establishment of the Communist regime in late 1947. The first, undertaken in 1948, aligned Romania's edu-

cational system with that of the Soviet Union by nationalizing all educational institutions and adopting Marxist-Leninist principles of education.[8] The second reform, undertaken in 1956 and 1957, established a unified system of primary and secondary schools and called for the reorganization of higher education.[9] The unified system of primary and secondary schools became known as schools of general education. Soon after the 1956 reform, the overall period of schooling was raised from 10 to 11 years, and further lengthened to 12 years in 1961 by extending the length of compulsory education from 7 to 8 years.[10]

The third major reform, enacted under Law No. 11 of May 1968, called for the extension of compulsory general schooling from 8 to 10 years.[11] However, five years after establishing government commitment for extending compulsory general schooling, "the rate of 10-year school generalization was thought to be inadequate." (Dimitriu et. al, 1981, p. 37) As a result, the government introduced an explicit mandate to implement the 10 year system of general education under the provisions of Decree No. 278 and the Resolution of the Communist Party's Central Committee of June 18 and 19, 1973. These educational reforms of 1973 prevented students from pursuing vocational training after only 8 years of general education and, instead, required them to complete two additional years of general education. In fact, this policy did not alter the total years of schooling but, rather, substituted more general education in lieu of vocational training. Decision No. 577 of the Council of Ministers in 1975 reaffirmed the earlier resolutions concerning 10 year compulsory general education and the restrictions on entry into vocational schools. Finally, all of these changes were brought together under Law No. 28 of May 1978, which replaced the earlier Law No. 11 of May 1968.

2.2 The Structure of Education in Romania

Apart from the changes induced by the 1973 reform, the structure of education in Romania throughout the 1970s was relatively stable. Students generally began compulsory schooling by entering schools of general education (*scoală de cultură generală*) after the age of 6.[12] More specifically, students entered grade 1 in September of the year following the calendar year in which they reached 6

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[8]This reform was undertaken under Decree No. 175 of the Presidium of the Grand National Assembly of August 3, 1948. The reforms also stipulated the eradication of illiteracy.

[9]This reform was initiated by the Second Congress of the Romanian Communist Party in 1955 and undertaken by Decree No. 1380 and Decision No. 1003 of 1956 and 1957 respectively.

[10]Prior to the Communism, the combined primary-secondary school period was 12 years (4 years of primary school and 8 years of secondary schools or lyceum). The school period was reduced to 11 years in 1948 and to 10 years in 1951 (7 years of primary and 3 years of secondary) to coincide with the Soviet model.

[11]In addition, this law established new schools for training junior engineers and architectural foremen, and organized post-university education to offer refresher courses for specialists. However, these were largely minor changes to the existing organizational structure of the educational system.

[12]Preschool education was offered in kindergartens for children ranging from 3 to 6 years of age.

years of age. Since the mid-1950's, these schools offered a continuous sequence of 8 years of general education, nominally composed of primary education from grades 1 to 4 and gymnasium education from grades 5 to 8. Approximately 40 percent of the subjects taught in schools of general education were in the humanities and social sciences, 30 percent were in the sciences, while the remaining courses included industrial and technological subjects, art and physical education. After graduating from schools of general education, students could continue into secondary school lyceums or enter vocational schools and apprenticeship programs. With the extension of compulsory general schooling to 10 years of education, some general schools also began to include grades 9 and 10 (often as branches of the secondary school lyceums).[13] The educational reform of 1973 prevented students from entering vocational and technical schools directly from schools of general education. Instead these students were required to stay on to grades 9 and 10 of general schools or enter lyceum schools in order to receive a general education.

Lyceums operated at two distinct levels. The first level corresponded to grades 9 and 10 of compulsory general education, while the second level encompassed general education in grades 11 and 12.[14] Graduates from the first level of lyceum who did not take further courses in the second level received a certificate of graduation from 10-year compulsory education (*cerificat de absolvire a învătămîntului obligatoriu de 10 ani*). Admission to the second level was based on a composite score computed from academic achievement in the lower level and a competitive entrance exam. Graduates from the second level who passed the baccalaureate exam received the baccalaureate diploma (*diploma de bacalaureat*) while those who failed received a certificate of graduation (*certificat de absolvire*). Curriculum in lyceums was relatively homogenous despite differing in emphasis and specialty:

> "During the first 2-years of lyceum education, students are offered a basically uniform curriculum both in academic and practical subjects whatever the character or orientation of a lyceum, its stated aims are to offer a well-balanced integrated curriculum composed of a number of subjects in the humanities, social studies, and the sciences, as well as subjects related to practical training in a particular field." (Braham, 1978, p. 10)

According to one count, about 56 percent of the classes were taken by basic training and general knowledge classes, 14 percent by specialty subjects and 31 percent by productive activities. (Dimitriu et. al, 1981, p. 41)

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[13]These additional years were also known as the upper 2-year cycle (*ciclul superior de 2 ani*) of schools of general education.

[14]At this level, there was some specialization. Appendix Figure 2 provides some indication of the breakdown across the largest types of lyceums. Agricultural, industrial and teacher-training lyceums sometimes offered 5 years of schooling.

Vocational schools (*şcoli profesionale*) provided training in numerous trades ranging from aircraft maintenance to winemaking. Appendix Figure 1 provides some indication of the breakdown across broad specialties. The length of training varied by trade and depending on whether students completed an additional two years of general education: "In 1967-68 vocational schools offered training in 232 trades, 175 of which required 3 years and 57, 2 years. With the decision to extend the compulsory educational system to 10 years the duration of day sessions in vocational schools was reduced in most fields." (Braham, 1972, p. 73, footnote 10) Indeed, for graduates from the first stage of lyceum schools, training generally lasted only 1 year. (Dimitriu et. al, 1981, p. 41) On-the-job apprenticeships (*ucenicia la locul de muncă*) trained workers in basically the same fields as those offered by vocational schools. The practical training period for apprenticeships was also normally 3 years. Thus, although on-the-job apprenticeships were generally provided on-site rather than in vocational schools, they were sufficiently similar to be considered jointly in most government statistics. We shall do the same in our analysis.

Several different institutions provided further education beyond secondary and vocational schools. Technical schools for master craftsmen admitted graduates of vocational schools and lyceums who spent between 3 and 5 years in production. Courses in these schools lasted from 1 to 3 years and were intended to train technicians skilled in the organization and management of the production process. Postsecondary specialization schools admitted graduates of lyceums and trained them in specialized fields ranging from as aircraft construction and radiology.[15] Finally, entrance to higher education in universities, institutes, academies and conservatories were open to graduates of the second level of lyceum schools and required a baccalaureate diploma.

2.3   The Educational Reform of 1973

The educational reforms of 1973, consisting of Decree No. 278 and the Resolution of the Communist Party's Central Committee of June 18 and 19, 1973, were intended to increase the proportion of students with 10 years of general schooling. In particular, the Resolution of June 1973 stated that "beginning with the school year 1974-75, the entire graduating class of grade 8 will start in grade 9 of lyceums; vocational schools will no longer accept students from this class [grade 8] directly."[16] Thus, these reforms prevented students from entering vocational schools after 8 years of general education and required them to enter the first level of lyceum schools instead. We will provide evidence to show that the total years of schooling remained essentially unchanged after

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[15]These schools were discontinued in 1977.

[16]These excerpts from the Resolution of the Communist Party's Central Committee of June 18 and 19, 1973 are translated by the authors from the original Romanian text.

these educational reforms. The structures of the educational system before and after the change in 1973 are depicted in Figure 1. Following the reform, students who would have otherwise received about three years of vocational training were required to obtain an additional two years of general education.

Depending on their aptitudes, skills, and preferences, graduates of the first level of lyceum schools could (i) enter the workforce, (ii) continue to vocational school for 1 year, or (iii) continue to grades 11 and 12 in the second level of lyceum schools. Obviously, the effect of the policy on overall educational attainment for this group of students depended on the relative proportion of students in each category after the policy change. But as we shall see empirically, there was little effect on overall educational attainment. The emphasis on additional general education after 1973 caused a marked decrease in the prevalence of vocational training. As one secondary source explains, "the number of apprentices decreased during the 1970's because of the extension of compulsory education to include 2 years in the lyceum," and similar drops were observed in the number of students in vocational schools. (Braham, 1978, p. 11) But even students who continued to enter vocational schools after the policy change were treated with more general and less vocational training.

The Resolution of June 1973 also introduced measures to assure that sufficient qualified teachers and school resources (such as science laboratories, classrooms, and dormitories) were allocated to local authorities. In most cases, these measures did not require any physical movement of resources; teachers and schools remained the same but their training and the curriculum were changed. As stated in the 1973 Resolution:

> "In order to provide for an effective educational environment and to use the existing facilities efficiently,...lyceums will, in general, function within the same premises as vocational schools and under the same leadership."

We can document some of these changes using the *Annual Statistics of the Socialist Republic of Romanian.* Figure 2 shows the large decline in the number of students enrolled in vocational schools and on-the-job apprenticeships between the school years 1973-74 and 1975-76. Moreover, Appendix Figure 1 reveals that declines occurred across all specialities in vocational schools. During this period, enrollment in lyceums increased sharply, as shown in Figure 3. Appendix Figure 2 indicates that enrollment increased across all types of lyceums with the largest increases occurring in industrial lyceums. As mentioned above, even these industrial lyceums emphasized general education much more than vocational schools. At the same time, the number of teachers in vocational schools fell while the number of teachers in lyceums rose in the initial years following the educational reform.

Further evidence for these dramatic changes is available from the Romanian Census of 1992.

Since students began their compulsory schooling at age 6, they would have completed grade 8 by age 14 and grade 10 by age 16. Consequently, students born in 1958 would have been unaffected by the policy while those students born in 1959 would have been required to continue to grades 9 and 10 of lyceum schools. Figure 4 shows the educational attainment of all individuals from the Romanian Census of 1992 by year of birth. There is a sharp decline in the proportion of individuals with vocational training between cohorts born in 1958 and 1959. At the same time, we observe a sharp increase in the proportion of individuals that completed the general lyceum education. No such discontinuity is observed for the proportion completing only lower/primary or higher education. Thus, the 1973 educational reform altered the proportion of students across vocational and general education as well as the nature of their exposure to vocational training.

3 Data

We use two main sources of data for this research. The first is the 15% sample of the Romanian Census of 1992. The 1992 Census provides information on gender, marital status, and age as well as ethnicity and region of birth for about 50,000 individuals in each year of birth.[17] There is also detailed information about the day and month of birth that prove especially useful in identifying the discontinuity induced by the policy within a narrow window of time. The 1992 Census distinguishes between various levels of education attainment: completion of primary education, gymnasium education, first stage of lyceum education (grade 9 and 10), second stage of lyceum education (grades 11 and 12), vocational training and apprenticeships, post-secondary technical education, and higher education. However, these categories are mutually exclusive so we cannot determine whether students with vocational training and apprenticeships also completed the first stage of lyceum education (for cohorts unaffected by the educational reform). As explained in the following section and in the Appendix, this makes it more difficult to estimate the local average treatment effect of vocational training. However, we will use aggregate data from the *Annual Statistics of the Socialist Republic of Romanian* on school enrollment for different types of education to move from reduced-form estimates of the effect of the policy to the effect of the policy on the treated population and the local average treatment effect of vocational education.

The Romanian Census contains several outcome variables of interest relating to employment status and occupations in 1992. We consider two different measures of employment status: un-

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[17]In addition, there is information on the status of the dwelling and availability of amenities in 1992. However, since these are contemporaneous with other outcomes, they may not be appropriate as proxy controls for income and class.

employment and nonemployment. The former is restricted to individuals that are actively seeking work and therefore part of the labor force. The latter consists of all individuals not currently working and includes those out of the labor force. For individuals that are employed, we have detailed information on their current occupation based on 3 digit ISCO 88 codes. We use this information to infer whether individuals are employed in a manual (ISCO codes 5-9) or craft-related occupation (ISCO code 7), as well as more specific occupations such as metal workers and clerks. In addition, there is information on marital and fertility outcomes. We can also match husbands and wives together in order to examine the effect on of the policy on the outcomes of spouses.

The second source of data are six yearly LSMS type household surveys collected between 1995-2000. This dataset has less detailed information on occupations (only 1-digit ISCO codes), but does measure both individual wages and family income. The basic educational and demographic variables from the 1992 Census are also available in the LSMS data. The LSMS data allows us to study labor market outcomes over a much longer time period. While the transition to a market economy was still in its initial stages in 1992 at the time of the census, unemployment continued to rise after 1992 and only reached a peak in 1999.[18] Therefore, with the LSMS data, we can examine labor market outcomes in the years with the most substantial technological and institutional change.

Table 1 presents summary statistics for the full sample of men born 3 years before and after the policy change, as well as the restricted sample of secondary educated men in these same cohorts. For the most part, we will restrict our attention to the sample of students with a secondary school education. Figure 4 shows that the policy did not alter the proportion of students between secondary education and the higher or lower levels of education. Students completing their education after primary school or gymnasium were probably living in relatively rural areas that could not extend their network of lyceums in any case while students completing higher education should not have been affected by the policy.[19] Panel A of Table 2 confirms these claims. While columns (2) and (3) demonstrate the dramatic changes in the probability of receiving vocational or general education, column (1) shows that the proportion of men with secondary level education did not change between cohorts affected and unaffected by the educational reform of 1973. Moreover, column (4) of Table 2 shows that the proportion of men with secondary education who were born in urban regions did not change after the educational reform. This is reassuring evidence that the composition of men

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[18]Statistics from the Romanian Statistical Yearbook of 2002 indicate that employment in industry continued to decrease from 29.2 percent in 1996 to 23.5 percent in 2001. Unemployment in the overall population rose from about 7 percent in 1996 to almost 12 percent in 1999 and then fell back to 9 percent in 2001.

[19]In fact, the government established explicit rules about the provision of schools. If the number of students registered in grade 9 exceeded 25, the community had to operate a 10-year school of general education; if the number of students registered in grade 5 is at least 25, the community had to operate a 8-year school of general education; and if the number of children aged 6-9 was at least 7, the community had to operate a 4-year school.

who completed secondary level education did not change after the policy reform. Consequently, we focus on men who received a secondary level education, although we will also estimate the effect of the policy for sample of the entire population for robustness.

4   Empirical Strategy

4.1   Basic framework

Most empirical studies examining the effect of vocational training adopt a simple specification where individuals who receive vocational training are distinguished from individuals who receive a general education by a dummy variable (i.e. a variable VOC_i that is equal to 1 if individual i received vocational training, and 0 otherwise).[20] However, we begin by assuming that we have information on the *amount* of vocational training and consider the following regression model:

$$outcome_i = \beta' \mathbf{X}_i + \delta VOC_i + \sigma S_i + \varepsilon_i \tag{1}$$

where $outcome_i$ is a labor market outcome such as unemployment, $\mathbf{X}_i$ is a set of observable characteristics, VOC_i is *years of vocational training*, and S_i is years of schooling for individual i.[21] According to this specification, the coefficient on VOC_i represents the difference between the benefit from a year of vocational training and a year of general education in terms of some labor market outcome. A positive δ would indicate that the benefits of vocational training exceed the benefits of general education (if the outcome is a favorable one). Clearly, an accurate cost-benefit analysis would also require consideration of the relative costs to providing vocational and general education. We abstract from this consideration here but evidence from other studies has suggested that providing vocational training is usually more expensive than providing general education (Bennel, 1996).

The principal problem with this specification is that years of vocational training may be correlated with unobserved ability which also affects labor market outcomes. Unobserved ability may be important because individuals with higher ability choose to enter general rather than vocational schools or because selection into different tracks is based on a competitive examination. The bias

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[20] For example, see the early work on vocational training by Grasso and Shea (1979) and Meyer (1982).

[21] We can also motivate this equation from the standard regression equation for estimating the return to schooling $y_i = \beta' \mathbf{X}_i + \sigma S_i + \varepsilon_i$ where y_i is log wages. (Mincer, 1974) . Distinguishing between vocational training and general education, we can write $y_i = \beta' \mathbf{X}_i + \upsilon VOC_i + \gamma GEN_i + \varepsilon_i$ where VOC_i is years of vocational training and GEN_i is years of general education for individual i. Given that total years of schooling $S_i = VOC_i + GEN_i$, we can rewrite the preceding equation as equation 1 when we allow for other labor market outcomes as dependent variables.

associated with such omitted variables could be avoided with an instrumental variable that was correlated with vocational training but uncorrelated with our labor market outcomes. The 1973 educational reform in Romania is one such instrument. By preventing students from entering vocational school from grade 8 after the 1974-75 school year, cohorts affected by the educational reform were treated with more general education and less vocational training. Since students usually entered grade 1 only after reaching the age of 6, we expect that individuals born before 1959 would have been unaffected by the policy while those born after 1959 would have been required to continue to the first level of general lyceum schools instead of vocational schools.[22]

Estimating equation 1 using the 1973 educational reform as an instrument would be relatively straightforward if we had information on VOC_i for each individual i *and* if we could isolate the group of students that were affected by the policy. Unfortunately, we cannot directly identify vocational students in the lower track who were affected by the policy from vocational students in the upper track that were not affected by the policy. Hence, we first consider the reduced form effect of the policy for the entire sample. Then, using supplementary enrollment data, we determine the proportion of students affected by the policy and derive the effect of the policy on the treated population and the local average treatment effect of a year of vocational training. Finally, using a subsample of the LSMS for which years of schooling is available, we show that the policy did not lead to additional schooling by cohorts of secondary school students.

4.2   Reduced-form effect of the policy

Romania's educational reform of 1973 prevented students from entering vocational school after grade 8 and, instead, required them to receive an additional 2 years of general education in the first stage of lyceum schools. As with all attempts to estimate treatment effects in this framework, we don't observe the counterfactual outcomes of students who would have entered vocational school after grade 8 had they not been affected by the policy since we can only observe their educational outcomes in the presence of the policy. So instead, we examine the group of students who received a secondary level education and therefore *may* have been affected by the policy. We can estimate the reduced-form effect of the policy according to the following regression model:

$$outcome_i = \beta' \mathbf{X}_i + f\left(c_i\right) + \delta AFTER_i + \varepsilon_i \tag{2}$$

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[22]Thus, for example, individuals born on Dec 31st, 1958 would have entered grade 1 in 1965-66 and grade 9 in 1973-74. On the other hand, individuals born on Jan 1st, 1959 would have entered grade 1 in 1966-67 and grade 9 in 1974-75.

where again, $outcome_i$ is a labor market outcome such as unemployment, $\mathbf{X}_i$ is a set of observable characteristics, $f(c_i)$ is a smooth function representing the age profile (e.g. a low order polynomial on month of birth), and $AFTER_i$ is equal to 1 if individual i was born on or after January 1, 1959, and 0 if born on or before December 31, 1958. As before, a positive δ would indicate that the benefits of vocational training exceed the benefits of general education. However, this coefficient represents the reduced-form effect of the policy rather than the effect of a year of vocational versus general education.

This regression-discontinuity approach essentially compares the outcomes of individuals in cohorts affected by the 1973 educational reform to their counterparts in cohorts born too early to be affected.[23] As with many recent studies employing this technique, we estimate the discontinuity using the parametric regression described above. The smooth function $f(c_i)$ should pick up any effects that are associated with age which vary continuously and we use a cubic trend in month of birth as the primary control in our regressions. Estimating this equation with non-parametric methods such as local linear regression leads to similar results. Restricting attention to a narrow window of cohorts minimizes any confounding effects associated with age or time of entry into the labor force. But an excessively narrow window reduces the sample size and leads to imprecise estimates. We therefore focus on a window that includes cohorts born 3 years on either side of the cutoff, although we will also consider other windows for robustness. All regressions cluster on month of birth in order to avoid the problems associated with specification error with discrete covariates (see Lee and Card, 2006).

4.3 Treatment on the treated (TOT) and local average treatment effect (LATE)

In addition to the reduced-form effect of the policy, we may be interested in the effect of the policy on the treated population or the effect of a year of vocational versus general education. Assuming that we could identify the group of students who entered vocational school after grade 8 prior to the educational reform, we could estimate the effect of the policy on the treated population directly. Alternatively, if we could determine the proportion of students, π, who would have been affected by the policy out of the total population of secondary educated students, then we could scale up the reduced-form effect. The effect of the policy on the treated population would then be δ/π.[24] Note that this resembles the standard calculation used in moving from an intention-to-treat (ITT)

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[23]See Hahn, Todd, and van der Klaauw (2000) for a detailed discussion of the specific assumptions necessary to identify treatment effects. Recent studies using regression discontinuity in other contexts include Lee and McCrary (2003) and Card, Dobkin, and Maestas (2004).

[24]Such scaling of the reduced form estimate by the proportion of individuals that actually received the treatment was introduced by Bloom (1984).

estimator to a treatment-on-the-treated (TOT) estimator. However, the reason for employing this method here is that we cannot identify the group of students who were affected by the treatment, rather than the conventional worry that individuals may be self-selecting into the treatment.[25]

Unfortunately, the group of students that entered vocational school after grade 8 prior to the policy change is not easily identified. We only have information on the highest level of education attained and some individuals listed as having completed vocational school may have already entered after grade 10 and were therefore not affected by the policy change. Hence, in Appendix A, we use enrollment data from the *Annual Statistics of the Socialist Republic of Romanian* to calculate the rough proportion of students who entered vocational school after grade 8 prior to the educational reform. Given reasonable assumptions, we estimate that approximately 50 percent of the students with vocational training would have been affected by the policy and about 45 percent of these students would have continued onto these higher-level vocational programs after completing their additional two years of general education following the reform.[26] If we regard these calculations seriously, then we can conclude that about 50 percent of students with vocational training before 1959 – or 33 percent of the students with secondary education – were affected by the policy. Consequently, we need to scale up the reduced-form estimate over all secondary educated individuals by a factor of 3 to derive an estimate of the effect of the policy on the treated population.

Even the effect of the policy on the treated population is difficult to interpret because the policy did not affect exposure to vocational training in the same way for all individuals. Appendix A uses both census and aggregate enrollment data to provide a rough calculation of the average difference in vocational training before and after the policy change by comparing cohorts of individuals born in 1958 and 1959. These estimates suggest that, among secondary educated individuals, the average decrease in vocational training was 0.8 years. Now, rather than scaling the reduced-form estimate of the effect of the policy by the proportion of individuals who were affected by the policy, we can scale the reduced-form estimate by the average change in years of vocational training induced by the policy. In other words, we can calculate the local average treatment effect (LATE) of a year of

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[25]Inflating the reduced-form estimate to yield an effect of the policy on the treated population requires the assumption that only *compliers* who were shifted from vocational to lyceum schools were affected by the policy. In other words, it is important that the educational experience of students who would have attended lyceum schools even in the absence of the policy was not affected due to the shift in students from vocational to lyceum schools. We have reason to believe that the effect on the quality of education due to crowding or changing peer groups was small. Data indicates that the number of teachers rose in line with enrollment in lyceum schools so that pupil-teacher ratios probably remained roughly constant. Moreover, the nature of the expansion of lyceum schools probably largely retained the peer groups that existed prior to the educational reform.

[26]These numbers suggest that the size of the cohort of students completing vocational training or apprenticeship programs of 1959 was about 75 percent of the size of the cohort of 1958, which is almost exactly what find in the data from the 1992 Census.

vocational versus general education.[27] Undertaking this calculation in Appendix A, we conclude that the effect of an additional year of vocational training instead of general education on labor market outcomes is approximately 1.25δ.

4.4 Testing for selection

Since higher ability students tended to be selected into general secondary schools, those students who were affected by the policy were lower on the ability distribution than their counterparts who had attended general lyceums before the educational reform.[28] As a consequence of this selection effect, we expect the average ability of students receiving general education to decline after the policy change. Unfortunately, we do not have good measures of ability in our data. Instead, we examine whether students were born in an urban or rural area which is a good proxy for socio-economic background and is correlated with higher educational attainment. Panel B of Table 2 shows changes in the rates of urban births for different levels of educational attainment. Specifically, column (6) reveals that men who received general education after the policy change were almost 4 percentage points less likely to have been born in an urban area than general-educated men who were unaffected by the policy.[29] This result appears to confirm the observation that higher ability students were selected into general secondary schools.

4.5 Quantity of schooling

As mentioned earlier, we have information on years of schooling for a subsample of individuals in the LSMS (specifically, from LSMS 1995 and 1996). Using this subsample, Panel C of Table 2 shows the effect of the policy on the quantity of schooling for different levels of educational attainment. Column (8) confirms that the policy did not lead to additional schooling by cohorts of secondary school students. The point estimate is essentially zero and quite precisely estimated with a standard error of only 0.12 years of schooling. The remaining columns of panel C indicate no significant difference in years of schooling for more narrow or more broad levels of educational attainment

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[27]Since we are estimating a local average treatment effect (LATE) for individuals affected by the policy, these results may not hold for the population at large. See Imbens and Angrist (1994) for a thorough discussion of this issue and some instructive examples.

[28]A competitive exam determined which students would be accepted into general secondary high schools. Moreover, that higher ability students were selected into general secondary schools is consistent with the cross-sectional findings that students completing general education have lower unemployment and higher wages than those completing vocational courses.

[29]That the proportion of men born in urban regions among those with vocational training did not change after the policy reform is also consistent with selection. While the most able of those who received vocational education prior to the policy change probably ended up completing the 2nd level of lyceum, the least able may not have succeeded in pregressing to vocational training which was available only at the higher track after the policy change.

(similar results are found with higher and primary education). These findings are consistent with the changes induced by the policy. According to the calculations discussed above, about 45 percent of the students affected by the policy continued onto higher-level vocational programs that lasted 1 year after completing 10 years of general education. Since these students would have completed 8 years of general education and 3 years of vocational training prior to the reform, they would not have experienced any change in quantity of schooling. The remaining students affected by the policy were split between receiving 10 and 12 years of general education. Consequently, we are confident that this policy affected the amount of vocational and general education while keeping the overall quantity of education constant.

5   Results

5.1   Cross-sectional analysis

Before turning to the central findings of the paper associated with the 1973 educational reform, we examine the standard cross-sectional relationship between vocational training and labor market outcomes. As mentioned earlier, studies in Romania and other Eastern European countries have found that rates of unemployment are higher among individuals with vocational training than those with general education during the transition from Communism to a market system.[30] We will examine the effect of vocational training on both occupational outcomes and labor market participation in 1992 using census data, as well as family income and wages using the 1995-2000 LSMS data. Tables 2 and 3 illustrate the cross-sectional relationship between vocational training and these various labor market outcomes. Essentially, we run the regression associated with equation 1 (but with VOC as a dummy variable for those who completed vocational school). The sample includes men with a secondary education who were born between 1956 and 1961 to correspond with the samples in the reduced-form regressions to be presented later. All regressions control for a cubic in month of birth, ethnicity, region of birth, an indicator for urban region of birth, and calendar of month fixed effects while robust standard errors are clustered by month of birth.

The effect of vocational training on occupational outcomes in 1992 is shown in panel A of Table 3. All the coefficients on VOC are highly significant. Column (1) indicates that men with vocational training are significantly more likely to be employed in manual occupations than their counterparts with general education. In particular, men are approximately 23 percentage points

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[30]The relevant study for Romania by Earle (1997) uses data from Labor Force surveys in 1993 and 1995.

more likely to be manual workers.[31] Similarly, column (2) reveals that men with vocational training are approximately 13 percentage points more likely to be employed in craft occupations than those with general education. When considering specific occupations, a similar pattern emerges. Columns (3) and (4) show that men with vocational training are significantly more likely to be metal workers and significantly less likely to be working as clerks.

Panel B of Table 3 shows the effect of vocational training on labor market outcomes in 1992. Men with vocational training are approximately 1.4 percentage points more likely to be unemployed than their counterparts with general education. On a base of 6 percent unemployment, the coefficient on VOC represents a large and significant difference.[32] Column (2) shows the effect of vocational training on nonemployment for men. Not surprisingly, since most men are employed in the labor force, the effect on nonemployment for men is similar to the effect on unemployment – approximately 1.5 percentage points.[33]. Column (3) indicates that men with vocational training live in households with smaller family income. Finally, the effect of vocational training on log wages from 1995-2000 is shown in column (4). Men with vocational training earn approximately 7.7 percent less than their counterparts with general education.[34]

These results from the cross-section confirm the findings from earlier studies that individuals with vocational training are more likely to be unemployed, exit from the labor force and earn lower wages than their counterparts with general education. They also confirm that individuals with vocational training are more likely to be employed in manual and craft-related occupations. These results hold when examined separately in the period before and after January 1, 1959 or when we include cohort fixed effects to focus on the relationship within each cohort (not shown).

5.2   Effect of the 1973 educational reform

Preceding sections have already provided some evidence for the change in the nature of secondary school education resulting from the 1973 educational reform. Recall that the policy prevented

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[31]Though not shown, covariates indicate that men who are married and individuals who were born in urban areas are less likely to be employed in manual occupations. Moreover, men with a Hungarian and Gypsy ethnic background are more likely to be employed in manual occupations compared to Romanians.

[32]Though not shown, the effect of the covariates on unemployment generally accord with intuition. The coefficient on the month of birth trend is positive and significant reflecting that younger individuals are more likely to be unemployed. Men born in urban regions are significantly more likely to be unemployed. Finally, men with a Hungarian or Gypsy ethnic background are also significantly more likely to be unemployed compared to Romanians.

[33]The results for unemployment and non-employment in the LSMS data (not shown) are similar to the results from the Census data both for the cross-sectional and reduced form regressions. For women, the effects on nonemployment are substantially larger.

[34]Again, the effect of the covariates on this measure of wages is generally significant and consistent with previous findings. Men who were born later are employed in jobs that earn significantly less. Men born in urban areas are earning significantly more and those with non-Romanian ethnicity earn significantly less than Romanians.

students from entering vocational school after only 8 years of schooling, and instead, required them to receive an additional 2 years of general education. Even if all students affected by the policy continued on to a shortened vocational course after completing the additional years of general education, they would have been treated with less vocational training and more general education. However, as seen in Figure 4, there was also a sharp drop in the proportion of students who received any vocational training for cohorts born between 1958 and 1959. Many students who would have otherwise attended vocational school prior to the educational reform ended up completing their education in general lyceum schools instead.

The effect of the 1973 educational reform on the proportion of students with vocational training is even more striking when we define cohorts narrowly. Panels A and C of Figure 5 plot the proportion of secondary educated men with vocational training by month and week of birth. Each panel indicates an extremely sharp discontinuity after January, 1959 – normalized as month 0. Linear regression analysis of the break in trend around this cutoff indicates that the probability of completing vocational school drops by about .13 for secondary-level educated men.[35] In other words, the probability of completing vocational school fell by more than 20 percent for cohorts of men with secondary education. Men born merely two weeks apart were exposed to extremely different types of education. In contrast, panels B and D of Figure 5 reveal no change in the proportion of secondary educated men out of the entire population before and after the policy change.

This section examines the reduced-form results for labor market outcomes based on equation 2 from section 4. We include men with a secondary education who were born between 1956 and 1961 and therefore within 3 years of the January 1, 1959 cutoff. All regression control for a cubic in month of birth and dummy variables for the calender month in order to avoid any confounding effect resulting from a particular month of birth). Demographic controls include controls for a month of birth trend, marital status, ethnicity, region of birth, and an indicator for urban region of birth. Robustness checks for alternative ranges of cohorts and samples are discussed in a subsequent section.

Panel A of Table 4 shows the reduced-form effect of the 1973 educational reform on occupation outcomes in 1992. All of the coefficients on $AFTER$ in the table are significant, implying that the educational reform altered the occupational structure of men who were affected by the policy. Column (1) indicates that the probability of being employed in a manual occupation was significantly lower for men in cohorts affected by the policy than their counterparts who were not affected by

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[35]Or, as shown in column (2) of Table 2, the probability of completing vocational school drops by .08 for all men.

the policy. The reduced-form effect of approximately 1.6 percentage points represents an effect of about 5 percentage points for the treated population. Based on the calculations of section 4, these estimates indicate that a year of vocational training instead of general education increased the probability of being employed in a manual occupation by 2 percentage points.[36] Column (2) shows that the probability of being employed as a craft worker was also significantly lower for men in cohorts affected by the policy. The magnitudes of this coefficient is even larger: about 2.5 percentage points for men. The corresponding effect on the treated population is about 8 percentage points and implies that an additional year of vocational training instead of general education probably increased the probability of being employed in a craft-related occupation by 3 percentage points.

Looking at particular occupations further confirms that the policy had an effect on occupational structure. Columns (3) and (4) show that the policy had a significantly negative effect on the probability of being employed as a metal worker but a positive effect on the probability of becoming a clerk. This is not surprising given that metal workers were more likely to have received vocational training and clerks were more likely to have received general education. Though the coefficients are smaller in magnitude, the effects are relatively large considering the small numbers of men in these occupations. Figure 6 provides a graphical representation of these results. The raw fractions of secondary educated men employed as manual workers, craft workers, metal workers, and clerks by month of birth around the policy change are indicated with open circles. There is a clear break in the trend around the policy change for each occupation. The solid lines plot cubic functions of these outcomes on either side of the discontinuity.[37] Together with the regression results, these findings establish that the educational reform of 1973 altered the occupational structure for individual in cohorts that were affected by the policy in a substantial fashion.[38]

Panel B of Table 4 shows the reduced-form effect of the 1973 educational reform on labor market outcomes and earnings in the transition period. Columns (5) and (6) show that the effect of the policy on the probability of being unemployed or nonemployed in 1992 is insignificant. The effect of the policy on family income and log wages as measured in the LSMS from 1995-2000 is also

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[36] This effect are slightly smaller than expected based on the cross-sectional relationships between vocational training and manual occupations. However, these results need to be interpreted in the context of Romania's unique Communist "labor market". Even individuals with more general education may have been required to enter manual occupations when joining the labor force. Thus, the effect on their occupation in 1992 may have been muted due to their standard labor market experience.

[37] Hahn, Todd, and van der Klaaw (2001) suggest using local linear regression to estimate the regression discontinuity because of their well-behaved properties at boundaries. Lines plotting local linear regressions look very similar to the parametric cubic functions.

[38] The effects on occupational outcomes using the 1995-2000 LSMS are similar and somewhat smaller, but not always significant as compared to the results presented in Table 4, arguably reflecting the continuing reallocation of labor to new occupations during the transition period.

insignificant, as shown in columns (7) and (8). Figure 7 confirms these findings. None of the panels reveal any obvious effect of the policy on unemployment, nonemployment, family income or wages. These findings contrast sharply with those from the cross-sectional analysis which indicated that vocational training increased the likelihood of unemployment and nonemployment, and was associated with lower family income and wages.

The six yearly LSMS surveys from 1995-2000 also allow us to analyze whether the relative benefits of general education over vocational training changed over the transition period. In particular, we focus on the relative performance of men with different types of secondary education before and after the comprehensive macroeconomic stabilization and structural reform program that was started in 1997 by the newly elected center-right coalition.[39] Table 5 presents the differential impact of the post 1997 economic reforms on four labor outcomes (unemployed, non-employed, family income and log wages) for our sample of men for both the OLS cross sectional regressions and the reduced form estimates of the effect of the 1973 educational reform.[40] Results for the OLS cross sectional regressions are presented in Panel A of Table 5 confirming that all groups experienced a worsening of their income and labor market outcomes following the 1997 economic reforms. The interaction of the vocational dummy and the post 1997 dummy is large and significant for three of the four variables, suggesting that the reforms hit vocationally trained individuals particularly hard. The results in Panel B of the same table which analyze the outcomes of cohorts affected by the educational reform of 1973 also shows the same negative effects of the post 1997 reforms. But in these models the coefficient on the interaction of being born after 1959 (and thus affected by the 1973 reform) and the post 1997 indicator is very small and statistically indistinguishable from zero. Based on the results from the OLS specification, the benefits of general education should show an increase during the period of structural reforms (as found in the OLS regressions). Since we do not find such an effect in the regressions that use the 1973 educational reform to account for the selection into general secondary education, we interpret these results as additional evidence that the OLS cross sectional relationship between vocational training and labor market success is driven by selection.

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[39] As can be seen in Appendix Figure 5, the national unemployment rate increased markedly after 1997 as a result of the economic reforms.

[40] For the OLS cross sectional analysis we estimate the following model: $outcome_i = \beta' \mathbf{X}_i + \upsilon VOC_i + \gamma post1997_i + \pi VOC_i * post1997_i + f(c_i) + \varepsilon_i$, while for the reduced form estimates of the 1973 educational reform we estimate the model: $outcome_i = \beta' \mathbf{X}_i + \upsilon AFTER_i + \gamma post1997_i + \pi AFTER_i * post1997_i + f(c_i) + \varepsilon_i$. The variable $post1997_i$ is defined as 1 if the observation is from a post 1997 survey and 0 otherwise, while the other variables are the same as defined previously.

5.3 The quality of general education

The sudden change in the educational character of secondary schooling in Romania that is essential to credibly identify the effect of vocational training may not have been ideal for the actual students. Indeed, the drastic expansion in general education may have caused a reduction in the quality of general education. With an educational reform that affected such a large fraction of the school-age population, the question of how resources were allocated to implement the reform becomes extremely important. As mentioned previously, the 1973 educational reform involved the reorganization of existing vocational schools which were transformed into "combo schools" offering both vocational and general high school education. Figures 2 and 3 show the influx of teachers from vocational to general high school and indicate that the average student/faculty ratios across the two types of schools were largely maintained. Although we have some anecdotal evidence that retraining occurred, these teachers may nevertheless have been relatively inexperienced at teaching the new curriculum.

We provide two additional tests to examine the possible changes in school quality of general education. First, we analyze the outcomes of individuals who completed general education secondary schools before and after the introduction of the policy. If the quality of general education declined due to the drastic expansion of general lyceum schools, we might expect that the labor market outcomes of cohorts who completed general secondary education would have been worse for cohorts affected by the policy. Columns 1 and 2 of Table 6 present the reduced form results of the effect of the 1973 educational reform on unemployment and nonemployed for men with general secondary education. The results are insignificant for both labor market outcomes and therefore suggest that the quality of general education was not adversely affected by crowding or other issues associated with the rapid expansion of general lyceum schools. This is confirmed by a visual inspection of Panels A and B of Figure 8 which plot the rates of unemployment and nonemployment for men who completed general education.[41]

The second way to test for changes in school quality is to analyze whether labor market outcomes differ by region of birth or school specialty. Since some regions and school specialties experienced larger increases in the number of students who were shifted to general secondary education as a result of the policy, the students in these regions and specialties should have also been affected

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[41]Recall that, since higher ability students tended to be selected into general secondary schools, labor market outcomes for men with general education may also have been worse for cohorts affected by the policy because of a selection effect. Note that there is no change in the probability of labor market participation for men with vocational training. This is consistent with the absence of a change in the background characteristics observed in panel B of Table 2 (on urban area of birth).

most by changes in the quality of education. As expected, a larger proportion of individuals were affected by the policy in the poorer and rural regions, yet there were no significant differences in labor market outcomes by region of birth for individuals that completed general school before and after the policy change (results not shown). Similarly, among the different school specialties (i.e. industry, construction, agriculture, forest, transport, economics, medicine, and arts), those with the largest increase in enrollment, which presumably suffered most from school crowding, did not have the largest increases in unemployment or non-employment in 1992. Hence, we conclude that it is unlikely that a change in the quality of general education due to the policy can explain why cohorts who have received more general education after 1973 do not have better labor market outcomes.

5.4   Marital and spousal outcomes

Although this paper has focussed on occupational and labor market outcomes, it is interesting to examine the effect of the 1973 educational reform on outcomes such as marriage and divorce in 1992. Panel A of Table 7 provides OLS estimates for the effect of the policy on marital and fertility outcomes of men at 31 to 36 years of age. The cross-sectional results indicate that having vocational training lowers the probability of being married. In other words, vocational types are probably less likely to find a match on the marriage market. Married men with vocational training have about 0.3 more children than those with general education. In Panel A of Table 8, the reduced form indicates no effect on fertility but very strong effects on marital outcomes. Figure 9 shows these results graphically in Panels A-D. Men born in cohorts affected by the policy were significantly more likely to be married and significantly less likely to be divorced. Based on the calculations of section 4, these estimates indicate that a year of vocational training instead of general education probably increased the probability of being married by 1.9 percentage points, decreased the probability of divorce by 0.7 percentage points, and decreased the probability of remaining single by 1.2 percentage points. If general education also provides certain skills that are valued on the marriage market, we would expect to see a higher rate of marriage for cohorts affected by the policy. It is possible that a more mechanical explanation underlies this result: Since the policy shifted a large proportion of men from vocational to general education, and women predominantly attended general secondary schools, it is likely that boys in cohorts affected by the policy were more likely to meet potential mates in school. However, the findings on divorce suggest that general education may also provide skills that help couples succeed in marriage or increase the quality of a marital match. These results do not appear to be explained by the labor market or occupational outcomes associated with the

later cohorts.[42] Interestingly, there is no effect of the policy on the marital outcomes of women (results not shown).

In order to investigate this phenomenon more closely, we match men and women from the same household and examine the characteristics of their respective spouses. Panels B of Table 7 and 8 provides OLS and reduced-form estimates for the effect of the policy on educational and labor market outcomes for the spouses of men in cohorts affected by the policy.[43] Wives of men who were affected by the policy were significantly more likely to have received general secondary education – see panel C of Figure 10. In particular, they were also more likely to have completed grades 11 and 12, which corresponds to unambigiously more education than the vocational track (results not shown). The effect on wives' vocational training is negative but insignificant. There is also some suggestive evidence that wives of men affected by the policy were less likely to have only completed primary education below grade 8 (and also more likely to have some level of secondary education). Although these are not robust to the inclusion of calendar of month effects, panel A of Figure 10 does show a marked discontinuity. Finally, wives of men affected by the policy were 2 to 3 percentage points less likely to be employed in manual occupations as might be expected given that they were more likely to receive a general education. In summary, although we cannot be sure of the precise mechanism, these results are consistent with the arguments developed by Michael (1982) that education may facilitate a more productive sorting of men and women in the marriage market. Becker, Landes and Michael (1977) also postulate that such marital sorting may lead to subsequent benefits such as more stable marriages, again consistent with our findings.

5.5   Robustness checks

The results of the previous section were based on a sample of individuals with a secondary education who were born between 1956 and 1961 and therefore within 3 years of the January 1, 1959 cutoff (3 year window). We consider three alternative samples that extend or restrict the window around the cutoff: individuals with a secondary education that were born between 1958 and 1959 (1 year window), between 1957 and 1960 (2 year window), and between 1955 and 1962 (4 years window). We expect the precision of the estimates to be higher in the broad windows. Panel A of Appendix Table 2 presents results for men with a secondary education for the main outcomes of interest under

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[42]Including unemployment, nonemployment, or occupational outcomes in the marital regressions does not change the results.

[43]Note that these results are only available for the sample of men who are married. From the preceding discussion, we know that the marriage rates for men in cohorts affected by the policy are higher than for those unaffected. Therefore, we might expect our results to be biased against finding spouses with more favourable outcomes if we are drawing additional couples from the bottom of the distribution.

these alternative window specifications. The effect of the educational reform on the probability of being employed as a manual worker, the probability of being employed as a craft worker, and the probability of being married remain as before. As expected, the standard errors are smaller in the broad windows. Moreover, the effect of the policy on unemployment and log wages is not significant in any of the specifications. Panel B presents results with the same alternative windows for *all* men, including those with primary, gymnasium and higher education. Since the policy should not have affected these other men, we expect the results to be smaller in magnitude but largely unchanged. Indeed, the coefficients on $AFTER$ that are significant do appear to be smaller in magnitude. But scaled up appropriately, these reduced-form estimates yield similar effects of the policy on the treated population.

Appendix Table 3 presents additional robustness checks for each labor market outcome. Focusing on the standard window of 3 years and including a full set of controls, we examine reduced-form estimates around alternative year cutoffs. In essence, we consider "placebo" experiments around January 1 of the three preceding and three following years. Columns (1), (2) and (3) confirm the exceptional effect of the policy in significantly reducing the likelihood of being employed in a manual or craft-related occupation, and the increasing the likelihood of being married for men. Columns (1)-(4) show that there is no significant difference in the likelihood of being employed in a manual or craft-related occupation and in unemployment, log wages, or marriage for cohorts born before or after January 1 in most other years.

In addition to these robustness checks, we also analyzed whether the differences in labor market outcomes between educational groups might be driven by occupation specific labor market conditions. Since the industrial sectors employing predominantly vocationally trained workers were the hardest hit during the transition period, differences in unemployment rates between vocational and general secondary educated men could be driven by occupation specific shocks. Appendix Table 4 presents results from the 1992 Census on the probability of being unemployed that control for the previous occupation in the cross sectional and the reduced form. While the size of the effect is slightly reduced in the cross-section, the effect of vocational training remains large and significant for men, implying that differences in labor market performance between these educational groups hold even within occupations. The reduced form results are unchanged. Appendix Table 5 confirms the large overlap of among men with vocational and general secondary education within occupational categories. Finally, we examined these effects using non-linear regression methods such as logit and probit. None of these variations altered our main results in a substantial way.

6   Conclusion

The relative benefits of vocational and general education have long been a subject of debate among scholars and policy makers in the fields of economics and education. This paper exploits an educational reform that occurred in Romania in 1973 to avoid the selection bias that arises because less able students are more likely to enroll in vocational programs. By requiring students born after January 1, 1959 to complete an additional two years of general education instead of entering vocational schools, the policy shifted about 15% of the students in secondary school from vocational to general lyceum schools within a single year. The policy also shortened the length of vocational courses so even students affected by the policy who continued to vocational school after completing an additional two years of general education received at least a year less of vocational training. Nevertheless, this policy change did not significantly alter years of schooling across cohorts of secondary students. Using the Romanian Census of 1992 and the LSMS from 1995-2000, we find evidence that individuals who were affected by the policy were more likely to work in manual and craft occupations than their counterparts who were born too early to be affected by the policy. However, we find no significant difference in unemployment, non-employment, family income and log wages between individuals who were affected by the policy and those who were unaffected by the policy. Examining marital outcomes, we do find that men in cohorts affected by the policy were significantly more likely to be married and less likely to be divorced or remain single by 1992.

The findings associated with the 1973 educational reform are in sharp contrast to the cross-sectional evidence that individuals with vocational training are significantly more likely to be unemployed, out of the labor force, and have lower wages. They suggest that the relationship between vocational training and labor market returns highlighted by previous studies may largely be a consequence of selection. We have argued that possible changes in the quality of general secondary education as a result of the policy are unlikely to explain why we do not observe the positive benefits of a general education. Nevertheless, there appear to be significant marital returns to the policy. General skills may provides certain skills that are both valued on the marriage market and may help couples succeed in marriage.

It is important to note that these estimates are relevant for the marginal student shifted from vocational to general education rather than for the average student. But this group of marginal students is probably the most likely to be affected by any policy which encourages general education over vocational training. The population of students affected by the educational reform may, in fact, have benefited more if they had remained in vocational schools that taught specific skills. More able students who were already attending general lyceum high schools would not necessarily

gain from such specialized vocational training.[44] In other words, it is crucial to consider the effect of vocational training on different segments of the population and across different parts of the ability distribution. The sweeping emphasis on general education adopted by the World Bank may not be appropriate for all individuals.

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[44]Bowlby and Schriver (1973) consider the possibility that rates of return to vocational training might differ by ability.

References

ACEMOGLU, D., and J.S. PISCHKE (1999) "Beyond Becker: Training in Imperfect Labor Markets" *Economic Journal* 109: 112-142

ANGRIST, J., IMBENS, G.W., and D.B. RUBIN (1996) "Identification of Causal Effects Using Instrumental Variables" Journal of the American Statistical Association 91(434): 444-455

BARBERIS, N, M. BOYCKO, A. SHLEIFER and N. TSUKANOVA (1996), "How Does Privatization Work? Evidence from the Russian Shops" *Journal of Political Economy* 104(4): 764-790

BECKER, G.S., LANDES, E.M., and R.T. MICHAEL (1977) "Economics of marital instability" *Journal of Political Economy* 86(6): 1141-1187

BENNEL, P. (1996) "General versus Vocational Secondary Education in Developing Countries: A Review of the Rates of Return Evidence" *Journal of Development Studies* 33(2): 230-47

BRAINERD, E. (1998) "Winners and Losers in Russia's Economic Transition" *American Economic Review* 88(5): 1094-1116

BLOOM, H. (1984) "Accounting for No-shows in Experimental Evaluation Designs" *Evaluation Review* 8: 225-46

BOWLBY, R.L. and W.R. SCHRIVER (1973) "Academic Ability and Rates of Return to Vocational Training" *Industrial and Labor Relations Review* 26(3): 980-90

BRAHAM, R.L. (1972) *Education in Romania: A Decade of Change*, US Government Printing Press

BRAHAM, R.L. (1978) *The Educational System of Romania*, US Government Printing Press

CARD, D., DOBKIN, C. and N. MAESTAS (2004) "The Impact of Nearly Universal Insurance Coverage on Health Care Utilization and Health: Evidence from Medicare" NBER Working Paper No. 10365

DIMITRIU, E., IONESCU, O. NICA, I. and I. ORGHIDAN (1981) *A Concise History of Education in Romania*, Editura Stiintifica si Enciclopedica

EARLE J.S. (1997) "Industrial Decline and Labor Reallocation in Romania" Working Paper 118 of the William Davidson Institute

EARLE J.S. and C. PAUNA (1996) "Incidence and duration of unemployment in Romania" *European Economic Review* 40: 829-837

EARLE J.S. and C. PAUNA (1998) "Long-term unemployment, social assistance and labor market policies in Romania" *Empirical Economics* 23: 203-235

GOLDIN, C. (2001) "The Human-Capital Century and American Leadership: Virtues of the Past" *Journal of Economic History* 61(2): 263-292

GRASSO, J.T. and J.R. SHEA (1979) *Vocational Education and Training: Impact on Youth.* Berkeley, California: Carnegie Council on Policy Studies.

HAHN, J., TODD, P., and W. VAN DER KLAAUW (2001) "Identification and Estimation of Treatment Effects with a Regression Discontinuity Design" *Econometrica* 69(1): 201-209

IBRD (1991) *World Bank Policy Paper: Vocational and Technical Education and Training.* Washington, DC: World Bank

IBRD (1995) *Priorities and Strategies for Education: A World Bank Sector Review.* World Bank Education and Social Policy Department, Washington , DC

IMBENS, G.W. and J.D. ANGRIST (1994) "Identification and Estimation of Local Average Treatment Effects" *Econometrica* 62(2): 467-475

KRUEGER, D. and K. KUMAR (2003a) "Skill-specific rather then General Education: A Reason for US-Europe Growth Differences?" NBER Working Paper 9408

KRUEGER, D. and K. KUMAR (2003b) "US-Europe Differences in Technology-Driven Growth: Quantifying the Role of Education" NBER Working Paper 10001

LECHNER, M. (2000) "An Evaluation of Public Sector Sponsored Continuous Vocational Training Programs in East Germany" *Journal of Human Resources* 35(2): 347-375

LEE, D. and J. MCCRARY (2005) "Crime, Punishment, and Myopia" NBER Working Paper No. 11491

LEE, D. and D. CARD (2006) "Regression Discontinuity Inference with Specification Error" *Journal of Econometrics*, forthcoming.

MALAMUD, O. (2005) "Breadth vs. Depth: The Effect of Academic Specialization on Labor Market Outcomes" Harris School Working Paper Series: 05.17

MEYER, R.H. (1982) "Job training in the Schools" in *Job Training for Youth*, ed. R.E. Taylor, H. Rosen, and F.C. Pratzner. 307-344. Columbus: The National Center for Research in Vocational Education, Ohio State University.

MICHAEL, R.T. (1982) "Measuring Non-monetary Benefits of Education: A Survey" In W.W. McMahon and T.G. Geske (Eds.) Financing Education: Overcoming Inefficiency and Inequity. 119-149. Urbana: University of Illinois Press

MIDDLETON, J., ZIDERMAN, A. and A. VAN ADAMS (1993) *Skills for Productivity: Vocational Education and Training in Developing Countries.* Oxford University Press

MINCER, J. (1974) *Schooling, Experience, and Earnings.* New York: Columbia University Press

NESPOROVA, A. (2002) "Unemployment in Transition Economies" Economic Analysis Division Seminar Paper, United Nations Economic Commission for Europe

NEUMAN, S. and A. ZIDERMAN (1991) "Vocational Schooling, Occupational Matching, and Labor Market Earnings in Israel" *Journal of Human Resources* 26(2): 256-281

NEUMAN, S. and A. ZIDERMAN (1999) "Vocational Education in Israel: Wage Effects fo the VocEd- Occupation Match" *Journal of Human Resources* 34(2): 407-420

PSACHAROPOULOS, G. (1987) "To Vocationalize or Not to Vocationalize?: That is the Curriculum Question" *International Review of Education* 33(2): 187-211

OECD (2000) *Reviews of National Policies for Education: Romania*

ROMANIA GOVERMENT, *Annual Statistics of the Socialist Republic of Romanian 1960-1980*

ROMANIA GOVERMENT, *Statistics Yearbook 2004,* http://www.insse.ro/download/anuar_2002

ROMANIA GOVERMENT (1973) *Resolution of the Communist Party's Central Committee of June 18 and 19, 1973*, Editura Politica, Bucharest

ROMANIA GOVERMENT (1968) *The Education Law of the Socialist Republic of Romania*, Didactical and Pedagogical Publishing House, Bucharest

ZYMELMAN, M. (1976) *The Economic Evaluation of Vocational Training Programs*. Baltimore, MD: Johns Hopkins University Press

A   Appendix

As mentioned in the main text, we do not have precise information on the number of years of vocational training and the total years of schooling for each individual. Instead, we only have information on whether students completed the first stage of lyceum school, the second stage of lyceum school, or vocational school.[45] The first and second stage of lyceum school are associated with 10 and 12 years of general education respectively. Following the 1973 educational reform, all students that completed vocational school also completed the first stage of lyceum school. These students therefore received 10 years of general education and 1 year of vocational training. However, prior to the 1974-75 school year, most students who completed vocational school would have received 8 years of general education and 3 years of vocational training. We cannot distinguish individuals who entered vocational school after grade 8 prior to the educational reform from those individuals who entered vocational schools after grade 10 and completed shorter vocational courses.

A.1   Effect of the policy on the treated population

Assuming that we could identify the group of students who entered vocational school after grade 8 prior to the educational reform, we could estimate the effect of the policy on the treated population directly. Alternatively, if we could determine the proportion of students, π, who would have been affected by the policy out of the total population of secondary educated students, then we could scale up the reduced-form effect. The effect of the policy on the treated population would then be δ/π.[46] Note that this resembles the standard calculation used in moving from an intention-to-treat (ITT) estimator to a treatment-on-the-treated (TOT) estimator. However, the reason for employing this method here is that we cannot identify the group of students who were affected by the treatment, rather than the conventional worry that individuals may be self-selecting into the treatment. Inflating the reduced-form estimate to yield an effect of the policy on the treated population requires the assumption that only *compliers* who were shifted from vocational to lyceum schools were affected by the policy. In other words, it is important that the educational experience of students who would have attended lyceum schools even in the absence of the policy was not affected due to the shift in students from vocational to lyceum schools.[47] However, we have reason to believe that the effect on the quality of education due to crowding or changing peer groups was small. Data indicates that the number of teachers rose in line with enrollment in lyceum schools so that pupil-teacher ratios probably remained roughly constant. Moreover, the nature of the expansion of lyceum schools probably largely retained the peer groups that existed prior to the educational reform.

Unfortunately, the group of students that entered vocational school after grade 8 prior to the policy change is not easily identified. We only have information on the highest level of education attained and some individuals that are listed as having completed vocational school may have already entered after grade 10 and were therefore not affected by the policy change. Lacking this information, we cannot scale up the estimate derived from the entire population of secondary educated student to determine the effect of the policy change on the treated population. Instead, we use enrollment data to try and infer the proportion of students that were entering vocational

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[45]In addition, we know whether they completed gymnasium (8 years of schooling), primary school (4 years of schooling) or some form of postsecondary schooling.

[46]Such scaling of the reduced form estimate by the proportion of individuals that actually received the treatment was introduced by Bloom (1984).

[47]Note that this type of interaction is usually assumed away in policy evaluations. It corresponds to the Stable Unit Treatment Value Assumption (SUTVA) in the terminology of casual inference (Angrist et. al., 1996).

school after grade 8 out of the total number of students entering vocational school before the policy change.

We estimate the rough proportion of vocational students at each level using enrollment data from the *Annual Statistics of the Socialist Republic of Romania*. Assuming that there were no dropouts and that the number of students entering vocational school after grade 10 remained constant over time, we estimate that approximately 45 percent of the students with vocational training born in 1958 had entered vocational school after grade 8.[48] Furthermore, we can estimate that approximately 40 percent of students that would have entered vocational school after grade 8 but for the policy reform, entered vocational school following grade 10 after completing an additional two years of general education.[49] Including students who were in apprenticeship programs (which are counted jointly with vocational students in the 1992 Census), we need to adjust these calculations so that approximately 50 percent of the students with vocational training or apprenticeships in 1958 were affected by the policy and about 45 percent of these students continued onto these programs after completing their additional two years of general education following the reform.[50] Given these numbers, we expect that the size of the cohort of students completing vocational training or apprenticeship programs of 1959 was about 75 percent of the size of the cohort of 1958, which is almost exactly what find in the data from the 1992 Census.

If we regard the calculations performed above seriously, then we must conclude that about 50 percent of the students with vocational training before 1959 – or 33 percent of the students with secondary education – were affected by the policy. Consequently, we would need to scale up the reduced-form estimate over all secondary educated individuals by a factor of 3 to derive an estimate of the policy on the treated population.

A.2 Effect of vocational training (LATE)

The calculations of the preceding section imply that the effect of the educational reform on the treated population is approximately 3δ. However, it is difficult to interpret the magnitude of this estimate because the policy did not affect exposure to vocational training in the same way for all individuals. Recall that following the 1973 educational reform, students who would otherwise have

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[48] Based on the enrollment data, approximately 250,000 students were enrolled in vocational schools in 1973-74 and 190,000 students were enrolled vocational schools in 1974-75. Since enrollment in 1973-74 includes three cohorts of students that entered after grade 8 whereas enrollment in 1974-75 only includes two cohorts of students that entered after grade 8 (in addition to a cohort of students that entered after grade 10 in each case), we can solve for the size of each cohort: 60,000 in the cohort that entered vocational after grade 8 and 70,000 in the cohort that entered vocational school after grade 10. Given these predicted sizes, we would expect the number of students enrolled in the following school year 1975-76 to equal 130,000 (which is not too far from the actual figure of 123,000).

[49] Enrollment in vocational schools in 1976-77 was approximately 94,000. Although no more cohorts of students who entered vocational school after grade 8 should remain, students who would have wished to enter vocational school after grade 8 in 1974-75 could now enter after having completed grade 10 in general school. Since the numbers of students entering vocational school after grade 10 is assumed to remain constant, we can calculate that approximately 24,000 out of 60,000 students who were denied entrance in vocational school after grade 8 decided to continue on to vocational school after completing their additional two years of general education. Assuming that a similar proportion wished to continue into vocational school from the second and third cohorts after the policy reform, we would expect the number of students enrolled in the years 1977-78 and 1978-79 to be equal to 118,000 and 142,000 respectively (which is not too far from the actual figures of 114,000 and 138,000).

[50] We employ a similar method is to derive the number of students in apprenticeship programs: Given enrollments of about 100,000 and 70,000 students in apprenticeships in 1973-74 and 1974-75 respectively, we calculate that approximately 30,000 students entered after grade 8 and 10,000 entered after grade 10. However, we also need to account for the secular decline in apprenticeships over time so that predictions of following years are adjusted accordingly.

entered vocational courses of 3 years could have either (i) entered the workforce, (ii) entered vocational school for shorter courses of 1 year, or (iii) entered the second stage of lyceum school. Then individuals in groups (i) and (iii) would have experienced three fewer years of vocational training while individuals in group (ii) would have experienced two fewer years of vocational training. In order to derive the effect of the policy on vocational training, we need to calculate the relative proportion of students among the three groups.

We can provide some rough calculations on the average difference in vocational training before and after the policy change by comparing cohorts of individuals born in 1958 and 1959 using data from the 1992 Census. Based on this data, the number of students completing the first and second level of lyceum schools increased by about 4 and 11 percentage points respectively while the number of students completing vocational school fell by about 15 percentage points. Moreover, according to the calculations of the previous section, the number of students completing vocational school after having attended the first level of lyceum school increased by about 18 percentage points after the policy.[51] These estimates suggest that, among secondary educated individuals, the average decrease in vocational training was 0.8 years.

Now, rather than scaling the reduced-form estimate of the effect of the policy by the proportion of individuals who were affected by the policy, we can scale the reduced-form estimate by the average change in vocational training induced by the policy. In other words, we can calculate the local average treatment effect (LATE) of a year of vocational versus general education. We can express an estimate of this effect as follows:[52]

$$E\left[outcome_i \mid V_i\right] = \frac{E\left[outcome_i \mid AFTER_i = 1\right] - E\left[outcome_i \mid AFTER_i = 0\right]}{E\left[V_i \mid AFTER_i = 1\right] - E\left[V_i \mid AFTER_i = 0\right]} \tag{3}$$

Conditional on observable characteristics, $\mathbf{X}_i$, the numerator of this expression is simply δ from equation 2. The denominator of the expression is the difference in the average quantity of vocational training between individuals in cohorts that were affected by the educational reform and their counterparts in cohorts that were unaffected. Applying the calculations above, we can conclude that the effect of an additional year of vocational training instead of general education on labor market outcomes approximately 1.25δ. Note that the standard method for estimating this expression is by two-stage least squares (2SLS). However, given the data limitations, we have had to resort to this rather indirect approach.

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[51] Those calculations suggest that approximately 50 percent of the students with vocational training in 1958 were affected by the policy and about 45 percent of these students entered vocational schools after completing the first stage of lyceum schools. Since about 65 percent of secondary educated students received vocational training in 1958, the number of students completing vocational school after first level of lyceum education decreased by 18 percentage points.

[52] See Imbens and Angrist (1994) for the assumptions that underly estimates of LATE. In particular, we need to assume a version of their montonicity requirement if we wish to allow for non-constant treatment effects.

Table 1: Descriptive Statistics

	Entire sample			Secondary-educated sample		
	Mean	SD	N	Mean	SD	N
Demographics						
Urban region (of birth)	0.27	0.45	134,154	0.26	0.44	83,425
Romanian	0.89	0.31	134,154	0.91	0.29	83,425
Hungarian	0.07	0.25	134,154	0.07	0.25	83,425
Gypsy	0.02	0.15	134,154	0.01	0.07	83,425
Educational attainment						
Lower (primary/gymnasium)	0.27	0.44	134,154	–	–	–
Vocational	0.36	0.48	134,154	0.58	0.49	83,425
Lyceum 9-12	0.26	0.44	134,154	0.42	0.49	83,425
Higher (postsec/university)	0.11	0.31	134,154	–	–	–
Labor market outcomes						
Manual worker	0.79	0.41	127,109	0.84	0.36	80,679
Craft worker	0.43	0.50	127,109	0.51	0.50	80,679
Metal worker	0.13	0.33	127,109	0.16	0.36	80,679
Clerk	0.03	0.16	127,109	0.03	0.17	80,679
Unemployed	0.07	0.25	129,233	0.06	0.24	81,552
Nonemployed	0.10	0.30	133,884	0.08	0.27	83,227
Log income*	15.53	0.80	21,325	15.54	0.73	14,519
Log wages*	15.25	0.50	14,261	15.19	0.46	10,102
Marital outcomes						
Married	0.80	0.40	134,000	0.82	0.38	83,357
Divorced	0.03	0.16	134,000	0.03	0.16	83,357
Single	0.17	0.37	134,000	0.15	0.35	83,357
Children	2.02	1.12	104,802	1.93	1.03	67,195
Spousal Outcomes						
Wife has lower education	0.36	0.48	104,405	0.27	0.44	67,050
Wife has vocational training	0.15	0.36	104,405	0.20	0.40	67,050
Wife has general education	0.41	0.49	104,405	0.51	0.50	67,050
Wife is manual worker	0.62	0.48	77,884	0.64	0.48	52,099

Notes: SD is the standard deviation and N is the sample size. All summary statistics based on cohorts born between 1956 and 1961 (within 3 years of January 1, 1959). The sample of secondary-educated men and women includes individuals with vocational and general secondary education only. Labor market outcomes are from the 1992 Romanian Census except for log wages and income (marked with *) which are from the LSMS 1995-2000. VOC is defined as 1 if an individual completed a course in vocational training and 0 otherwise. Manual worker is defined as 1 if an individual is employed in an occupation with ISCO category 5-9, and 0 if otherwise employed. Craft worker is defined as 1 if an individual is employed in an occupation with ISCO category 7, and 0 if otherwise employed. Metal and clerk correspond to metal workers and clerks respectively. Unemployed is defined as 1 if an individual is actively seeking work, and 0 if employed. Nonemployment is defined as 1 if an individual is not employed (unemployed or out of the labor force) and 0 otherwise. Family income is total income including credits, loans, withdrawals, downpayments, etc. Log wages are log annual wages.

Table 2: Effect of the 1973 Educational Reform on Educational Outcomes, Urban Status, and Years of Schooling

Panel A: Educational Outcomes

| | Secondary school level | | |
| | All | Vocational | General |
	(1)	(2)	(3)
AFTER	-0.010	-0.081**	0.071**
	[0.006]	[0.005]	[0.004]
R^2	0.03	0.04	0.04
Sample Size	134,154	134,154	134,154
Mean of dep. variable	0.62	0.36	0.26

Panel B: Born in an Urban Area

| | Secondary school level | | | All |
| Sample restricted to: | All | Vocational | General | |
	(4)	(5)	(6)	(7)
AFTER	-0.006	-0.002	-0.038**	-0.001
	[0.008]	[0.09]	[0.011]	[0.005]
R^2	0.13	0.09	0.16	0.14
Sample Size	83,425	48,130	35,295	134,154
Mean of dep. variable	0.26	0.20	0.34	0.27

Panel C: Years of Schooling (1995-96 LSMS only)

| | Secondary school level | | | All |
| Sample restricted to | All | Vocational | General | |
	(8)	(9)	(10)	(11)
AFTER	0.018	-0.198	-0.076	-0.159
	[0.118]	[0.130]	[0.143]	[0.176]
R^2	0.01	0.02	0.04	0.07
Sample Size	2,930	1,617	1,313	4,532
Mean of dep. variable	11.48	11.10	11.95	11.47

Notes: Robust standard errors clustered by month of birth in brackets. ** and * indicate statistical significance at the 1 and 5 percent level, respectively. Samples include all cohorts born between January 1, 1956 and December 31, 1961. All regressions include a cubic in month of birth and calendar of month dummies. Data for Panels A and B is from the 1992 Census. Data for Panel C is from the 1995 and 1996 LSMS. Demographic controls include ethnicity, region of birth, and an indicator for urban or rural area of birth. In all regressions, AFTER is defined as 1 for individuals born on or after January 1, 1959 and 0 for individuals born on or before December 31, 1958.

Table 3: Effect of Vocational Training on Labor Market Outcomes: OLS results

Panel A: Occupational Outcomes

	Manual worker (1)	Craft worker (2)	Metal worker (3)	Clerk (4)
VOC	0.231** [0.006]	0.133** [0.006]	0.065** [0.003]	-0.042** [0.001]
R^2	0.11	0.02	0.02	0.02
Sample Size	80,679	80,679	80,679	80,679
Mean of dep. variable	0.84	0.51	0.16	0.03

Panel B: Labor Market Participation and Earnings

	Unemployed (5)	Nonemployed (6)	Log family income (7)	Log wages (8)
VOC	0.014** [0.002]	0.015** [0.002]	-0.146** [0.016]	-0.073** [0.012]
R^2	0.01	0.01	0.06	0.10
Sample Size	81,552	83,227	14,519	10,102
Mean of dep. variable	0.06	0.08	15.54	15.18

Notes: Robust standard errors clustered by month of birth in brackets. ** and * indicate statistical significance at the 1 and 5 percent level, respectively. Samples include cohorts with a secondary-level education born between January 1, 1956 and December 31, 1961. All regressions include a cubic in month of birth and calendar of month dummies. Columns (1)-(6) use data from the 1992 Census; columns (7)-(8) use data from the 1995-2000 Romanian LSMS. Demographic controls for the 1992 Census regressions include ethnicity, region of birth, and an indicator for urban or rural area of birth. Controls for the LSMS regressions include ethnicity and dummies for year of survey. In all regressions, VOC is defined as 1 if an individual completed a course in vocational training and 0 otherwise.

Table 4: Effect of the 1973 Educational Reform on Labor Market Outcomes: Reduced-form results

Panel A: Occupational Outcomes

	Manual worker (1)	Craft worker (2)	Metal worker (3)	Clerk (4)
AFTER	-0.016* [0.006]	-0.025** [0.008]	-0.023** [0.006]	0.006* [0.002]
R^2	0.00	0.01	0.01	0.00
Sample Size	80,679	80,679	80,679	80,679
Mean of dep. variable	0.84	0.51	0.16	0.03

Panel B: Labor Market Participation and Earnings

	Unemployed (5)	Nonemployed (6)	Log family income (7)	Log wages (8)
AFTER	0.004 [0.004]	0.004 [0.005]	-0.023 [0.052]	-0.024 [0.028]
R^2	0.01	0.01	0.05	0.09
Sample Size	81,552	83,227	14,519	10,102
Mean of dep. variable	0.06	0.08	15.54	15.18

Notes: Robust standard errors clustered by month of birth in brackets. ** and * indicate statistical significance at the 1 and 5 percent level, respectively. Samples include cohorts with a secondary-level education born between January 1, 1956 and December 31, 1961. All regressions include a cubic in month of birth and calendar of month dummies. Columns (1)-(6) use data from the 1992 Census; columns (7)-(8) use data from the 1995-2000 Romanian LSMS. Demographic controls for the 1992 Census regressions include ethnicity, region of birth, and an indicator for urban or rural area of birth. Controls for the LSMS regressions include ethnicity and dummies for year of survey. In all regressions, AFTER is defined as 1 for individuals born on or after January 1, 1959 and 0 for individuals born on or before December 31, 1958.

Table 5: The Differential Effect of the 1997 Structural Reform Program on Labor Market Outcomes

	Unemployed (1)	Nonemployed (2)	Log family income (3)	Log wages (4)
Panel A: OLS				
VOC	0.014	0.017*	-0.105**	-0.048**
	[0.007]	[0.008]	[0.021]	[0.013]
POST1997	0.052**	0.055**	-0.208**	-0.164**
	[0.009]	[0.010]	[0.019]	[0.014]
VOC*POST1997	0.028*	0.028	-0.082**	-0.056**
	[0.013]	[0.014]	[0.029]	[0.021]
R^2	0.02	0.02	0.05	0.06
Sample Size	14,046	14,555	14,519	10,102
Mean of dep. variable	0.12	0.15	15.54	15.19
Panel B: Reduced form				
AFTER	0.014	0.029	-0.019	-0.022
	[0.014]	[0.016]	[0.053]	[0.032]
POST1997	0.063**	0.074**	-0.251**	-0.196**
	[0.010]	[0.010]	[0.017]	[0.015]
AFTER*POST1997	0.011	-0.005	-0.012	0.000
	[0.013]	[0.014]	[0.025]	[0.021]
R^2	0.01	0.01	0.04	0.05
Sample Size	14,046	14,555	14,519	10,102
Mean of dep. variable	0.12	0.15	15.54	15.19

Notes: Robust standard errors clustered by month of birth in brackets. ** and * indicate statistical significance at the 1 and 5 percent level respectively. Estimates are based on a linear probability model. Samples include cohorts with a secondary-level education born between January 1, 1956 and December 31, 1961. Data is from the 1992 Census. Demographic controls include ethnicity. AFTER is defined as 1 for individuals born on or after January 1, 1959 and 0 for individuals born on or before December 31, 1958. VOC is defined as 1 if an individual completed a course in vocational training and 0 otherwise. POST1997 is defined as 1 if the observation is from LSMS surveys after 1997, the starting year of a macroeconomic stabilization and structural reform program.

Table 6: Effect of the 1973 Educational Reform on Labor Market Outcomes by Education

	General Lyceum		Vocational Training	
	Unemployed (1)	Nonemployed (2)	Unemployed (3)	Nonemployed (4)
AFTER	0.006 [0.006]	0.004 [0.007]	0.004 [0.006]	0.007 [0.007]
R^2	0.01	0.01	0.01	0.01
Sample Size	34,438	35,124	47,114	48,103
Mean of dep. variable	0.05	0.07	0.06	0.08

Notes: Robust standard errors clustered by month of birth in brackets. ** and * indicate statistical significance at the 1 and 5 percent level respectively Columns 1 and 2 are restricted to individuals with general high school (lyceum) education while columns 3 and 4 are restricted to individuals with vocational education. Samples include cohorts born between January 1, 1956 and December 31, 1961. Demographic controls include ethnicity, region of birth, and an indicator for urban or rural area of birth. Unemployed is defined as 1 if an individual is actively seeking work, and 0 if employed. Nonemployment is defined as 1 if an individual is not employed (unemployed or out of the labor force) and 0 otherwise. AFTER is defined as 1 for individuals born on or after January 1, 1959 and 0 for individuals born on or before December 31, 1958.

Table 7: Effect of Vocational Training on Marital/Spouse Outcomes: OLS results

Panel A: Marital Outcomes

	Married (1)	Divorced (2)	Single (3)	Num. of children (4)
VOC	-0.014**	0.000	0.013**	0.277**
	[0.003]	[0.001]	[0.003]	[0.011]
R^2	0.01	0.01	0.01	0.06
Sample Size	83,357	83,357	83,357	67,195
Mean of dep. variable	0.83	0.03	0.15	1.93

Panel B: Spouse Outcomes

Wife has	Lower education (5)	Vocational Training (6)	General Education (7)	Manual Occupation (8)
VOC	-0.033**	0.134**	-0.282**	0.234**
	[0.001]	[0.004]	[0.005]	[0.006]
R^2	0.02	0.04	0.1	0.09
Sample Size	67,050	67,050	67,050	52,099
Mean of dep. variable	0.27	0.20	0.51	0.65

Notes: Robust standard errors clustered by month of birth in brackets. ** and * indicate statistical significance at the 1 and 5 percent level, respectively. Samples include cohorts with a secondary-level education born between January 1, 1956 and December 31, 1961. All regressions include a cubic in month of birth and calendar of month dummies. Data is from the 1992 Census. Demographic controls include ethnicity, region of birth, and an indicator for urban or rural area of birth. In all regressions, VOC is defined as 1 if an individual completed a course in vocational training and 0 otherwise; AFTER is defined as 1 for individuals born on or after January 1, 1959 and 0 for individuals born on or before December 31, 1958.

Table 8: Effect of the 1973 Educational Reform on Marital/Spouse Outcomes: Reduced-form results

Panel A: Marital Outcomes

	Married (1)	Divorced (2)	Single (3)	Children (4)
AFTER	0.019**	-0.007*	-0.012*	-0.014
	[0.007]	[0.003]	[0.006]	[0.019]
R^2	0.01	0.01	0.01	0.05
Sample Size	83,357	83,357	83,357	67,195
Mean of dep. variable	0.83	0.03	0.15	1.93

Panel B: Spouse Outcomes

Wife has	Lower education (5)	Vocational Training (6)	General Education (7)	Manual Occupation (8)
AFTER	-0.013	-0.006	0.020*	-0.025*
	[0.008]	[0.009]	[0.009]	[0.09]
R^2	0.03	0.02	0.03	0.03
Sample Size	67,050	67,050	67,050	52,099
Mean of dep. variable	0.27	0.20	0.51	0.65

Notes: Robust standard errors clustered by month of birth in brackets. ** and * indicate statistical significance at the 1 and 5 percent level, respectively. Samples include cohorts with a secondary-level education born between January 1, 1956 and December 31, 1961. All regressions include a cubic in month of birth and calendar of month dummies. Data is from the 1992 Census. Demographic controls include ethnicity, region of birth, and an indicator for urban or rural area of birth. In all regressions, VOC is defined as 1 if an individual completed a course in vocational training and 0 otherwise; AFTER is defined as 1 for individuals born on or after January 1, 1959 and 0 for individuals born on or before December 31, 1958.

Appendix Table 1: Vocational Educational Enrollment in Selected Countries in 1985

Country	Gross-secondary enrollment as a percentage of secondary school age children	Vocational enrollment as a percentage of secondary enrollment
Africa		
Kenya	20.0	1.7
Senegal	13.0	6.7
Somalia	17.0	13.0
Gabon	25.0	19.6
Cameroon	23.0	24.2
Asia		
Pakistan	17.0	1.9
China	39.0	6.5
Indonesia	39.0	9.2
Thailand	30.0	17.3
Korea	94.0	17.3
Middle East		
Yemen	10.0	1.5
Jordan	79.0	9.2
Tunisia	39.0	18.9
Turkey	42.0	21.1
Egypt	62.0	22.9
Europe		
Portugal	47.0	1.3
Greece	86.0	13.4
Yugoslavia	82.0	25.0
Hungary	72.0	73.7
Poland	78.0	77.0
Latin America		
Mexico	55.0	11.7
Chile	69.0	19.3
Panama	59.0	26.6
Brazil	35.0	49.1
Argentina	70.0	60.2

Notes: Source: Middleton, Ziderman, and Adams (1993, Table A-1, p.307-309). Gross secondary enrollment as a percentage of the population of secondary school age children is taken from Table 30 of the World Development Report 1988. Vocational education as a percentage of secondary enrollment was calculated from Table 3.7 of the Statistical Yearbook 1987 and Unesco statistics.

Appendix Table 2: Robustness Checks for Effect of the 1973 Educational Reform
(coefficients on AFTER)

	Manual worker (1)	Craft worker (2)	Unemployed (3)	Log wages (4)	Married (5)
Panel A: **Secondary-educated men**					
2 year window	-0.021*	-0.034**	0.007	0.000	0.020**
	[0.008]	[0.012]	[0.005]	[0.000]	[0.006]
4 year window	-0.014**	-0.025**	0.004	-0.019	0.019**
	[0.005]	[0.008]	[0.004]	[0.023]	[0.006]
8 year window	-0.019**	-0.031**	0.004	0.000	0.014*
	[0.006]	[0.008]	[0.004]	[0.021]	[0.006]
Panel B: **All men**					
2 year window	-0.014*	-0.039**	0.006	0.000	0.015*
	[0.005]	[0.008]	[0.005]	[0.000]	[0.006]
4 year window	-0.009	-0.024**	0.001	-0.012	0.015**
	[0.005]	[0.007]	[0.003]	[0.019]	[0.005]
8 year window	-0.013**	-0.028**	0.000	-0.008	0.009
	[0.005]	[0.006]	[0.003]	[0.021]	[0.005]

Notes: Robust standard errors clustered by month of birth in brackets. ** and * indicate statistical significance at the 1 and 5 percent level respectively. Estimates are based on a linear probability model or OLS (in the case of log wages). 2 and 4 year windows include a linear trend while the 8 year window includes a cubic in birth month. 4 and 8 year windows include calendar of month dummies. Columns (1), (2), (3), and (5) use data from the 1992 Census; column (4) uses data from the 1995-2000 Romanian LSMS. Demographic controls for the 1992 Census regressions include ethnicity, region of birth, and an indicator for urban or rural area of birth. Controls for the LSMS regressions include ethnicity and dummies for year of survey.

Appendix Table 3: Placebo tests based on alternative year cutoffs (coefficients on AFTER)

	Manual worker	Craft worker	Unemployed	Log wages	Married
	(1)	(2)	(3)	(4)	(5)
Placebo year					
1956	-0.001 [0.006]	-0.021* [0.010]	0.001 [0.004]	0.051 [0.029]	-0.003 [0.006]
1957	0.006 [0.007]	0.019 [0.011]	0.003 [0.004]	-0.051 [0.028]	0.003 [0.005]
1958	0.002 [0.007]	0.003 [0.009]	-0.003 [0.004]	-0.001 [0.024]	-0.012* [0.006]
1959	**-0.016*** **[0.006]**	**-0.025**** **[0.008]**	**0.004** **[0.004]**	**-0.024** **[0.028]**	**0.019**** **[0.006]**
1960	0.003 [0.006]	0.009 [0.009]	0 [0.005]	0.033 [0.032]	-0.006 [0.008]
1961	0.002 [0.005]	0.005 [0.011]	-0.004 [0.004]	-0.01 [0.026]	0.003 [0.007]
1962	-0.002 [0.005]	-0.013 [0.011]	0.003 [0.004]	0.006 [0.036]	-0.004 [0.008]

Notes: Robust standard errors clustered by month of birth in brackets. ** and * indicate statistical significance at the 1 and 5 percent level respectively. All regressions include a cubic in month of birth and calendar of month dummies. Columns (1), (2), (3), and (5) use data from the 1992 Census; column (4) uses data from the 1995-2000 Romanian LSMS. Demographic controls for the 1992 Census regressions include ethnicity, region of birth, and an indicator for urban or rural area of birth. Controls for the LSMS regressions include ethnicity and dummies for year of survey. AFTER is defined as 1 for individuals born on or after January 1 of the respective year and 0 for individuals born on or before December 31 of the previous respective year.

Appendix Table 4: OLS and Reduced-form results of unemployment controlling for previous occupation

	Unemployment: cross-section (OLS) results			Unemployment: reduced-form results		
	1-digit ISCO (1)	2-digit ISCO (2)	3-digit ISCO (3)	1-digit ISCO (4)	2-digit ISCO (5)	3-digit ISCO (6)
VOC	0.012** [0.002]	0.011** [0.002]	0.009** [0.002]			
AFTER				0.003 [0.004]	0.003 [0.004]	0.003 [0.004]
R^2	0.01	0.02	0.03	0.01	0.02	0.03
Sample Size	80,614	80,614	80,614	80,614	80,614	80,614
Mean of dep. variable	0.06	0.06	0.06	0.06	0.06	0.06

Notes: Robust standard errors clustered by month of birth in brackets. ** and * indicate statistical significance at the 1 and 5 percent level, respectively. Estimates are based on a linear probability model. Samples include cohorts with a secondary-level education born between January 1, 1956 and December 31, 1961 (3 years window around January 1, 1959). ISCO codes are for the previously held occupation before becoming unemployed. Other controls include marital status, ethnicity, region of birth, and an indicator for urban or rural area of birth as well as a cubic in month of birth and calendar month of birth dummies. AFTER is defined as 1 for individuals born on or after January 1, 1959 and 0 for individuals born on or before December 31, 1958

Appendix Table 5: Percentage vocationally trained and percentage unemployed by occupation

	Entire sample		Secondary-educated sample	
	% Voc	% Unemp	% Voc	% Unemp
Managers	9.2	4.2	21.9	2.3
Professionals	0.2	0.1	6.3	4.2
Technicians	9.4	4.7	13.0	4.4
Clerks	19.8	9.3	25.0	6.1
Service/sales	30.5	22.4	38.2	3.2
Agriculture	21.3	7.4	66.7	3.9
Crafts	48.2	37.3	63.8	5.3
Operators	47.9	32.2	64.1	4.9
Unskilled	24.1	16.0	67.6	7.7
All	36.5	19.1	57.5	5.1

Notes: All summary statistics based on cohorts born between 1957 and 1961 (within 3 years of January 1, 1959). The sample of secondary-educated men includes men with vocational and general secondary education only. The sample of secondary-educated women includes women with vocational and general secondary education only.

Figure 1: Structure of Education in Romaina

Panel A: Before 1973 (Individuals born before January 1, 1959)

Lyceum 2nd level (2 years)	Vocational schools (1 year)

Vocational schools (3 years)

Lyceum 1st level (2 years)

Schools of general education (8 years)
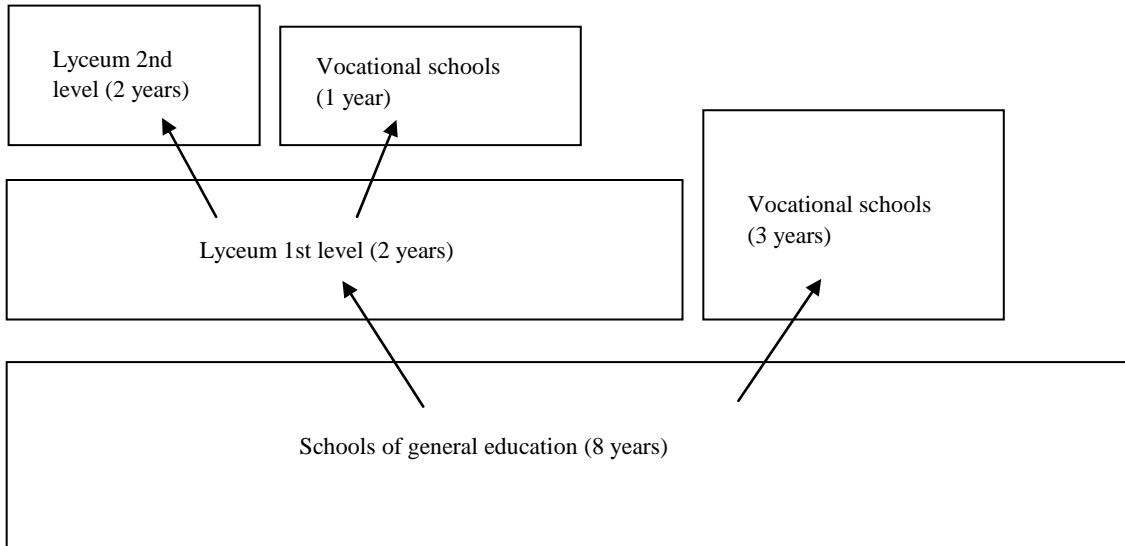
Panel B: After 1973 (Individuals born after January 1, 1959)

Lyceum 2nd level (2 years)	Vocational schools (1 year)

Lyceum 1st level (2 years)

Schools of general education (8 years)
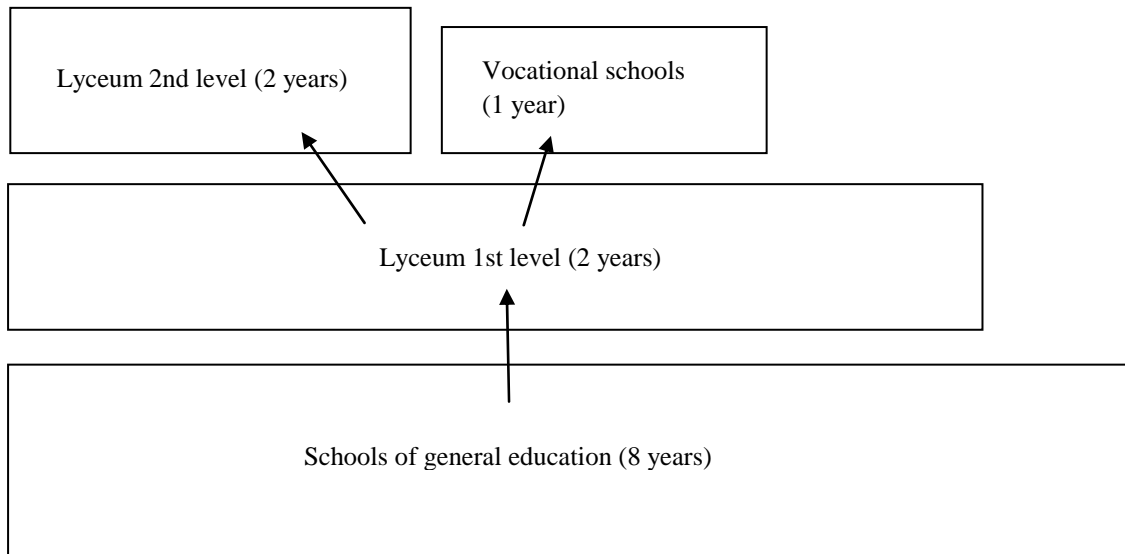
Source: Braham (1978)

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Figure 2: Enrollment in vocational schools and apprenticeships by school-year
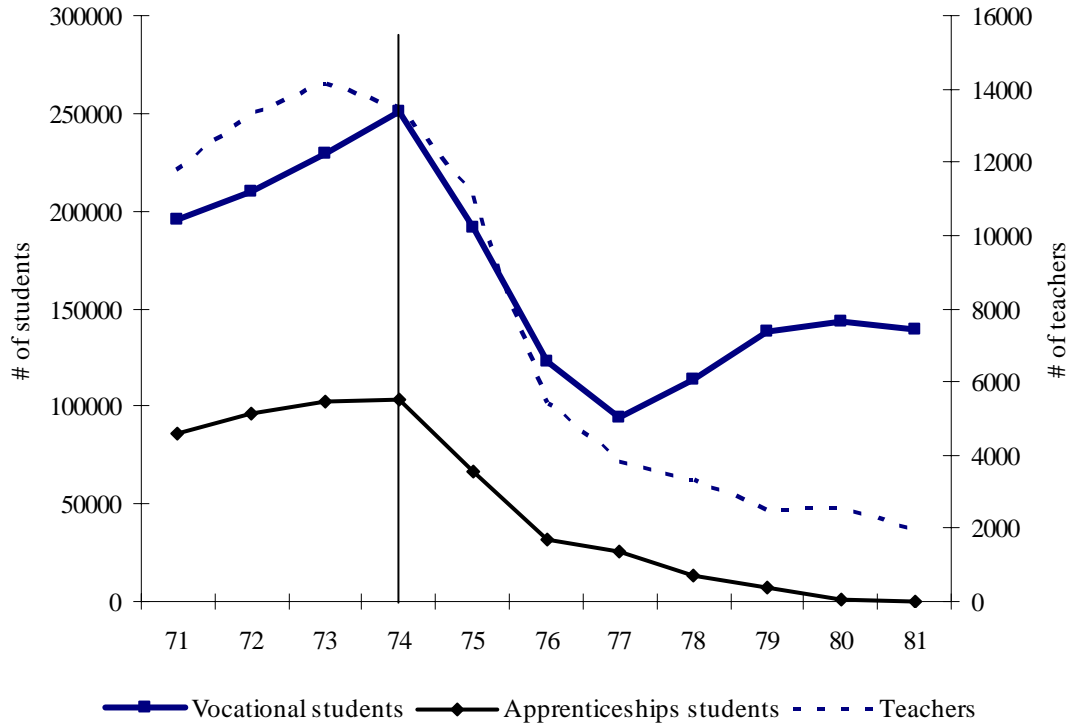
Source: INSSE

Figure 3: Enrollment in lyceums by school-year

Source: INSSE

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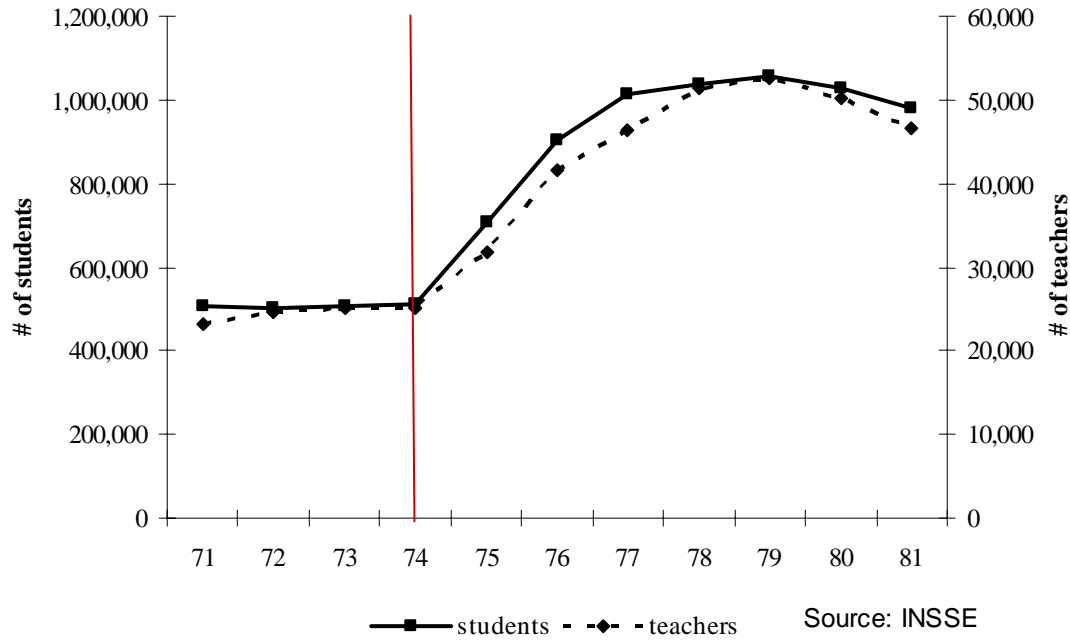
Figure 4: Educational attainment for all individuals by birth cohort (Census 1992)
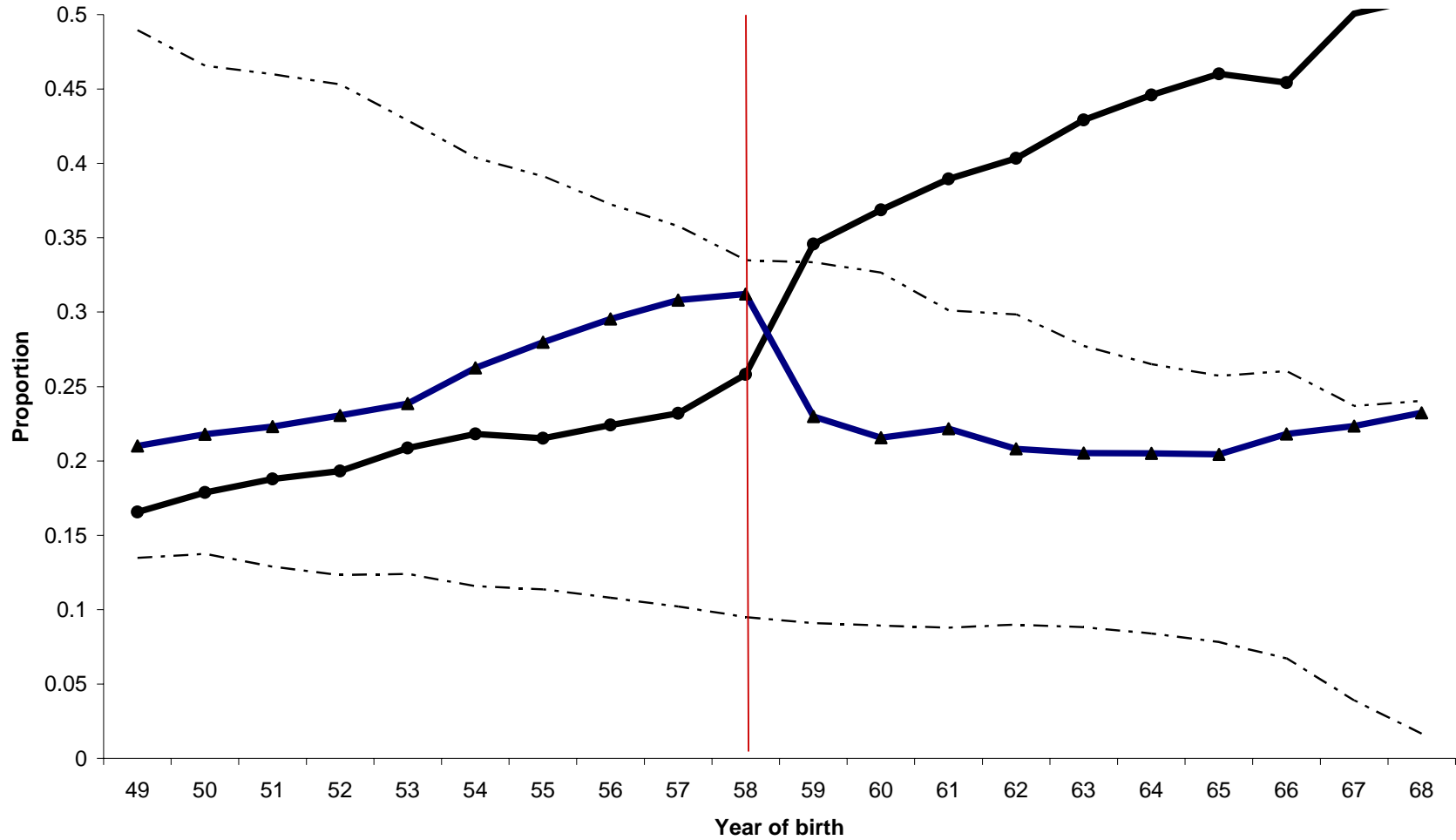
Source: 1992 Census
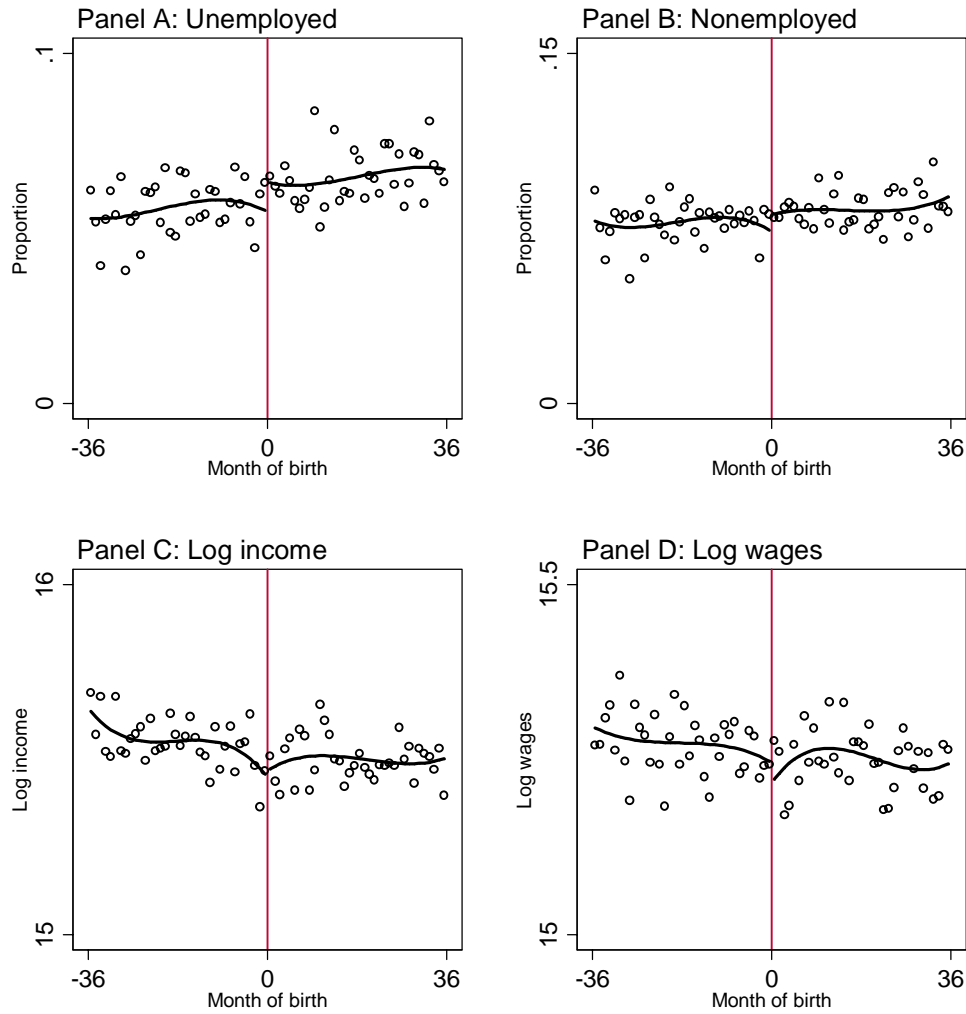
Figure 5: Proportion in Vocational Training and Secondary Level
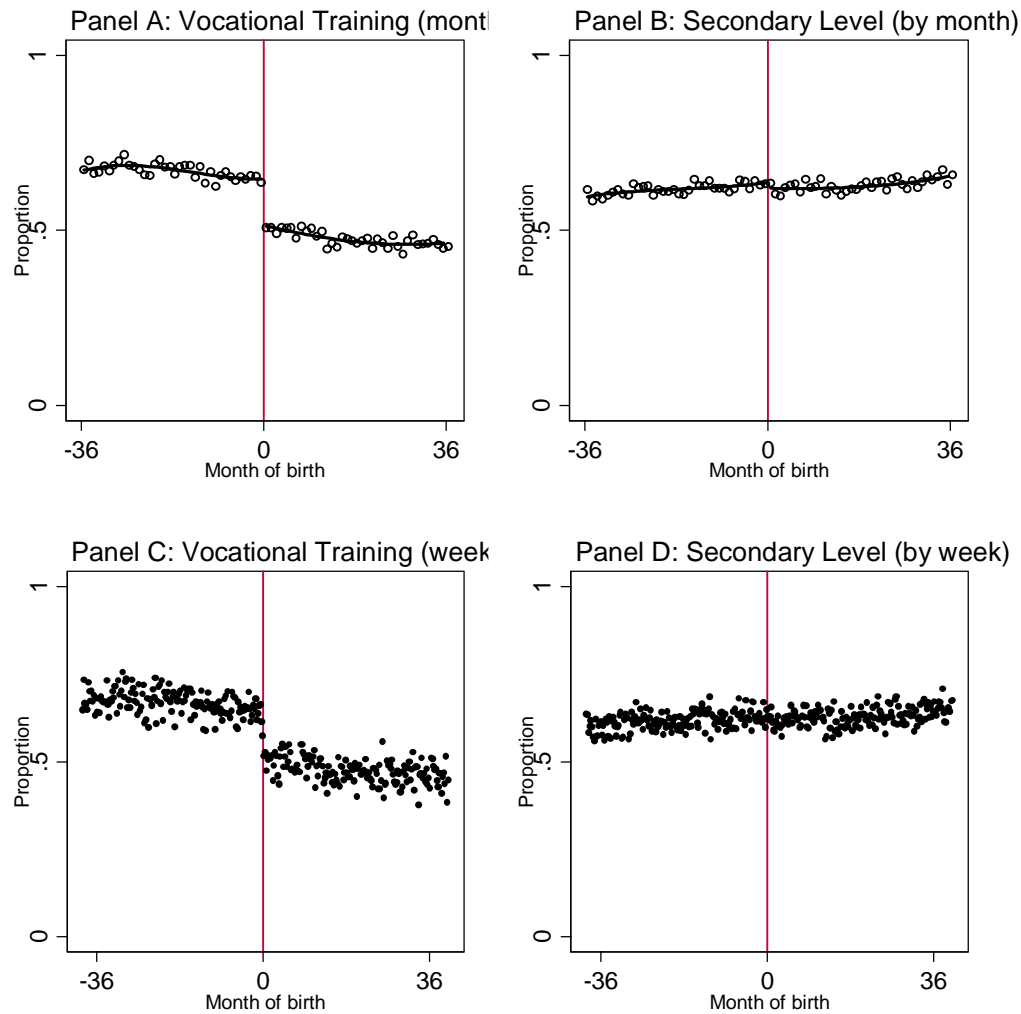
Notes: All panels are restricted to men born between January 1, 1956 and December 31, 1961. Panels A and C are further restricted to men with secondary education (vocational or lyceum). The solid lines are fitted values from regressions of the dependent variable on a cubic polynomial in month of birth. The open circles indicate the fraction of men employed in these occupations by month of birth. Source: 1992 Romanian Census.

Figure 6: Men's Occupational Outcomes in 1992 (by month of birth)
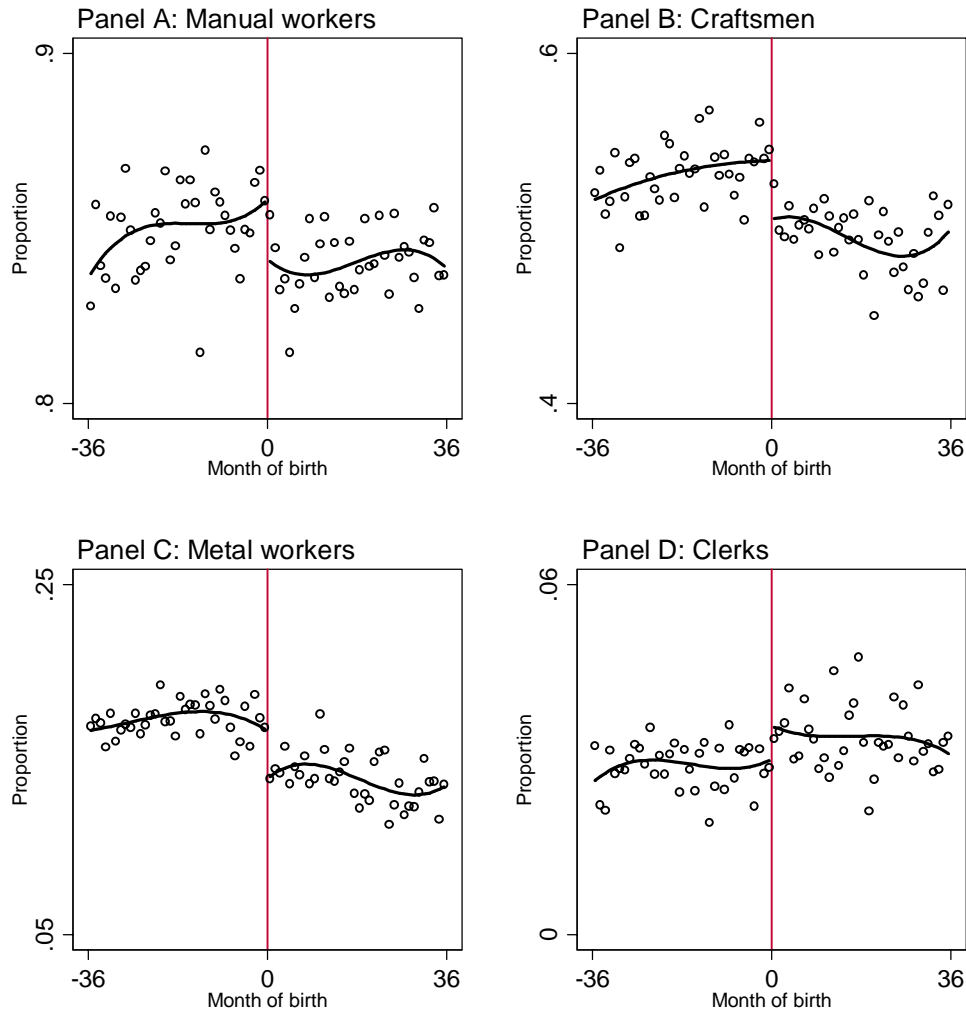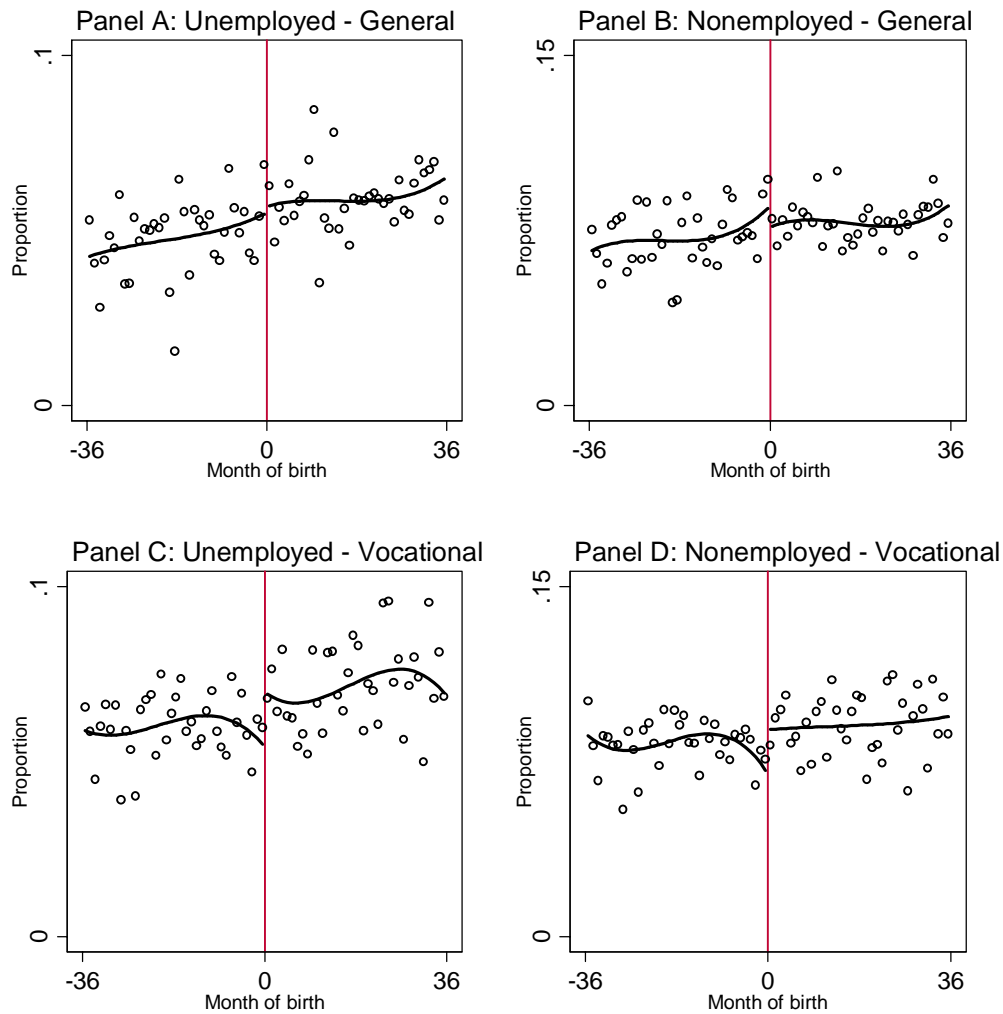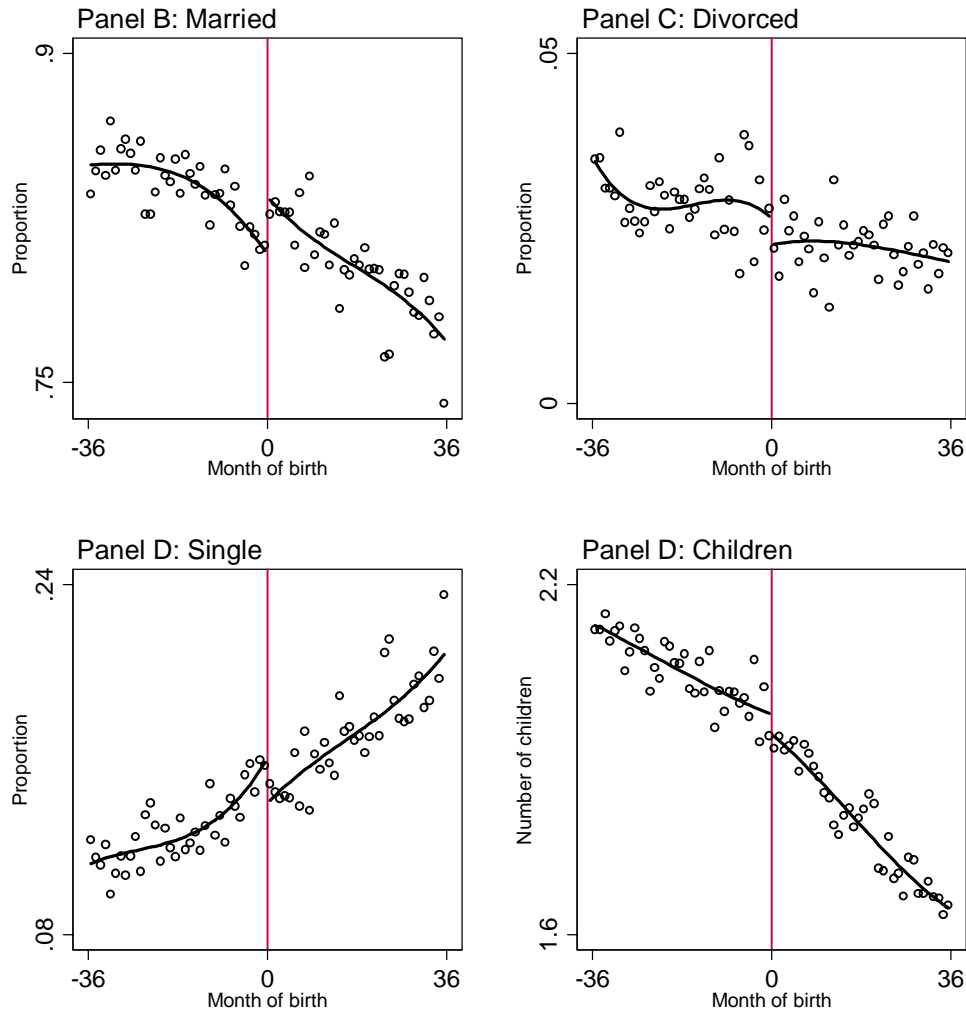

Notes: All panels are restricted to men with secondary education (vocational or lyceum) between January 1, 1956 and December 31, 1961. The solid lines are fitted values from regressions of the dependent variable on a cubic polynomial in month of birth. The open circles indicate the fraction of men employed in these occupations by month of birth. Source: 1992 Romanian Census.

Figure 7: Men's Labor Outcomes in 1992 (by month of birth)

Notes: All panels are restricted to men with secondary education (vocational or lyceum) between January 1, 1956 and December 31, 1961. The solid lines are fitted values from regressions of the dependent variable on a cubic polynomial in month of birth. The open circles indicate the fraction of men that are unemployed and nonemployed, or the average log income and wages by month of birth. Source: 1992 Romanian Census and LSMS 1995-2000.

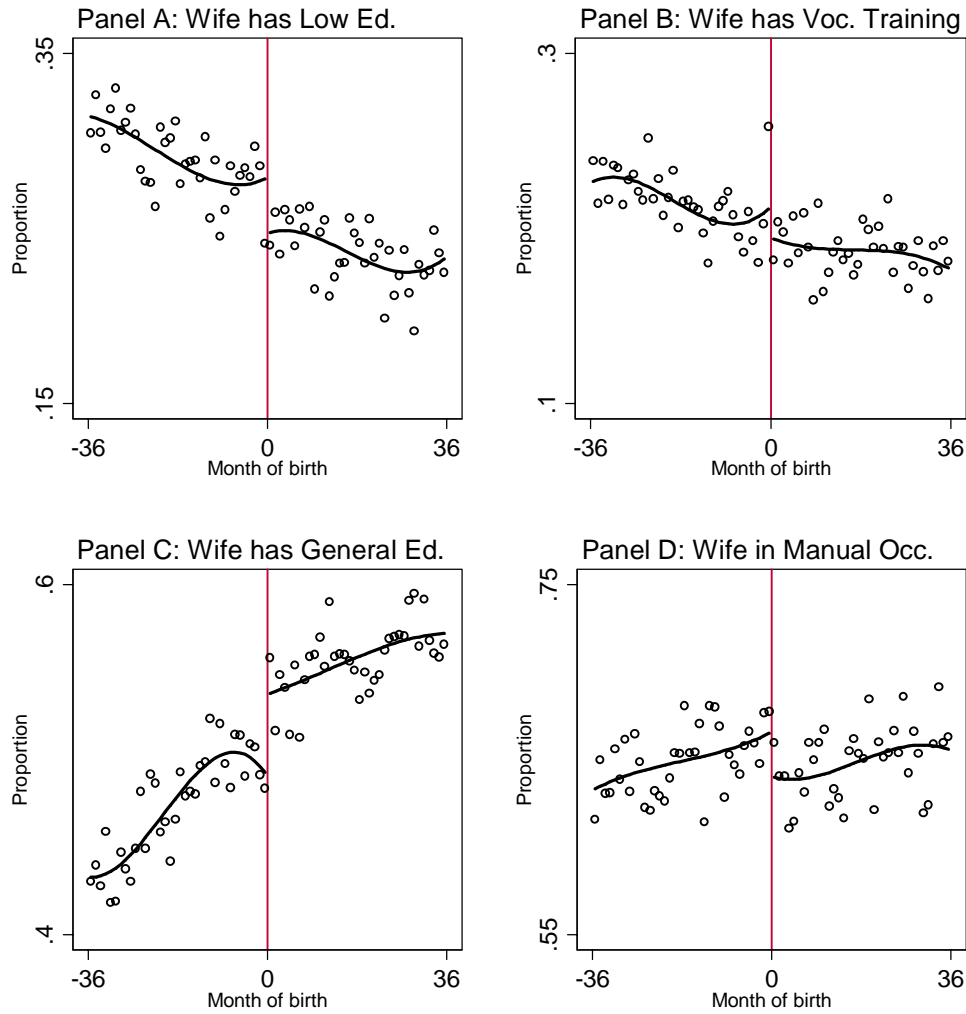Figure 8: Men's Labor Market Outcomes in 1992 by Education

Notes: All panels are restricted to men with secondary education (vocational or lyceum) between January 1, 1956 and December 31, 1961. Panels A and B are further restricted to men with general education while Panels C and D are further restricted to men with vocational training. The solid lines are fitted values from regressions of the dependent variable on a cubic polynomial in month of birth. The open circles indicate the fraction of men that are unemployed or the average log wages by month of birth. Source: 1992 Romanian Census and LSMS 1995-2000.

Figure 9: Men's Marital Outcomes in 1992 (by month of birth)

Notes: All panels are restricted to men with secondary education (vocational or lyceum) between January 1, 1956 and December 31, 1961. The solid lines are fitted values from regressions of the dependent variable on a cubic polynomial in month of birth. The open circles indicate the fraction of men that are married, divorced or single, or the average number of children by month of birth. Source: 1992 Romanian Census.

Figure 10: Men's Spouse Outcomes in 1992 (by month of birth)

Panel A: Wife has Low Ed.

Panel B: Wife has Voc. Training

Panel C: Wife has General Ed.
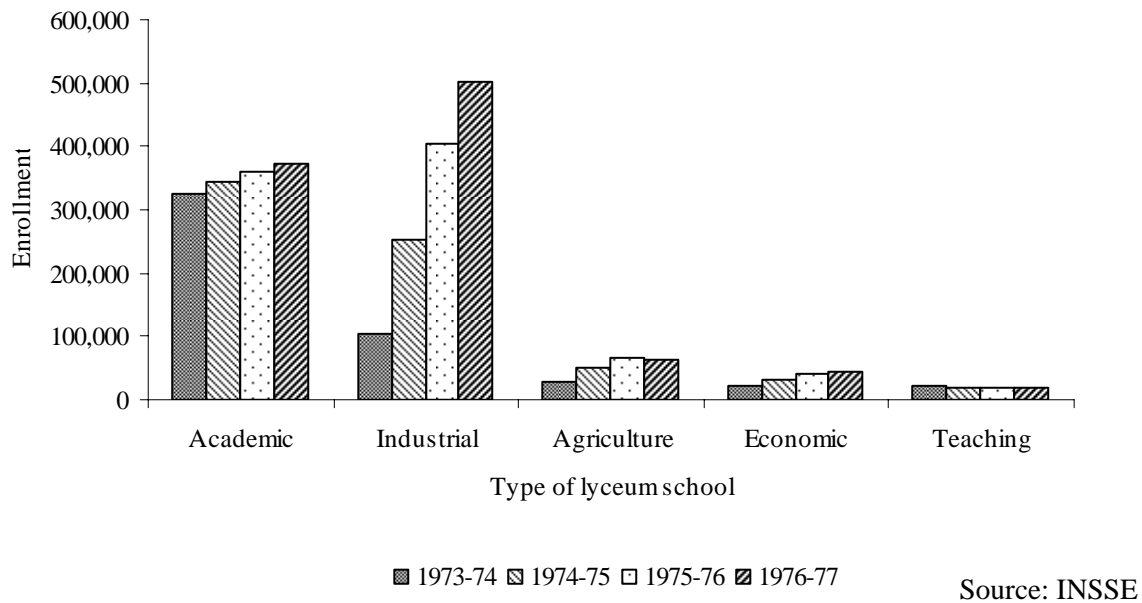
Panel D: Wife in Manual Occ.

Notes: All panels are restricted to wives of men with secondary education (vocational or lyceum) between January 1, 1957 and December 31, 1961. The solid lines are fitted values from regressions of the dependent variable on a cubic polynomial in month of birth. The open circles indicate the fraction of wives in each educational and occupational category by month of birth. Source: 1992 Romanian Census.

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Appendix Figure 1: Change in vocational school enrollment by specialty
from 1973-74 to 1976-77

Type of vocational school

■ 1973-74 ☒ 1974-75 ☐ 1975-76 ▨ 1976-77   Source: INSSE
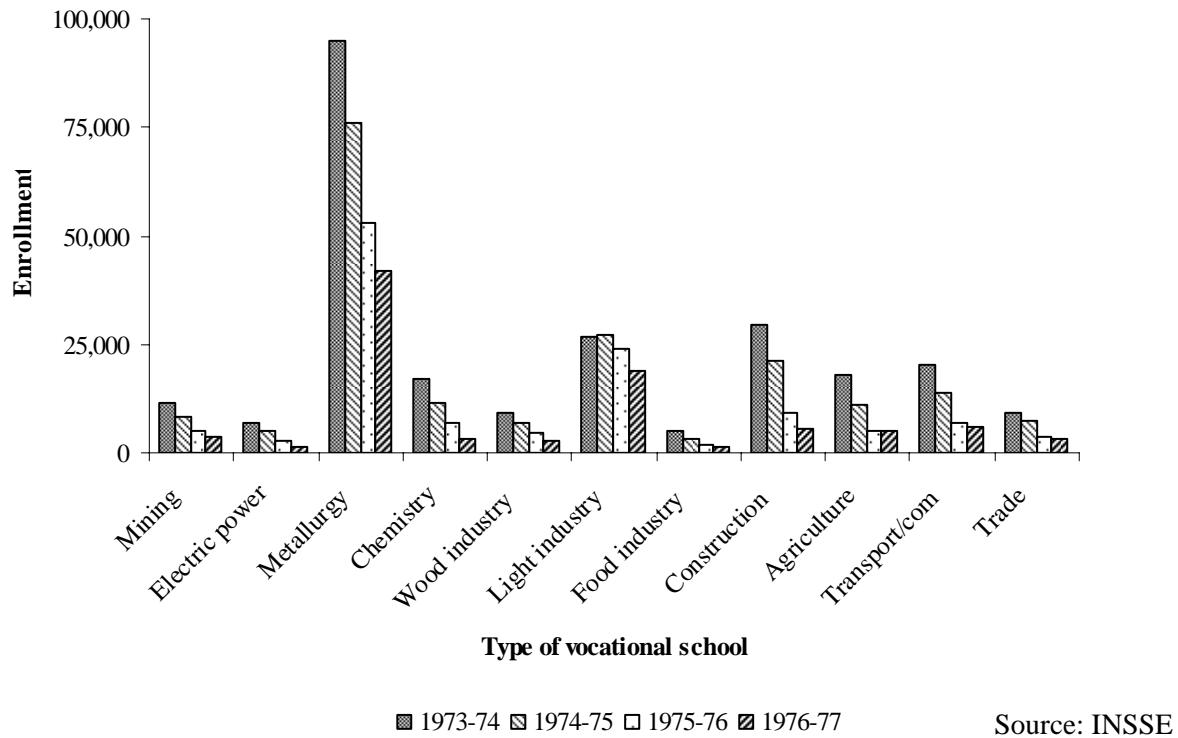
Appendix Figure 2: Change in lyceum enrollment by main specialty from
1973-74 to 1976-77

Type of lyceum school

■ 1973-74 ☒ 1974-75 ☐ 1975-76 ▨ 1976-77   Source: INSSE

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Appendix Figure 3: Recipients of Unemployment Benefits and Unemployment Rate in Romania (1991-2003)

Source: INSSE website

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