Received on: 06 August 2025 Revised on: 25 August 2025 Published: 30 September 2025

RESEARCH ARTICLE
DOI: 10.47703/ejebs.v69i3.547

More Freedom, Less Equality: The Unexpected Economics of Abortion in Central Asia

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How to cite this article:
Kovaleva, I., Taylor, L., Korosteleva, A. & Kudebayeva, A. (2025). More Freedom, Less Equality: The Unexpected Economics of Abortion in Central Asia. Eurasian Journal of Economic and Business Studies, 69(3), 125-139.

Conflict of interest:
author(s) declare that there is no conflict of interest.

ABSTRACT

Few papers about Central Asia explore the economic effects of abortion on women. This econometric paper the objective is to assess whether abortions in Kazakhstan and Kyrgyzstan are associated with women's economic empowerment. The study finds that when abortions increase, measures of female relative income decrease, in both simple correlations and Ordinary Least Squares regressions. The annual series for 2002-2022 and comparable aggregates for the two countries are used (a total of 32 observations on key variables), where the gender pay gap is defined as the ratio of the average incomes of women to the incomes of men. This implied that Kazakhstan and Kyrgyzstan had different permanent institutions, such as the labor market. Instrumental-variable analysis, which controls for the impact of the model itself on abortion estimates, showed that a rise of one abortion per 1,000 live births led to a 2% decrease in the female-to-male ratio of average income. The descriptive part reveals a stable negative relationship between abortions and women's relative income: for the 2011-2022 subsample in Kazakhstan, the simple correlation is about -0.63 (statistically significant), which is consistent with the "constraints" hypothesis. The paper concludes that female economic empowerment in Central Asia may depend more on institutions and social structures than on individuals' short-term reproductive decisions, such as whether to have an abortion. The findings contradict the theory that abortion empowers women economically by freeing them from raising children so that they can pursue education and careers.

KEYWORDS: Abortion Economics, Gender Economy, Gender Pay Gap, Female Labor, Women's Economic Empowerment, Income Inequality, Kazakhstan, Kyrgyzstan

SCSTI: 06.77.97

JEL Code: I14, J13, J16

FINANCIAL SUPPORT: This research has been funded by the Science Committee MSHE RK within the project IRN AP23487405 and the Astana International Financial Center (AIFC) under the Greater Eurasia Research Center (GEAR) initiative.

1. INTRODUCTION

In Central Asia, abortion has been one of the primaries means of birth control since Soviet times. Research has focused on demographic and cultural determinants of abortion, and on its impact on public health. Its economic effects are rarely explored. The paper contributes to the literature with its first detailed comparative study of econometric models. The five models analyzed confirm that, contrary to conventional theory, abortion cannot be treated as an exogenous variable in a study of its economic effects. Abortion is determined by factors, such as education and distribution by age, that also affect the economic position of women directly. To ignore the endogeneity of abortion in economic models would severely misstate its direct impact on women's economic position. This can lead abortion policy astray by suggesting, for example, that the government can adopt the same policy in all areas and without regard to demographics.

Although Central Asia has moved towards modern contraception, its abortion rates remain high (Westoff, 2000; Guttmacher Institute, 2020). This raises a question: Does abortion help women find better jobs by freeing them to pursue education and careers, as conventional theory suggests? Or does abortion perversely strengthen social and institutional barriers to women? For example, abortion may reduce the woman's status in a farm family as someone who raises productive children. The loss of family's support may prevent a woman from pursuing her own career.

Consistent with the theory that abortion reinforces barriers, the literature identifies cultural traditions, together with social stigma, economic insecurity, and healthcare access, that interact with abortion rates (Hilevych, 2015; Johnson et al., 2018; Cooley & Chesnokova, 2011). For example, the lack of a woman's income to raise children may make abortion a clear and sound solution. This, in turn, may weaken her motivation to pursue a lucrative career that would provide for a family for decades to come. Despite such possibilities, few studies examine quantitatively how abortion affects female economic status.

In light of that gap in the research, this paper aims to assess how abortion rates affect the human capital and income of women, relative to men, in Kazakhstan and Kyrgyzstan, which have more data on abortion than the rest of the region. Thus, the objective of this study is to assess whether abortions in Kazakhstan and Kyrgyzstan are associated with women's economic empowerment. Additionally, the paper tests two competing hypotheses:

1. *Empowerment Hypothesis* – Higher abortion rates increase women's relative income by freeing them of childbearing responsibilities, since this enables them to earn diplomas and accumulate work experience that qualifies them for better jobs.

2. *Constraint Hypothesis* – Higher abortion rates decrease women's relative income by depriving them of family and community support for careers. They lose support because the family or community regards raising children as their top priority. Unsafe abortions may also leave women too sick to work.

2. LITERATURE REVIEW

"Culture" can be an elusive term. Thus, religion is cultural because believers largely accept its tenets without debate. However, a marriage arrangement is social, not cultural, because it is an interaction. The distinction between cultural and social factors is important because it influences the appropriate analysis. In neoclassical economics, culture is seen as a result of the economy, rather than the other way around. Certain practices and beliefs persist because they produce something of value at the lowest possible cost. One practice is that a family produces household services through negotiations among its members.

In the neoclassical view, there occur abortions based on gender because the family believes that a male baby is more likely to become an asset to it than a female one. Therefore, many Asian families abort female babies because they prefer male ones (Meh & Jha, 2022). However, Kazakh families do not

abort to eliminate females but to balance family composition (Cooley & Chesnokova, 2011). Perhaps beliefs about family equilibrium persist because they stabilize society; the preference for sons can lead to a shortage of women, making it difficult for families to form.

The neoclassical approach may also explain a recent regional trend in abortions. Historically, ethnic Kazakhs have been much more likely to oppose abortions than ethnic Russians. The nomadic tradition among Kazakhs emphasized children's participation in practical work, although this distinction appears to be fading as the tradition itself evolves. In the Asian part of Russia, abortions rose in the early years of the Russian Federation (Wites, 2004). A transactional approach provides an additional perspective. Muslim women need not choose conservative birth control methods even though Muslims generally prefer conservative family policies (Kan, 2024). Therefore, while culture influences abortion decisions, it rarely determines them. Patrilocal living arrangements limit women's autonomy and reinforce economic inequalities; yet, such inefficient arrangements persist because many rural families in Central Asia remain reluctant to adopt radical change (Kovaleva & Taylor, 2023).

An example of social dynamics is the generation of information, which typically results from discussion. Information deficiencies may lead to abortions. In particular, incorrect contraceptive information causes numerous unintended pregnancies among Muslim youths (Sarsenova et al., 2024). Although Kyrgyzstan's abortion laws are liberal, many women do not know how to obtain a safe abortion (Johnson et al., 2018). Information failures lead to abortion in other permissive legal regimes as well (Sedgh et al., 2016). Education plays a dual role, empowering women economically while also delaying childbearing and decreasing fertility. These offsetting effects complicate decisions about reproduction (Urbaeva et al., 2019). The choice to abort, rather than resort to other methods of birth control, need not shed light on reproductive choice as a path to empowerment (Johnson et al., 2018).

It is not surprising, then, that abortions result from more than traditional gender roles, as Szreter (2002) noted. They also result from a woman's relations with a spouse, which may change over time, and from the presence or absence of autonomy, as noted by Hilevych (2015). For example, in Soviet Ukraine, women viewed birth control as the husband's responsibility. A woman in a troubled marriage may also abort the child out of fear that it will not have a good father. These examples are far from the traditional gender roles.

Demographic factors lie somewhere between cultural and social factors. However, they affect the decision to abort. For example, pregnancies and abortions are much more likely among teens than older groups (UNCRC, 2015). The adolescent birth rate in Kazakhstan has decreased, while modern methods have enabled more women than before to plan their families (United Nations, 2022). Nevertheless, recent regional dashboards show that in Kazakhstan, youths have trouble getting sexual and reproductive health services even though they have a legal right to them (UNFPA, 2023). Globally, unintended pregnancies remain common, and most result in abortions (Bearak et al., 2020).

Economic factors comprise the subset of social factors that stem from trade. Their impact on abortion is indisputable. In Kazakhstan, abortion is legal up to the 22nd week for unemployment or nonmarriage of the woman, according to the International Planned Parenthood Federation European Network (n.d.). In the trans-Caucasian countries of Armenia, Georgia, and Azerbaijan, abortions after the turn of the 21st century stemmed from economic insecurity and shifting preferences in politics (Schief et al., 2024). Recent studies examine how comparable economic limits affect relationships among gender roles, work patterns, and innovation in post-Soviet Central Asia. Kovaleva et al. (2025a; 2025b) investigated the impact of household structures and gender norms on women's participation in labor markets in Kazakhstan and Kyrgyzstan.

Abortion may resolve contradictions in the labour market. When women must do chores at home while pursuing a career, abortion may ease their double burden (Rotkirch & Kesseli, 2010). In rich areas, abortions reduce teen motherhood and strengthen the woman's attachment to the labor force (Angrist & Evans, 1996; Ananat et al., 2009). The strength of such effects varies by race, cohort, and institutional context. This variance leads to caution against the simple extrapolation of global results to Central Asia. Poverty may compel abortions, but these need not raise relative female income much. Drezgić (2010) finds that male-dominant societies flourish despite economic stagnation.

Institutions are rules that change slowly. In Kazakhstan, ignorance, stigma, and institutional weakness make abortions dangerous (Urbaeva et al., 2019). High abortion rates across countries that differed in average income and degree of democracy suggest that Soviet institutions supported abortion. Studying Russia, Belarus, Ukraine, and the three Baltic countries from 1970 to 1994, Mogilevkina et al. (1996) found that annual abortion rates were one in five women. In Kyrgyzstan, abortion services from mid-level providers have improved in remote areas. Telemedicine services beginning in 2023 reduced geographic barriers (Bozgorpoeva, 2024). The problem is to commit resources over time to improve abortion services for the good.

Institutions changed in Kazakhstan as abortions declined sharply. During the transition to a market economy in the 1990s, abortions abounded. A Kazakhstani survey in the mid-1990s found that 37% of pregnancies were aborted, two-thirds of accidental pregnancies ended in abortion (Westoff, 2000). The Demographic and Health Surveys (hereinafter – DHS) from Central Asia revealed "replacement of abortion by contraception" in Kazakhstan, Uzbekistan, and Kyrgyzstan. Abortion rates decreased as the use of modern methods increased. In Kazakhstan, from 1962 to 1980, the annual number of reported and estimated abortions exceeded the number of live births. However, the ratio of abortions to live births fell to one-fifth in 2018 (Johnston, 2025). The Guttmacher Institute (2020) found that unintended pregnancy and abortion rates halved from 1990-1994 to 2015-2019 because of contraceptives and sexual and reproductive health care. These lessons extend to the region (Agadjanian & Dommaraju, 2011).

In conclusion, laws, healthcare, and information systems affect adolescent fertility conditions and reproductive choices in Central Asia. However, aside from a few descriptive statistics, the literature is discursive. This paper will contribute to econometrics.

3. METHODOLOGY

Before specifying the mathematical form of the regression model, it is necessary to describe the dataset and the procedures applied to prepare it for estimation. The analysis focuses on the period from 2002 to 2022, based on the available official data. Gaps in the dataset between 2010 and 2020 were filled by linear interpolation of missing HCI and HDI values. Interpolation over short gaps is justified because HCI and HDI are slow-changing indicators that usually follow monotonic trends. Without interpolation, the missing values would reduce the number of usable observations (Newbury, 1981). Already, there are no more than 23 annual observations. To check the accuracy of the linear interpolation, the authors also modeled the time trends as piecewise rather than linear. This did not change the signs of correlations. To further check for robustness, the analysis combines data from Kyrgyzstan to that from Kazakhstan by using country dummy variables.

A mathematical model is to be fitted to the regressions. A mathematical approach enables the identification of control variables and the formulation of the regression model carefully. Otherwise, any combination of controls and functions is possible. Ambiguity must be avoided because the limited number of observations restricts the number of explanatory variables that can be included, including controls not directly tested in the

hypotheses. In this dataset, the small sample size requires judicious selection of explanatory variables.

The model considers whether the accumulation of education or work experience following the abortion could raise average income for women, relative to men. To measure the gender pay gap, the following formula was used (1):

$$Pay\ Gap(t) = \frac{women_{inc(t)}}{men_{inc(t)}} \qquad (1)$$

where:

t – time period (year) in the panel dataset;

$women_{inc(t)}$ – average real income of women at time t;

$men_{inc(t)}$ – average real income of men at time t.

The paper seeks to determine how abortion will affect *Pay Gap*. *Abortions* are an independent variable explaining the *Pay Gap*, a dependent variable. The following formula was used (2):

$$Pay\ Gap = b * Abortions \qquad (2)$$

The model relates the pay gap to relative human capital accumulated by a woman since the abortion. The idea behind the Empowerment Hypothesis is that postponing children, or refraining from having them, allows acquiring education and work skills. This capital raises income level of women relative to a men's. The following formula was used (3):

$$k(t_1; t_0) = \int_{t0}^{t_1} dk(s)\ ds \qquad (3)$$

where:

k (t_1; t_0) – the amount of human capital that the woman accumulates by time t_1;

dk(s) – the increase in the capital at time *s*;

t_0 – the onset of capital accumulation; under the Empowerment Hypothesis, t_0 corresponds to the abortion event.

Three variables pertain to the hypothesis: Abortion, female human capital, and the gender pay gap. The gender pay gap is represented by *Pay Gap(t)*. Nevertheless, there is only enough data to estimate the response of *Pay Gap* to either abortion or capital, but not both. Since data are more precise on abortion than on capital, the regression will estimate the impact of abortion on *the Pay Gap and assume a positive relationship between capital and the Pay Gap.* In other words, in the hypothesized relationship of abortion => capital => *Pay Gap*, the regression estimates the relationship between abortion and *Pay Gap* and assumes a positive link between capital and *Pay Gap*. Given that assumption, a positive relationship between abortion and the *Pay Gap* is consistent with the Empowerment Hypothesis and evidence against the Constraint Hypothesis. A negative relationship between abortion and the *Pay Gap* has the reverse interpretation.

Increases in female human capital may reduce the gender pay gap because productivity growth is faster for women than for men. Especially in developing countries, initial productivity is lower for women than for men due to their initial involvement in unskilled occupations. As women acquire skills, the catch-up in their human capital raises their income, relative to men. The following formula was used (4):

$$PayGap(t) = a + b * Abortions(t - i) + c * x(t) + e(t) \qquad (4)$$

where:

a – the intercept, reflecting determinants of *Pay Gap* that are constant over the period studied, such as the educational system. Such institutions are too large to change quickly;

$Abortions(t - i)$ – the abortions lag which permits capital to affect the gender pay gap eventually;

c – vector of coefficients;

x(t) – vector of other independent variables at time *t*.

e(t) – the residual.

The abortion rate indirectly measures the woman's opportunity costs from childbearing. Women who delay childbearing tend to invest more in education, which enhances their job prospects and career opportunities. The proposed regression assumes that women have

similar educational trajectories in rural and urban settings so that abortion would have the same impact on female human capital in either locale.

The education lag, part of the capital lag, aligns with research findings that educational outcomes affect fertility decisions (Angrist & Evans, 1996; Ananat et al., 2009). The theory for distinguishing between the one-year lag and the five-year lag is that even recent education or work experience may significantly raise the relative female income. However, the impact may be less than that of capital created five years ago, which has had cumulative effects on income or development.

The paper specifies a one-year lag to capture short-term effects because this is the shortest possible lag with annual data. In contrast, a five-year lag is the most considerable lag feasible with the available data, since no more than 16 such lags would be possible. Using both short and medium lags also checks that the findings are robust.

Lagging the abortion rate also rules out the possibility that the coefficient *b* measures the impact of capital on abortions rather than the other way around. Greater economic development could well lead women to avoid abortions. That is, the relationship between development and abortions could run in either direction. Since that would make the interpretation of *b* ambiguous, we exclude the possibility of observing how development affects concurrent abortions by using the lag of abortions.

To measure the gender gap, in addition to the average-income ratio in Equation (1), the study uses two proxies: the Human Capital Index (HCI) for women, as reported by the World Bank (2025), and the Human Development Index, as reported by the United Nations. This use of two checks makes robust findings about any connection between abortion and the gender gap. The HCI measures labor productivity in relation to a worker's education and health, compared to a worker with a complete education and perfect health. Higher numbers indicate greater productivity.

The analysis also estimates the correlation between the lagged abortion rate and the broad Human Development Index, as defined by the United Nations Development Programme. The HDI equally weights affluence, education, and health (United Nations Development Programme, 2022). Higher values denote greater human development.

This paper assumes that, consistent with (4), larger HDI values are correlated with smaller gender pay gaps. That is, countries with more human development should have more equal pay for women relative to men. Nevertheless, another possibility stems from the fact that one component of the HDI reflects purchasing power for both sexes. Abortions have offsetting effects on this average real income. On the one hand, they can increase female human capital, thereby raising the average female income relative to that of homemakers. This could raise the average income. On the other hand, abortions also increase labor supply by encouraging female entry into the labor market.

4. RESULTS AND DISCUSSION

This section presents the findings in stages of increasing complexity, making them easier to comprehend. The first findings are for the simple correlation between abortion and the gender gap. Then, moving through ever-more advanced models, each stage of the analysis targets a different econometric concern: Correlation and OLS for transparency, FE and RE for heterogeneity, and 2SLS for endogeneity.

The asterisks in Table 1 denote the years used to calculate the correlations between the HCI and HDI with the five-year lag of abortions in the original dataset, which ended in 2020 and covered Kazakhstan but not Kyrgyzstan. The bottom of Table 1 refers to these correlations as "base-year." The simple correlation between the HCI and lagged abortions is -.55. This is not statistically significant at the 10% level of significance. Neither is their evidence that abortions lead over the medium term to human development

TABLE 1. Correlation of linear HCI, HDI and abortion rate

Year	HCI (W)	HDI (W)	Aborts(t-5)
2010	0.629	0.594	29.1
2011	0.651	0.616	30
2012	0.672	0.639	30.3
2013	0.694	0.661	28.1
2014	0.715	0.683	25.6
2015	0.737	0.705	23
2016	0.758	0.728	20.7
2017	0.78	0.75	20.8
2018	0.808	0.777	18.4
2019	0.73	0.703	18.3
2020	0.652	0.629	17.9
correlation* (base years)	-0.55	-0.59	
correlation (all years)	-.63	-.86	
(i) Years marked with "*" are base years used for comparative correlation analysis. (ii) Compiled by the authors using Stata.			

Note: compiled by the authors based on the Bureau of National Statistics (2024), World Development Indicator (2025)

as measured by the HDI. This correlation is -.59. It is statistically insignificant at the 10% level of significance.

Table 1 also shows that the number of abortions per fertile woman declined rather steadily from 2010 through 2020. This may be due to improvements in other methods of birth control. Westoff (2000, p. vii) writes, "The evidence that the increase in contraceptive practice and the decline in abortion have continued is unmistakable and strong."

The Table 1 analysis of the base years uses a tiny dataset. Thus, the lack of statistical significance in the base-year correlations could be due to the imprecision of the data rather than to the lack of a genuine relationship between abortion and female income or human development.

Nevertheless, with linear interpolation of the HCI and HDI for the missing years, the study can use all annual data for abortions since 2010. The bottom row of Table 1 refers to the correlations across these 11 observations as the all-years correlations.

The analysis obtains a simple correlation of -.63. This is statistically significant at the 5% level of significance (the critical value in absolute terms is .602). Table 1 also gives similar estimates for the HDI. Here, the correlation for the 11 observations is -.86. This is also statistically significant at the 5% level of significance. These correlations contradict the Empowerment Hypothesis and are consistent with the Constraint Hypothesis.

Approximations that increase the degrees of freedom.

In Table 2, a one-year lag of abortions relates negatively and significantly to relative female income.

TABLE 2. OLS Regression Results of Pay Gap on Abortion Rates (One-Year Lagged and First-Differenced)

Variable	(1) AbortLag	(2) DiffAbort	(3) DiffAbLag
Intercept	82.618*** (6.464)	-0.183 (0.937)	0.085 (1.272)
AbortLag	-0.615* (0.304)		
DiffAbort		-0.973 (0.552)	
DiffAbLag			-0.465 (0.736)
R^2	0.291	0.237	0.042

Adj. R^2	0.220	0.161	-0.064
Observations	12	12	11
(i) Dependent variable: Pay Gap. (ii) Model (1) uses abortions per 1,000 live births lagged by one year; (2) uses the first-differenced abortion rate; (3) uses the first-differenced lag of the abortion rate. (iii) Standard errors in parentheses. (iv) * p<0.10, ** p<0.05, *** p<0.01. (iv) Compiled by the authors using Stata.			

Note: compiled by the authors based on the Bureau of National Statistics (2024)

Differentiating the concurrent and one-year lag of Abortions to remove confounding factors does not produce significant results.

For robustness, the second column of Table 2, titled AbortLag, regresses the pay gap on a one-year lag of abortions per 1,000 live births with annual data in Kazakhstan for 2011-2022.

The pay gap is the ratio of the average female income to the average male income, expressed as a percentage point. The coefficient on the pay gap is negative and statistically significant at the 10% level of significance. The impact is also quite significant in a practical sense: An additional abortion per 1,000 live births decreases the pay gap by more than six-tenths of a percentage point. This result contradicts the Empowerment Hypothesis and is consistent with the Constraint Hypothesis. However, the R-squared value is low, at 0.291. This statistic indicates that the model explains only 29.1% of the variation in the pay gap over the dataset. Evidently, the model does not identify the most important determinants of the pay gap. Additionally, the intercept, 82.618, is both statistically and practically significant. This indicates that factors are independent of both abortions and time.

Some factors may correlate with both the pay gap and the abortion rate, obscuring the proper relationship between these two variables. One solution is to take first differences of all variables. The first difference is the change in a variable over a unit of time. Taking first differences removes a linear time trend from the variables. One can then examine the relationship between abortions and female income directly. The third column of Table 2, titled "DiffAbort," regresses the first difference of the pay gap on the first difference of concurrent abortions (DiffAbort) per 1,000 live births, using annual data for Kazakhstan. The abortion coefficient remains negative, albeit slightly less statistically significant at the 11% level of significance, rather than 10%. The impact is significant in a practical sense: A positive change in abortions from one year to the next lowers the pay gap changes over that year by about one percentage point. However, abortion is not the primary factor in the pay gap. According to R-squared, it accounts for less than a fourth of the variation in the annual change of the pay gap over time.

The fourth column of Table 2, titled DiffAbLag, regresses the first difference of the pay gap on the first difference of the one-year lag in abortions (DiffAbLag). The coefficient is negative (-.465) but highly insignificant. The model accounts for only 4% of the variation in the first difference of the pay gap over time. One may discard this model.

In the third and fourth columns of Table 2, the intercept does not differ significantly from zero. This is to be expected. First differencing eliminates the intercept, since it remains constant over time.

Overall, Table 2 suggests that even after controlling for confounding factors in the regression, there is no evidence that abortions, either concurrent or with a one-year lag, affect the pay gap outside of the sample. This contradicts the Empowerment Hypothesis, but it agrees with the Constraint Hypothesis.

In sum, the authors find no evidence so far that abortions increase female human capital or human development. But the small number of observations in Tables 1 and 2 limits the power of the results. The model below expands the dataset to include Kyrgyzstan and Kazakhstan.

A dummy variable (KAZ) controls for the country's permanent characteristics. KAZ

equals 1 for Kazakhstan observations and 0 for Kyrgyzstan observations.

Extending the dataset to Kyrgyzstan.

In Table 3, Pearson's correlations show that abortions relate negatively and insignificantly to female relative income.

TABLE 3. Descriptive statistics and correlations of all variables used in the analysis

Variable	Mean	Std. Dev.	Min	Max	Simple Correlations
Pay Gap	69.766	4.680	62.459	78.4	Abortions = -0.284 (0.115); KAZ = -0.064 (0.727); Year = 0.644* (0.0001)
Abortions	115.329	91.957	15.9	296.11	Pay Gap = -0.284 (0.115); KAZ = -0.865*** (0.000); Year = -0.781*** (0.000)
KAZ	0.406	0.499	0	1	Pay Gap = -0.064 (0.727); Abortions = -0.865*** (0.000); Year = 0.452* (0.009)
Year	2013	5.521	2002	2022	Pay Gap = 0.644* (0.0001); Abortions = -0.781*** (0.000); KAZ = 0.452* (0.009)

(i) There are 32 observations for every variable.
(ii) Correlations are reported with p-values in parentheses.
(iii) An asterisk "*" indicates statistical significance at the 5% level.
(iv) Compiled by the authors using Stata.

Note: compiled by the authors based on the Bureau of National Statistics (2024), World Development Indicator (2025)

This income also exhibits a positive and significant time trend, but it does not correlate significantly with institutions in either Kazakhstan or Kyrgyzstan.

Table 3 presents significant relationships between institutional and temporal variables and the gender pay gap. The *Year* variable shows a positive and significant relationship with *Pay Gap* (r = 0.64), indicating that gender income inequality has decreased over time. However, the Kazakhstan dummy variable *KAZ* has a strongly negative and significant connection with abortion rates (0.72), suggesting that national institutions influence reproductive choices. Compared to Kazakhstan, institutions in Kyrgyzstan are more positively correlated with abortions. This is probably because Kyrgyzstani women are poorer than Kazakhstani women, so they have fewer safe alternatives to abortion. Also, abortion does not increase income equality between genders. The correlation between *Abortions* and *the Pay Gap is negative (-0.284*) and statistically insignificant at the 10% level of significance.

The correlation between *Year* and *Abortions* is negative and highly statistically significant. Abortions in the two-country region are falling over time, perhaps because of improvements in medical technology that provide safe birth control. Finally, the positive correlation between *Year* and *KAZ* means that the unbalanced panel has more observations for Kazakhstan than for Kyrgyzstan.

Comparing the fixed-effects and random-effects models.

In Table 4, the Hausman test finds that the fixed-effects model better suits the analysis of the impact of abortion on relative female income than does the random-effects model. The results showed that Kazakhstan and Kyrgyzstan have distinct institutional structures. The fact that abortion rates are higher in Kyrgyzstan than in Kazakhstan raises the possibility that the two countries have different healthcare institutions. A more general question is: Are two neighboring countries in Central Asia truly different? If they are, then the fixed effects model is better.

TABLE 4. Panel regression of pay gap on abortions using fixed effects and random effects

Variable	(1) Random Effects	(2) Fixed Effects	(3) Hausman Test
Abortions	-0.01447 (0.0089)	-0.068*** (0.014)	Difference = -0.0541 (0.0105)
Constant	71.435*** (1.306)	77.676*** (1.710)	
R^2 (overall)	0.081	0.081	
Observations	32	32	
Groups (KAZ)	2	2	
Hausman χ^2			26.38 (p=0.000)

(i) Dependent variable: Pay Gap.
(ii) Model (1) reports random effects GLS estimates, Model (2) fixed effects estimates, and Model (3) Hausman specification test.
(iii) Coefficients reported with standard errors. (iv) * p<0.10, ** p<0.05, *** p<0.01. (v)
(iv) Compiled by the authors using Stata.

Note: compiled by the authors based on the Bureau of National Statistics (2024); National Statistical Committee of the Kyrgyz Republic (2025)

The FE model would permit permanent characteristics of Kazakhstan to differ from those of Kyrgyzstan by using a different intercept in the model for each country. The intercept reflects the impact of the institutions on relative female income. However, suppose Kazakhstan and Kyrgyzstan do not differ. In that case, the random effects model treats variations in characteristics of both countries as accidental and fleeting, as "noise." Both countries have the same expected intercept, but their actual values differ by a random error. For example, Kazakhstan and Kyrgyzstan could have the same basic health institutions. However, Kazakhstan could have a greater impact on relative female income because of an arbitrary belief that abortions are safer there.

The Hausman test determines whether the random-effects or fixed-effects model is the better one. In the random-effects approach, both countries follow the same model; differences in the characteristics of the two countries are unsystematic and peripheral. In that case, the random and fixed models should produce similar coefficients, because they stem from the same basic model. When the coefficients are sufficiently close, the random-effects model is the appropriate specification. However, if the coefficients of the two countries differ, then they do not follow the same basic model; their permanent institutions are significantly different. For example, the philosophy guiding Kazakhstan's educational system may be more practical than that of Kyrgyzstan. In that case, the fixed-effects model provides a better specification. The null hypothesis of the Hausman test is that the coefficients of the two countries are equal, indicating that the random effects model is suitable.

The abortion coefficients from both the fixed and random effects models (Table 4) are negative but significant only for the fixed-effects model. This is consistent with the recurring conclusion of this paper that abortions do not increase relative female income. Nevertheless, the important point at the moment concerns the bottom right-hand cell in Table 4. The p-value of the Hausman test is effectively zero. Therefore, the authors reject the null hypothesis that the random-effects model is a better fit than the fixed-effects model. Notably, Kazakhstan and Kyrgyzstan differ in their structures. The pay gap is influenced more by country-specific factors than by regional factors.

In principle, the Hausman test may not be consistent because of the endogeneity of Abortions. Because abortions correlate with the error term, their coefficient may measure the impact of the error term as well as the impact of abortions per se. Any difference in the abortion coefficients between the fixed- and random-effects models may mislead the reader,

even when the sample size increases indefinitely. This paper analyzes endogeneity below. However, suppose the fixed-effects model is indeed superior to the random-effects model. In that case, political factors are vital to national institutions, as Kazakhstan and Kyrgyzstan share the same geography and history.

Analyzing endogeneity. The Hausman test in Table 5 suggests that *Abortions* may be endogenous to a fixed-effects model of the impact of abortion on relative female income, so it requires an instrument. However, the dataset does not satisfy the asymptotic restrictions of the Hausman test.

TABLE 5. OLS and IV estimations of the regression of pay gap on abortions

Model / Variable	(1) OLS	(2) 2SLS (IV)	(3) Wu-Hausman Test
Abortions	-0.0081 (0.0254)	-0.088*** (0.016)	
KAZ			
Year	65.285*** (0.238)		
Constant	-1240.355***(482.53)	79.89*** (1.99)	
R^2	0.362	0.081	
Observations	32	32	32
Hausman/Wu Test			$\chi^2(2)$=-16.77

(i) Dependent variable: Gender Pay Gap.
(ii) Model (1) reports OLS estimates with heteroskedasticity test and VIF diagnostics. Model (2) shows 2SLS random-effects IV regression, using KAZ and Year as instruments for abortions. Model (3) reports the Wu-Hausman test for endogeneity of abortions.
(iii) Coefficients reported with standard errors. (iv) * p<0.10, ** p<0.05, *** p<0.01.
(iv) Compiled by the authors using Stata.

Note: compiled by the authors based on the Bureau of National Statistics (2024); National Statistical Committee of the Kyrgyz Republic (2025)

The OLS specification represents the baseline model, which assumes that all independent variables are exogenous and their values do not depend on the model itself. In contrast to OLS is the model in the third column (titled 2SLS (IV)). Here, the abortion rate depends on factors that are part of the error term. Thus, the coefficient on the endogenous variable may reflect not only the variable's impact on the dependent variable but also the impact of the error term. This biases the coefficients.

The justification for the instruments is as follows: The year captures an exogenous temporal decline in abortion rates associated with modernisation. At the same time, the Kazakhstan dummy reflects institutional differences between the two countries. Both instruments correlate with abortion rates but plausibly do not correlate with the error term.

The instrumental approach is implemented by estimating a two-stage least squares model. In the first stage, Abortions are instrumented by *Year*. *Year* affects Abortions negatively, reducing the abortion rate by more than one-third of an abortion per 1,000 live births per year. The Kazakhstan dummy variable *KAZ* increases the *abortion* rate more than sixfold. Both effects are highly significant statistically. The second stage regresses *Pay Gap* on the instrumental variable version of *Abortions*. The results indicate that the impact of the instrumented *Abortions* is large, negative, and highly significant. At an estimated mean abortion rate of 15.5, Abortions reduce the relative female income by more than 40%. The *KAZ* coefficient is large, positive, and highly significant. Kazakhstani institutions raise relative female income by almost a seventh of the mean.

Is the two-stage least squares approach the right choice? If the independent variable was not endogenous to begin with, then two-stage least squares is needlessly complex. To determine whether Abortions are endogenous, the authors use the Wu-Hausman test. It

compares OLS to a model that is accurate regardless of whether Abortions are endogenous. OLS assumes that Abortions are not endogenous. If the OLS model produces coefficients that are like those in the model that is always accurate (IV), then it is not essential to treat *Abortions* as endogenous. The simpler OLS model gives similar results.

The Wu-Hausman test is applied to two random-effects equations, one estimated by IV and the other by OLS. The random-effects model is chosen because it performs better than the fixed-effects model. Usually, for a chi-squared test value of the magnitude obtained, the Hausman test would support that Abortions are endogenous. Moreover, the authors argue that since the fixed-effects model is superior to the random-effects model, institutions in the two countries differ, which would be consistent with the endogeneity of Abortions. How abortions affect female income depends on the constitution, the legal system, and other national institutions that differ between the two countries.

In sum, the Wu-Hausman results reject the Empowerment Hypothesis and align with the Constraint Hypothesis. The findings also suggest that reproductive health decisions are at least partly determined by factors that are difficult to measure and therefore appear in the error term. An abortion policy can have unexpected consequences. Finally, regional institutions and characteristics affect female income. However, abortions have little effect on it; the R-squared value is only 0.08 (Ozili, 2023).

5. CONCLUSIONS

This paper examines whether abortion in Kazakhstan and Kyrgyzstan functions as an instrument of women's economic empowerment or is associated with constraints on relative female income; our evidence is more consistent with the latter. A plausible channel is lower subsequent human-capital accumulation among women with past abortions. For example, women with higher education may be less likely to have abortions due to greater access to effective contraception and safer alternatives; likewise, abortions may be more prevalent among women with stronger preferences for child-rearing over tertiary education or market work, who use abortion primarily to avoid higher parity. While our estimates are robust across specifications, they should be interpreted as associations rather than definitive causal effects.

Policymaking would benefit from closing data gaps: each country should field a nationally representative household survey on reproductive behavior and labor outcomes every two years (renewing instruments analogous to Kyrgyzstan's LiK, discontinued after 2019) and publish annual, gender- and age-disaggregated demographic series by ethnicity and by method of birth control to enable credible monitoring and policy evaluation.

Three more areas are essential:

(1) Expansion of modern contraception, along with sexual education, to decrease unintended pregnancies.

(2) Vocational training, access to colleges, and childcare support to smooth the transition from school to work for young women.

(3) Village health kiosks and national online diagnosis services that can be accessed by phone, to provide accurate information and steer patients to clinics for treatment if needed.

Reproductive freedom is an essential right, but it does not automatically lead to economic equality across genders. Reaching equality requires more statistics and case studies.

Future research needs to focus on three essential directions for expansion. The analysis requires panel datasets that include detailed information about individual and household characteristics to study differences between various age groups, educational backgrounds, ethnicities, and urban and rural areas. The inclusion of sectoral outcomes between formal and informal labor markets and occupational segregation in econometric models would enable researchers to determine how abortion impacts women based on their economic options. Research that compares Kazakhstan and Kyrgyzstan to other transition economies

in Eastern Europe, South Asia, and the Caucasus region will establish whether the findings of this paper represent a unique case or a global pattern. The combination of quantitative analysis with qualitative interview data in mixed-methods studies would enable researchers to understand how social stigma, family expectations, and institutional barriers influence the economic effects of abortion.

Future policy development should support the UN Sustainable Development Goals by aligning reproductive health initiatives with education programs, labor market improvements, and institutional development.

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