

An aggregate economic value perspective on Korea's marriage decline

– Transitory and secular

Jung Hyuk Lee^{a*}, Jin Seok Park^b, and Seungwoo Chin^c

^a*Ministry of Economy and Finance, Sejong, Korea;*

^b*Department of Economics, University of Southern California, Los Angeles, USA;*

^c*Ministry of Economy and Finance, Sejong, Korea*

* Jung Hyuk Lee; leejunghyuk@korea.kr, (+82) 010-4923-6554

Abstract:

Marriage rates in Korea have been declining at an unprecedented pace in the recent two decades. Drawing on the classical economic theory of marriage as a rational choice, we compute local aggregate economic values of prime-age working men and women to examine the relationship between the relative values of men and marriage rates. The relative values of men fell dramatically by 40% during this period, undermining the economic justification of marriage under unequal allocation of housework. The two-way fixed-effects estimation using region-year transitory variations shows that a 1% decrease in the relative values of men was associated with a 0.088% decrease in marriage rates. To explain the precipitous convergence of economic values between both genders, we decompose the changes in the relative values into four components – (gender-neutral) structural changes, (gender-specific) industrial segregation, (gender-neutral) wage growth, and (gender-specific) wage gaps within industries – to measure their contributions to secular marriage decline. In the 2000s, both the alleviated industrial segregation and the structural changes toward industries with higher female proportions played a major role. On the other hand, the impact of reduced gender wage gaps within industries became also prominent in the 2010s.

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Keywords: Marriage decline; Korea; Becker; Economic values; Structural change

1. Introduction

Korea's marriage rates have been declining fast. In 2020, the crude marriage rate was recorded at 4.2 in 1,000 populations, the lowest among East Asian countries. The pace of the decline, 40% in the recent two decades, was as dramatic as the society's symbolic economic growth. In contrast to the thick literature on the fertility decline in Korea, that focuses on marriage has been relatively sparse. Within a similar context, the Korean government's policy measures have been more focused on “family policies,” incentivizing married couples to have more children. However, in societies where childbirth outside of marriage is scarce, the extensive margin (marriage *per se*) can have stronger implications on fertility than the intensive margin (childbirth conditional on marriage).

Although Korea's marriage rates are moving downward in secular trends, they are not declining without fluctuations. These transitory fluctuations motivate us to ascribe them to economic conditions, separated from other potential sources of marriage decline, including cultural changes. How much of the marriage fluctuations and secular marriage decline can be explained by economic factors, particularly the changes in the labor market conditions and structure? To answer this question, we draw on Becker's classical economic theory of marriage as a rational choice. The Becker theory emphasizes *production complementarities* as an economic justification for marriage. When men have higher earnings in the labor market, and women have a comparative advantage over home production, both parties can be benefit by forming a family and specializing in each of the different types of work. Since these gains from trade can be maximized when spouses

have greater differences in skill sets, negative assortative mating occurs in a way that men's better economic prospects in the labor market result in a higher chance of marriage, while those of women have a negative impact on marriage. Although empirical evidence on the negative assortative mating is mixed in advanced economies, the recent literature argues that the importance of Beckerian production complementarities in family formation depends on societal contexts, necessitating country-specific evaluations.

The idea of testing the Becker theory with local-level labor market proxies is nothing new. Researchers have tested an empirical relationship between gender-specific labor market shocks and marriage using unemployment or labor force participation variables. However, we highlight the limitations of this approach in measuring the economic prospects of both genders. The economic eligibility of partners in marriage is affected not only by their employment status but also by *wages*. The analysis exploiting only variations in employment overlooks the fact that the substantial portion of convergence in economic values between both genders has come from reduced gender wage gaps (Blau & Kahn, 2017). Within this context, we merge various administrative survey datasets and calculate *aggregate economic values* of prime-age men and women by multiplying the number of employment and average wages to construct an age-gender-industry-region-specific panel dataset from 1998 to 2020.

The national level calculation of the relative economic values of men over women shows that there has been around 40% decline in the past two decades, which is almost the same magnitude as that of the marriage decline. The convergence came from a relatively faster increase in women's employment, as well as reduced gender wage gaps. To evaluate the impact of the changed relative values of men on marriage rates, we implement a set of two-way fixed-effects regressions with local (Sido) level relative values. The result is that a 1% decrease (increase) in the relative values of men (women) was associated with 0.088% reductions in marriage rates, robust to the inclusion of various control variables and region-specific linear trends. Assuming the linearity of the impact, we conclude that approximately one-eighth of the decline in secular marriage trend is explained by the convergence of economic values.

The advantage of our aggregate economic value perspective expands to the decomposition of the convergence. Exploiting gender-industry level variations in the economic values, we decompose the changes into four components – (gender-neutral) structural changes, (gender-specific) industrial segregation, (gender-neutral) wage growth, and (gender-specific) wage gaps within industries, all of which could theoretically reduce gender gaps in economic values.

Our strategy of comparing the actual trajectories of the relative values to the counterfactual ones under four scenarios corresponding to each component reveals that all four components contributed with distinct magnitudes across decades. In the 2000s, the first two employment components played a major role. In other words, both the increased share of female-dominated sectors in total employment and reduced employment segregation within industries had brought about higher relative values of women. On the other hand, in the 2010s, while the employment structural changes within and across industries continued, substantial reductions in gender wage gaps occurred within industries.

This study contributes to three areas of research. First, it provides a novel strategy to empirically test the Becker theory by considering variations in both employment and wages simultaneously. The previous approaches addressing only one of them – employment (Schaller, 2013; Schaller, 2016; Dorn, Hanson, & others, 2019) or wages (Zhang & Liu, 2003) had limitations on assessing the full implications of changing gender-specific labor market conditions for marriage, especially during ongoing

transformations in both dimensions. Our approach provides a simple but powerful tool to systematically decompose the economic prospects of both genders into the four essential components to account for their impact on family formation. To the best of our knowledge, this is the first attempt to directly evaluate the role of gender-specific structural changes in an economy in demographic transitions.

Second, it empirically supports the recent development of the Becker theory that underscores societal contexts. The theory has been criticized for its lack of empirical support in advanced economies despite its theoretical clarity (Lam, 1988; Sweeney, 2002). The recent literature has tried to reconcile the discrepancy by considering additional factors that either strengthen or weaken Becker's theoretical predictions. One promising direction is to adopt gender norms that work as a psychological cost for women even when they have a comparative advantage over men in the labor market (Akerlof & Kranton, 2000; Bertrand, Cortes, Olivetti, & Pan, 2021). We examine the implications of the convergence of economic prospects between both genders in an East Asian context with strong gender norms, providing coherent empirical support for sociologists' views which ascribe East Asia's marriage decline to “tensions between rapid socioeconomic changes and slower changes in social norms” (Raymo, Park, Xie, & Yeung, 2015).

Third, within a Korean studies context, we fill the gap in the demographic analysis of Korea in the most recent decades and explain the precipitous drop in marriage rates in the 2010s. Partly due to the data constraints, most literature on Korea's marriage or fertility analyzes the trends before the 2010s or the mid-2010s at the latest (Raymo & Park, 2020; Lee, Klein, Wohar, & Kim, 2021; Yoon, Lim, & Kim, 2021). Instead of relying on time-lagged census data, we merge various administrative surveys to construct up-to-date panel data to document an additional wave of marriage decline in the past 10 years.

2. Background

2. 1. A rational choice theory of marriage

The economic theory of marriage as a rational choice was outlined in Gary Becker's seminal works (Becker, 1973; Becker, 1991). His theory is based on *production complementarities* where a husband and a wife specialize in the market and domestic spheres, respectively. When a man has a comparative advantage over winning bread and a woman has it over home production, the two identities have the economic justification for forming a household and maximizing their utility by division of labor. Within this context, men's better economic prospects in the labor market are positively correlated with their likelihood of getting married, while that of women is negatively associated.

On the other hand, the literature after Becker has argued that the relationship between the relative socioeconomic status of both genders and marriage is far from monotonic. In advanced societies, women's human capital attainments have begun to exceed that of men, and technological advancements have dramatically reduced the amount of time spent on household labor (Greenwood, Seshadri, & Yorukoglu, 2005). In addition, having children became a matter of post-marital choice due to the availability of birth control pills (Bailey, 2006).

Since the core assumption behind the Becker theory – (i) a comparative advantage of men in wage-earning power and (ii) gains from trade – has been undermined, evidence

shows that women with higher labor market prospects are not necessarily less likely to get married in advanced societies (Sweeney, 2002; Blossfeld, 2009). In those settings, the economic rationale for marriage is more understood as consumption complementarities or insurance against uncertainties than production complementarities (Stevenson & Wolfers, 2007).

Within this context, the recent literature has tried to reconcile the discrepancies by focusing on conditions that bring about differential implications of gender-specific economic prospects for family formation. One example is a recent comparative study (Bertrand, Cortes, Olivetti, & Pan, 2021) that explicitly adopts a gender norms component in the model and documents the heterogeneity in the evolution of the marriage gaps between skilled and unskilled women over time across countries. According to their account, while the “U-shape” relationship is observed in the marriage gap between skilled and unskilled women by birth cohort in the U.S. and Western European countries, the pattern does not emerge in East Asian and Southern European countries with more conservative gender norms. In those societies, the relative deficit of skilled women in the marriage market is more pronounced, and the relationship between women's economic prospects and marriage tends to remain negative.

All in all, the implications of gender-specific economic prospects for marriage remain to be a matter of societal contexts. In the next section, we explain Korea's context in terms of steep declines in both marriage and gender gaps in the labor market.

2.2. Korea's context

2.2.1. Marriage decline

As shown in Figure 1 (a), Korea's marriage rates have been declining since it reached its peak in 1980. The slope had been relatively flat until the mid-1990s and became steeper downwards since then. As a result, it dropped by 40% from 7.0 in 2000 to 4.2 in 2020.

In Panel (b), we compare the trends of marriage rates by region. All regions show remarkably similar secular trends toward lower marriage. On the other hand, there also has been substantial heterogeneity in transitory fluctuations across regions. For example, before 2010, there had been clear decoupling of marriage rates between urban and rural regions. However, marriage rates converged to a narrower range across regions in 2020, diminishing regional distinctions. The differential trends not only indicate that there are region-specific factors affecting marriage rates that can be separated from nationally common trends but also allow us to use those variations for identification, as outlined in Section 3.

2.2.2. Gender gaps

The Korean labor market is known for its remarkable proportion of college-educated, high-skilled workers. About 70% of the total adult population aged 25 to 34 has degrees in higher education, which is the highest among OECD countries (OECD, 2020). Like most other OECD countries, this proportion is higher for women (76.5%) than men (63.8%).

On the other hand, Korea is at the top among those countries in another criterion, a gender wage gap in the labor market (OECD, 2021). The gender wage gap calculated as the difference between median earnings of men and women is 32.5%, 2.5 times larger

than the OECD average of 12.8%. Women's labor participation rate is 75.5%, lower than the OECD average of 77.3% in 2020. A strong M-shape is observed in the labor force participation by age group, indicating that Korean women tend to quit their jobs after marriage or childbirth and come back to less favorable work positions (Lee, Jang, & Sarkar, 2008).

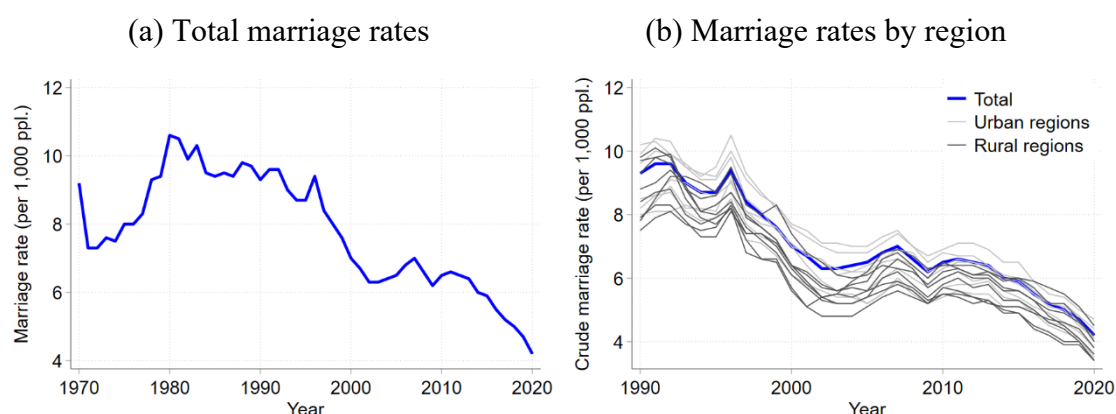


Figure 1. Trends in marriage rates. Source: Korea Census Vital Statistics.

To explain this coexistence of high educational attainment of women and severe gender gaps, researchers have focused on both occupational segregation by gender and within-occupation/industry wage differences. Like many other countries (Anker, Melkas, Korten, & others, 2003; Blau, Brummund, & Liu, 2013), there is a substantial distinction between *men's jobs* and *women's jobs* in Korea, and the former pays more than the latter. Although occupational segregation of the total workers has been alleviated throughout the past 20 years, the reduction was concentrated on low-skilled occupations (Sa, 2015) and was accompanied by the deteriorating quality of women's jobs within those occupations (Kim & Voos, 2007).

Even more severe segregation by gender is found within Korean households. It is reported that Korean wives spent an average of 23.6 hours on household labor in 2014, while their husbands spent 3.6 hours (Lee J. H., 2024). Evidence shows that this extreme specialization of gender roles in households is pervasive even for dual-earning couples (Hwang, Lee, & Lee, 2019) and throughout parenthood transitions (Kim & Cheung, 2019). Many researchers have ascribed this phenomenon to historical and cultural contexts of East Asian societies, including gender norms based on Confucianism and agricultural tradition (Palley, 1990; Qian & Sayer, 2016).

3. Changing relative economic values and marriage rates

3.1. Trends in the economic values of prime-age men and women

Empirical tests on Becker's theory of marriage with aggregated datasets have been

implemented with proxy variables for the economic prospects of each gender in the local labor market. For example, Dorn, Hanson, & others (2019) compared the number of U.S. employment of each gender at the commuting zone level and ascribed the marriage decline during 1990-2014 to the decrease in the relative economic status of young men (over young women), prompted by negative labor demand shocks in the U.S. manufacturing. Similarly, Schaller (2013) studied the relationship between unemployment rates at the state level and fertility, concluding that improvements in men's labor market conditions increased fertility, while those in women's labor market had negative effects on fertility. Following those studies that inherit the Beckerian perspective, our core underlying assumption is that the labor market equilibrium reflects the production complementarities between genders. More specifically, men's (women's) comparative advantage in the labor market (home production) results in relatively higher (lower) labor market engagement and market-oriented human capital investments.

However, using employment statistics has limitations in that the economic prospects of men and women are determined not only by employment but also by wages. For example, if women only desire men with higher earnings than themselves, an increase in male employment with lower wages might not expand the pool of eligible partners. This notion is particularly important considering that the gender gaps in the modern labor market have been closing in both dimensions (Blau & Kahn, 2017). Within this context, we calculate the aggregate *economic values* of prime-age men and women in the local labor market. The total (national) economic values of prime-age men and women are conceptually defined as the total number of prime-age workers of each gender multiplied by their average market wages. This approach enables researchers not only to properly take two important drivers of changing economic prospects into account but also to decompose the changes into the contribution of each component.

To set up formally:

$$\begin{aligned} Value_{gt} &= Employment_{gt} \times Wage_{gt}, \quad g \in \{m, w\} \\ &\equiv \sum_j \sum_i (Employment_{ijgt} \times Wage_{ijgt}) \end{aligned}$$

where $Employment_{gt}$ is the number of the prime-age (defined as ages 25 to 39)¹ employment of gender g in year t , and $Wage_{gt}$ is the average wage of gender g in year t . The second line of the equation means that the $Value_{gt}$ is equivalent to the sum of region-industry specific values. More specifically, the national aggregate economic values of prime-age men equal the sum of the economic values of men in industry i in region j . Therefore, if we have an age-gender-industry-region-specific panel dataset of employment and wages, we can use this decomposition for empirical evaluations.

To construct the dataset at the region (Sido) level,² we merge three administrative surveys provided by the Korean statistical agency – the Economically Active Population Survey, the Establishment Status Survey, and the Labor Conditions Survey. The Establishment Status Survey provides the number of employees by region, gender, and industry, and the Labor Conditions Survey provides average wages by gender and

¹ 77% of men and 78% of women who got married in 2020 were in this age group.

² As of 2020, there are 17 Sidos in Korea. Since Sejong was independently included in the marriage data from 2012, we incorporated it into Chungbuk throughout our analysis.

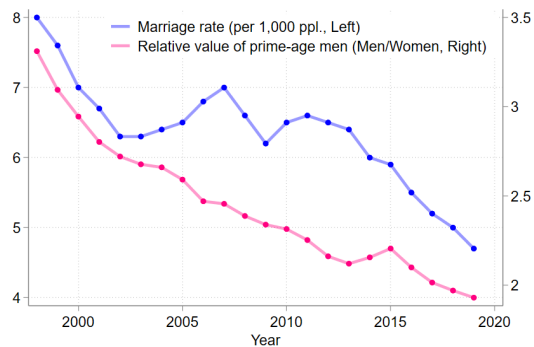
industry. The number of prime-age workers of each gender is calculated by multiplying the proportion of employment in that age group from the Economically Active Population Survey. The time span of the available data is recent 22 years, from 1998 to 2019.

Table 1. Data construction

	Description	Data used
The Economically Active Population Survey	A monthly survey of labor force participation, employment, and unemployment	The number of the employed by age, gender, and region (sido)
The Establishment Status Survey	A monthly survey of employment and wages of the establishments	The number of the employed by gender, industry, and region (sido)
The Labor Conditions Survey	An annual survey of employment conditions and labor market arrangements	The average wages by gender, industry, and tenure

The left panel of Figure 2 compares the trajectories of the relative economic values of prime-age men over women (i.e., $Value_{mt} / Value_{wt}$) and the national (crude) marriage rates. The relative value declined by 42% in the recent two decades, from 3.3 times for women in 1998 to 1.9 times in 2019. This trajectory shows a remarkably similar pattern with the decline in marriage rates during the same period, which dropped by 41%, from 8.0 per 1,000 population to 4.7. This indicates that the reduced economic merits of marriage from a Beckerian perspective coincided with a substantial marriage decline in Korea.

(a) Relative values vs. marriage rates



(b) Decomposition of the decline

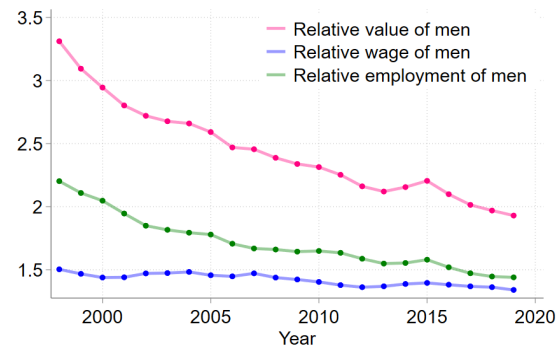


Figure 2. The trajectory of the relative economic values of prime-age men over women, computed by authors. Source: Economically Active Population Survey, Establishment Status Survey, and Labor Conditions Survey (Korean Statistical Information Service).

The right panel decomposes the decline in the relative values, showing that it came from decreases in both the relative number of employment and the relative (real) wages of men compared to women. More specifically, approximately 2.5 million men and 1.2 million women of prime age were employed in 1998. Thus, the relative number of employment was 2.20. By 2019, women's employment showed a steeper increase to 2.3 million, while men's employment increased to 3.3 million, making the relative number of employment 1.44. During the same period, the real wages of women increased by 97%, outpacing those of men which increased by 75%. As a result, the relative wages decreased from 1.50 to 1.34.

Notably, this close relationship between the relative economic values and marriage rates cannot be directly understood as the impact of the former on the latter, since there is a concern on endogeneity. In the following section, we explain the key potential issues in identification and introduce our empirical strategies to address them.

3.2. Impact of changing economic values on marriage rates

3.2.1. Empirical strategy

The key problem in identifying the impact of changes in the relative economic values of men on marriage rates is a potential omitted variable bias. For example, there might exist other nationally common factors that affect both economic values (employment and wages) and marriage which explain the similar trends shown in Figure 2.

To address this issue, we use region-year variations with 16 regions (Sido) and 22 years (1998 - 2019) to estimate the following two-way fixed effects model:

$$\ln(\text{MarriageRate}_{jt}) = \beta * \ln(\text{RelValue}_{jt}) + \alpha_j + \gamma_t + \omega_j * T + \theta * X_{jt} + \epsilon_{jt}$$

where MarriageRate_{jt} is the crude marriage rate in region j at year t , RelValue_{jt} is the relative values of prime-age men compared to women (equals $\text{Value}_{mt} / \text{Value}_{wt}$), α_j is region fixed effects, γ_t is year fixed effects, and ϵ_{jt} is a random error term. Standard errors are clustered at the region level.

This specification captures the association between *transitory* fluctuations of the relative economic values and marriage rates, in that the variations are used for estimation after the nationally common trends in marriage decline (year fixed effects) and time-invariant regional characteristics (region fixed effects) are controlled for. In our preferred specification, we also include the interaction term between region fixed effects (ω_j) and year (T) to capture any of linear region-specific time trends.

Although all time-invariant and linear regional characteristics are absorbed by the fixed effects, we include a set of potentially time-variant variables that can non-linearly affect marriage rates. Those region-year level control variables (X_{jt}) are the proportion of prime-age men and women among the population, the proportion of adults with tertiary education, sex ratios of second childbirth, (log) housing price index, (log) Gross Regional Domestic Product (GRDP), and (log) GRDP per capita. Including the proportion of prime-age men and women among the population is important because there could have been differential changes in the pool of eligible marriage partners across regions. Educational attainment and housing price are commonly adopted control variables that have established empirical relationships with marriage rates in the literature. The sex

ratios of second childbirth are used as a regional proxy for gender norms since traditional son preference in East Asian countries resulted in higher sex ratios at birth. Finally, (log) GRDP and GRDP per capita were controlled because of the potential elasticity of economic values of men and women to the aggregate average income and industry-specific average income. The descriptive statistics of the key variables in the dataset are presented in Appendix Table 1.

3.2.2. Results

Table 2. Regressions of marriage rates on the relative economic values

Dependent variable: (Log) Marriage rates						
	(1)	(2)	(3)	(4)	(5)	(6)
(Log) Rel. value	0.216** (0.075)	0.248** (0.074)	0.088* (0.043)			
(Log) Value of men				0.232*** (0.072)	0.348*** (0.113)	0.161*** (0.063)
(Log) Value of women				-0.150** (0.062)	-0.152*** (0.046)	-0.043 (0.049)
Share of prime-age men			1.921 (1.273)			2.076 (1.201)
Share of prime-age women			-1.937 (1.417)			-2.426 (1.546)
Share of tertiary edu.			-0.229 (0.306)			-0.314 (0.318)
Sex ratio of 2nd child			0.001 (0.001)			0.001 (0.001)
(Log) Housing price			-0.008 (0.040)			-0.007 (0.038)
(Log) Real GRDP			0.412*** (0.121)			0.345** (0.140)
(Log) Real GRDP per capita			-0.062 (0.113)			-0.037 (0.116)
Controls	No	No	Yes	No	No	Yes
Region time trends	No	Yes	Yes	No	Yes	Yes
Adjusted R^2	0.935	0.947	0.958	0.936	0.950	0.958
Obs.	352	352	352	352	352	352

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors clustered at the region level are in parentheses.

Table 2 shows the results of the estimated panel two-way fixed effects model³. Our preferred model result, columns (3), shows that a 1% change in the relative economic values of men was *positively* associated with approximately 0.088% changes in marriage rates, robust to the inclusion of various controls and region-specific linear time trends. In other words, transitory fluctuations of the relative economic values *within* each region over 20 years could explain a statistically significant portion of marriage changes in those regions. Under the assumption of linearity of marriage rate change, we can calculate the contribution of the converging economic values to the decline in secular marriage by using the magnitude of the estimated coefficient. In other words, around a 42% decline in the relative value in the past two decades is associated with around 2.6% drop in annual percent change of the relative value⁴. If we apply the estimated annual elasticity of the marriage rate with respect to the relative economic value, the marriage rate impacted by the relative economic value would decrease by 0.229% annually. By applying this to the crude marriage rate of 8.0 in 1998, the estimated marriage rate in 2019 is 7.6. Hence, out of the total marriage rate change from 8.0 to 4.7, approximately one-eighth (0.38 points per 1,000 population) can be explained by the reduced relative economic values of men alone under our model assumptions.⁵

Columns (4) to (6) show the results with (log) economic values of men and women ($Value_{mt}$ and $Value_{wt}$), instead of the relative values. The results support the Beckerian negative assortative mating in that men's economic values are *positively* associated with marriage rates, while those of women are *negatively* associated. Within the same context as what Bertrand, Cortes, Olivetti, & Pan (2021)'s cross-country comparison indicates, the socioeconomic improvement of each gender (either in employment or wages) bears the opposite consequences on marriage under Korea's severely skewed gender norms.

In Table 3, we check the robustness of our results by running the same regressions with conventional proxy variables of economic prospects – local unemployment rates and labor force participation (LFP) rates. In these specifications, the coefficients for men's economic prospects are positively and statistically significantly associated with marriage rates. In our preferred models, presented in columns (2) and (4), the coefficient on the male unemployment rate is negative and significant at the 1% level, while the coefficient on the male labor force participation (LFP) rate is positive and also significant at the 1% level. In contrast, the relationship between women's economic prospects and marriage rates is imprecisely estimated. Negatively significant coefficients of women's economic values in Table 2 and insignificant coefficients of women's employment in Table 3 indicate the important role of wages in the relative economic prospects of both genders, verifying the validity of our economic values approach.

³ We provide a correlation matrix of the variables of the estimation model in Appendix Table 2.

⁴ From the calculation of $(1.9/3.3)^{(1/21)} - 1 = r$, we have an annual percent change of -0.026.

⁵ Note that there exist substantial discrepancies among estimated coefficients in Columns (1) to (3) and Columns (4) to (6). Particularly, the inclusion of log GRDP and log GRDP per capita as controls affected the results, suggesting that there might remain endogeneity stemming from the relationship between marriage rates and aggregate average income level that was not completely addressed in our specifications. Due to the data constraints, we could not adopt further measures to address the issue and chose the most conservative results for our interpretation.

Table 3. Regressions of unemployment/LFP on marriage rates

Dependent variable: (Log) Marriage rates				
	(1)	(2)	(3)	(4)
Unemp. rate (men)	-0.006 (0.006)	-0.009*** (0.004)		
Unemp. rate (women)	0.008 (0.009)	-0.001 (0.004)		
LFP (men)			0.008* (0.004)	0.008*** (0.002)
LFP (women)			-0.003 (0.002)	0.000 (0.002)
Controls	No	Yes	No	Yes
Region time trends	No	Yes	No	Yes
Adjusted R^2	0.927	0.958	0.931	0.960
Obs.	352	352	352	352

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors clustered at the region level are in parentheses.

4. Decomposition of trends in the relative values

4.1. Components of the economic values

In the previous section, we provided empirical evidence on the relationship between transitory fluctuations of economic values and marriage, which conceptually corresponds to the regional variations around the secular trends in marriage decline shown in Figure 1 (b). Now, we move our focus to the secular trends and analyze what caused the steep decline in men's relative economic values in the past two decades. Our economic value approach provides a useful tool of analysis in that it enables us to decompose the decline into four potential drivers of the changes – i) (gender-neutral) structural changes of employment, ii) (gender-specific) industrial segregation by gender, iii) (gender-neutral) wage growth, and iv) (gender-specific) wage gaps within industries – by construction.

Formally, the change in the relative economic values of prime-age men over women at time t' ($\Delta RelValue_{t'}$) can be defined as:

$$\begin{aligned} \Delta RelValue_{t'} &= RelValue_{t'} - RelValue_t \\ &= \frac{\sum_i (W_{imt'} * E_{imt'})}{\sum_i (W_{iwt'} * E_{iwt'})} - \frac{\sum_i (W_{imt} * E_{imt})}{\sum_i (W_{iwt} * E_{iwt})} \end{aligned}$$

where W_{imt} is men's average wage in industry i in year t and E_{imt} is the number of employed men in industry i in year t . The equation can be further decomposed as:

$$= \frac{\sum_i (W_{imt}(1 + g_{imt}^W) * E_{imt}(1 + g_{imt}^E))}{\sum_i (W_{iwt}(1 + g_{iwt}^W) * E_{iwt}(1 + g_{iwt}^E))} - \frac{\sum_i (W_{imt} * E_{imt})}{\sum_i (W_{iwt} * E_{iwt})}$$

where g_{imt}^W and g_{iwt}^W stand for the wage growth and employment growth of men in industry i , respectively.

Using this simple decomposition, we can conceptualize the four components of the changes in the relative economic values. First, men's relative values could decrease if the economy experienced an industrial structural change toward sectors that are female-dominated in employment (*Component 1: (gender-neutral) structural change*). For example, if the employment share of manufacturing (a representative male-dominated sector) among all industries decreased and that of education (a female-dominated sector) increased, female employment would increase relatively more than that of men, assuming that the female employment shares within those two industries remained constant. Second, if the female employment shares increased within each of the traditionally male-dominated sectors, the aggregate female employment would increase, even without structural changes across industries (*Component 2: (gender-specific) industrial segregation*). Third, if the average wages of female-dominated sectors increased faster than those of male-dominated sectors, the relative economic values of men would decrease (*Component 3: (gender-neutral) wage growth*). Finally, if gender wage gaps within each industry decreased, the relative economic values of men would also decrease, even without differential changes in average wages across industries (*Component 4: (gender-specific) wage gaps*).

Table 4: Four components of the changes in the relative economic values

	Employment	Wages
Gender-neutral	<i>Component 1</i>	<i>Component 3</i>
Gender-specific	<i>Component 2</i>	<i>Component 4</i>

4.2. Decomposition of trends in each component

4.2.1. Descriptive trends

Before formally assessing the contributions of the four components, we describe their trends in the three last years of each decade – 1999, 2009, and 2019 – in our data. Table 5 illustrates the employment structure of the top 15 industries of each year.⁶

First, the names of the top 15 industries and their employment shares give us an overview of the (gender-neutral) industrial structure (*Component 1*). There had been

⁶ The comparison of industry-specific labor statistics requires matching industrial classifications across the period of interest. From 1998 to 2020, there have been four rounds of revisions to the Korea Standard Industry Code (KSIC), from the 6th to the 10th round. In the analysis, we used 2-digit industrial codes of the 6th revision (KSIC-6) and converted all the following years' data to match it. The specific conversion methods can be shared upon request.

notable structural changes between 1999 and 2009. The employment shares of Other business-related activities (4.2 → 9.6%)⁷ and Health and social work (3.9 → 6.9%) increased substantially. Manufacture of textiles and Insurance and pension funding was replaced by Real estate activities and Recreational, cultural, and sporting activities in the top 15 rankings. Among those sectors with increased employment shares, Health and social work and Recreational, cultural, and sporting activities had lower men-to-women ratios (henceforth “M/W ratios”) in employment than the total average in 2009, while Other business activities and Real estate activities also had relatively balanced gender composition. The employment share rankings were more similar between 2009 and 2019, except for an additional expansion in Health and social work (6.9 → 10.4%), which remained a severely female-dominated sector.

Second, the M/W ratios of industries show that women's proportion of employment increased in almost all industries (*Component 2*). Between 1999 and 2009, the M/W ratios had increased in 14 out of the 15 industries, with only one exception of Manufacture of radio, television, and communication equipment. Similarly, the ratios again increased in 13 industries between 2009 and 2019. Women began to take greater portions even in severely male-dominated sectors of the past, including Manufacture, Construction, and Land transport. On the other hand, the proportion of men decreased further in traditionally female-dominated sectors, including Health and social work and Education. This indicates a one-sided alleviation of industrial segregation, in that men's reluctance to enter female-dominated industries was strengthened, while women began to infiltrate into male-dominated industries.

Now, we turn to the wage structure. Table 6 illustrates the average monthly salaries of the same top 15 industries as the previous table. First, evidence is weak that the industries that are relatively female-friendly in wages had a steeper increase in wages between 1999 and 2009 (*Component 3*). For example, among the top 15 industries, Other business related activities, Manufacture of machinery and equipment n.e.c., and Manufacture of radio, television, and communication equipment had shown a greater increase in wages than average. However, all those three sectors had relatively high gender gaps in wages. Similarly, Only Manufacture of machinery and equipment n.e.c. was a sector with both a reduced gender wage gap and a lower M/W ratio than average in 2019.

Second, gender wage gaps within industries shrank more substantially in the 2010s than in the 2000s (*Component 4*). In 2009, only five industries out of 15 had shown lower M/W ratios than in 1999. On the other hand, gender wage gaps in 12 industries in 2019 were smaller than in 2009. Traditionally male-dominated sectors including Construction, Land transport, and Manufacture of machinery and equipment n.e.c. showed the lowest gender wage gaps in 2019.

⁷ Other business-related activities include Legal, Accounting, Tax consultancy, Architecture, Advertising, and Business activities n.e.c. as subclassifications.

Table 5. Employment shares in top 15 industries in employment

1999			2009			2019		
Industry	Emp. share	M/W ratio (Emp.)	Industry	Emp. share	M/W ratio (Emp.)	Industry	Emp. share	M/W ratio (Emp.)
1 Hotels and restaurants	9.3%	<u>0.6</u>	Other business related act.	9.6%	1.7*	Other business related act.	10.6%	1.5*
2 Retail trade	8.2%	<u>1.6</u>	Hotels and restaurants	9.2%	<u>0.5*</u>	Health and social work	10.4%	<u>0.2*</u>
3 Wholesale & commission trade	6.8%	3.0	Retail trade	8.1%	<u>1.1*</u>	Hotels and restaurants	9.6%	<u>0.6</u>
4 Construction	6.2%	9.5	Health and social work	6.9%	<u>0.3*</u>	Retail trade	8.0%	<u>0.9*</u>
5 Education	4.8%	<u>0.9</u>	Construction	6.7%	7.6*	Construction	8.0%	6.5*
6 Other business related act.	4.2%	2.6	Wholesale & commission trade	6.6%	2.5*	Wholesale & commission trade	6.3%	2.0*
7 Health and social work	3.9%	<u>0.6</u>	Education	5.6%	<u>0.8*</u>	Education	4.9%	<u>0.7*</u>
8 Land transport	3.6%	19.0	Land transport	3.3%	14.3*	Manuf. of machinery/equip. n.e.c.	2.5%	5.5*
9 Manuf. of machinery/equip. n.e.c.	3.4%	6.6	Manuf. of fabricated metal prod.	2.7%	5.0*	Land transport	2.5%	9.8*
10 Manuf. of radio, television. n.e.c.	2.8%	<u>1.7</u>	Manuf. of machinery/equip. n.e.c.	2.6%	6.3*	Manuf. of fabricated metal prod.	2.4%	4.4*
11 Manuf. of textiles	2.7%	<u>1.5</u>	Real estate activities	2.5%	2.4*	Real estate activities	2.4%	2.0*
12 Financial intermediation	2.7%	<u>1.9</u>	Manuf. of radio, television. n.e.c.	2.4%	1.8	Recreational, cultural, sporting act.	2.2%	<u>1.2*</u>
13 Insurance and pension funding	2.6%	<u>0.5</u>	Recreational, cultural, sporting act.	2.0%	<u>1.5*</u>	Manuf. of motor vehicles	2.0%	5.1*
14 Manuf. of fabricated metal prod.	2.5%	5.7	Manuf. of motor vehicles	2.0%	6.2*	Publishing & printing	1.8%	2.3*
15 Manuf. of motor vehicles	2.3%	7.4	Financial intermediation	2.0%	<u>1.4*</u>	Manuf. of radio, television. n.e.c.	1.8%	2.5
Total	100%	2.1	Total	100%	1.6	Total	100%	1.4

Notes: The list of top 15 2-digit industries in prime-age employment shares. The M/W ratios in the third column are the relative number of men over women in each industry. The underlined industries are those with a lower M/W ratio than the total average. The industries with asterisks are those with lower M/W ratios than 10 years ago.

Table 6: Average wages in top 15 industries in employment

1999			2009			2019		
Industry	Avg. wage (mil. KRW)	M/W ratio (wage)	Industry	Avg. wage (mil. KRW)	M/W ratio (wage)	Industry	Avg. wage (mil. KRW)	M/W ratio (wage)
1 Hotels and restaurants	1.5	1.5	Other business related act.	<u>3.2</u>	1.5	Other business related act.	3.3	1.3*
2 Retail trade	1.7	1.4	Hotels and restaurants	2.0	1.5	Health and social work	2.8	1.8
3 Wholesale & commission trade	2.2	1.4	Retail trade	2.3	1.5	Hotels and restaurants	<u>2.4</u>	1.3*
4 Construction	2.3	1.7	Health and social work	2.4	1.6	Retail trade	<u>2.8</u>	1.5
5 Education	2.4	1.4	Construction	2.8	1.5*	Construction	3.3	1.2*
6 Other business related act.	2.0	1.6	Wholesale & commission trade	3.0	1.4	Wholesale & commission trade	<u>3.7</u>	1.3*
7 Health and social work	1.9	1.4	Education	3.1	1.5	Education	3.2	1.3*
8 Land transport	1.8	1.6	Land transport	2.0	1.2*	Manuf. of machinery/equip. n.e.c.	<u>3.3</u>	1.2*
9 Manuf. of machinery/equip. n.e.c.	1.9	1.8	Manuf. of fabricated metal prod.	2.4	1.5*	Land transport	2.3	1.0*
10 Manuf. of radio, television. n.e.c.	1.8	1.5	Manuf. of machinery/equip. n.e.c.	<u>2.7</u>	1.6*	Manuf. of fabricated metal prod.	<u>3.1</u>	1.3*
11 Manuf. of textiles	1.6	1.7	Real estate activities	1.9	1.2*	Real estate activities	<u>2.4</u>	1.4
12 Financial intermediation	2.2	1.3	Manuf. of radio, television. n.e.c.	<u>3.1</u>	1.6	Recreational, cultural, sporting act.	3.0	1.3*
13 Insurance and pension funding	2.1	1.5	Recreational, cultural, sporting act.	2.6	1.5	Manuf. of motor vehicles	<u>3.2</u>	1.4*
14 Manuf. of fabricated metal prod.	1.8	1.7	Manuf. of motor vehicles	2.5	1.6	Publishing & printing	3.8	1.3*
15 Manuf. of motor vehicles	2.0	1.5	Financial intermediation	3.0	1.5	Manuf. of radio, television. n.e.c.	3.5	1.3*
Total	1.9	1.5	Total	2.7	1.4	Total	3.2	1.3

Notes: The list of top 15 2-digit industries in prime-age employment shares. Average wages in the second column are the average monthly salaries in a million KRW (1USD = 1,200 KRW). The underlined industries are those whose average wages increased faster than the total average in the past 10 years. M/W ratio in the third column are the relative wages of men over women in each industry. The industries with asterisks are those with lower M/W ratios than 10 years ago.

4.2.2. Counterfactual assessments

Now, we formally assess the contributions of the four components to the decline in the relative economic values of men by comparing the actual relative values and the counterfactual ones under the four scenarios, which correspond to each of the four components defined in the previous section. The relative economic values had decreased from 3.09 times of women in 1999 to 2.34 times in 2009. Then, the values declined again to 1.93 times in 2019. We construct counterfactual values under the following four scenarios by fixing each component at a baseline year and allowing for actual changes in all other components. If counterfactual values under one of the four scenarios showed a significant discrepancy from the actual values at the year of comparison, we could verify its large contribution to the actual changes in the values.

Scenario 1. (Gender-neutral) industrial structure of employment:

Fix the industrial composition among total employment at baseline (t) and allow for actual changes in gender composition within each industry and wages.

$$g_{it'}^E = (g_{imt'}^E + g_{iwt'}^E) = \overline{g^E}, \quad \forall i$$

Scenario 2. (Gender-specific) industrial segregation:

Fix the female proportion of each industry at baseline (t) and allow for actual changes in the industrial composition and wages.

$$g_{imt'}^E = g_{iwt'}^E, \quad \forall i$$

Scenario 3. (Gender-neutral) wage growth:

Fix the relative wage structure across industries at baseline (t) and allow for changes in the gender wage gaps within industries and employment.

$$g_{it'}^W = \overline{g^W}, \quad \forall i$$

Scenario 4. (Gender-specific) wage gaps:

Fix the relative wages of men over women within each industry at baseline (t) and allow for changes in the wage structure across industries and employment.

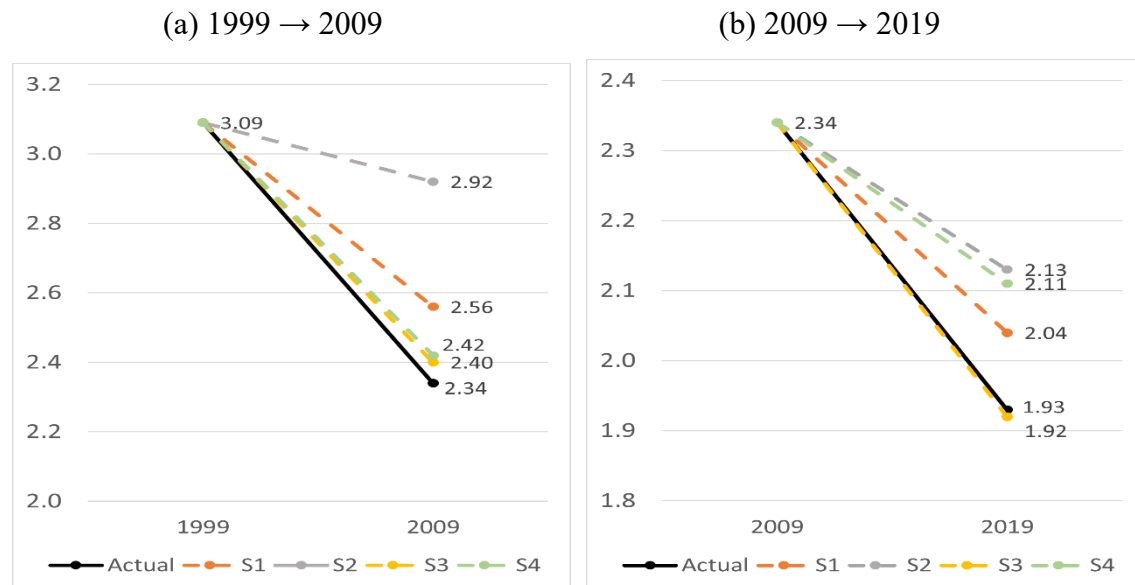
$$g_{imt'}^W = g_{iwt'}^W, \quad \forall i$$

Figure 3 (a) shows the changes between 1999 and 2009. The counterfactual trajectory under Scenario 2 demonstrates that if the female proportion of each industry had been fixed in 1999, the relative economic values would have reduced only to 2.92, suggesting that the alleviation of occupational segregation by gender played a major role in the actual decline in the 2000s. The second biggest impact was found under Scenario 1. With the fixed proportion of employment across industries, the relative value would have reduced to 2.56, 0.22 points higher than the actual value of 2009. On the other hand, the counterfactual values under Scenarios 3 and 4 were close to the actual values, indicating limited contributions of wage factors in the 2000s.

Panel (b) shows the changes between 2009 and 2019, of which trends look different from the previous decade. In the 2010s, the impact of the changes in gender composition within sectors (Scenario 2) was still the biggest. On the other hand, the closing of gender wage gaps within industries (Scenario 4) also played a substantial role with a similar magnitude to the former. While the gender-neutral changes in industrial composition (Scenario 1) also contributed to the reduced relative values, the gender-neutral changes in relative wage structure across industries (Scenario 3) contributed *negatively*, meaning that the average wages in male-dominated industries grew slightly faster than those in female-dominated ones.

The results corroborate what we found about the four components in the descriptive trends of 15 representative industries. In the 2000s, the relative values decreased by 0.75 points, mainly due to both gender-neutral and gender-specific structural changes in employment. On the other hand, in the 2010s, while there were still important changes in employment structure, the diminished gender wage gaps within industries began to affect the reductions in gender value gaps substantially.

Figure 3: Counterfactual assessments of the four components



Notes: This figure compares the actual trajectories of the relative economic values of men over women and the counterfactual trajectories under the four scenarios.

5. Conclusion

In this article, we provided an analysis of Korea's recent marriage decline from a perspective of novel economic values derived from Becker's theory of marriage as a rational choice. Using region-year variations of the relative economic values of men over women, we empirically estimated that approximately one-eighth of the marriage decline in the past two decades can be explained by the convergence of the economic values between both genders. Then, we implemented a counterfactual analysis to assess the contributions of the factors pertaining to the structural changes of the Korean economy in two dimensions – gender-neutral and gender-specific, as well as within and across industries. The result highlighted the prominence of employment-side transitions in the 2000s and wage-side transitions in the 2010s, respectively.

Our results imply even lower marriage rates in the future, assuming continuing convergence of both genders' labor market conditions and static gender norms. Considering Korea's fast structural change to a knowledge-based service economy and strengthening institutional support for female workers, the comparative advantage that Korean men have enjoyed in the labor market is likely to dwindle. Within this context, it is not economically rational for women to get married to take a disproportionate burden of household labor at the cost of their economic prospects. Therefore, the corresponding changes in gender norms are necessary to weaken the importance of production complementarities among economic rationales for marriage. In the U.S. and Western European countries where intra-household gender roles are relatively less segregated, men and women are more likely to get married to achieve consumption complementarities and/or insurance against uncertainties, based on collaborative efforts within and outside households. Although our study exemplified Korea, we believe that the results can be readily generalized by further research on other East Asian societies that are facing fast marriage decline since they share similar societal backgrounds pertaining to labor market convergence and gender norms.

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Appendix

Appendix Table 1. Summary Statistics

	1998 - 2008			2009 - 2019			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
Marriage Rates	6.402	0.826	187	5.558	0.752	187	5.980	0.894	374
Unemployment (Total)	3.825	1.589	187	3.204	0.845	187	3.514	1.308	374
Male	4.270	1.803	187	3.358	0.917	187	3.814	1.499	374
Female	3.210	1.348	187	2.997	0.847	187	3.103	1.129	374
LFP (Total)	59.199	3.426	187	60.215	2.819	187	59.707	3.174	374
Male	70.884	3.259	187	70.832	2.762	187	70.858	3.017	374
Female	48.147	4.669	187	49.916	3.756	187	49.032	4.323	374
Share of Prime-Aged									
Men	0.259	0.024	176	0.222	0.023	176	0.240	0.030	352
Women	0.248	0.031	176	0.204	0.027	176	0.226	0.037	352
2nd Child Sex Ratio	106.88	2.719	187	105.27	2.800	187	106.07	2.872	374
Tertiary Edu Share	0.212	0.061	187	0.318	0.060	187	0.265	0.080	374
Housing Price	86.284	12.195	102	88.871	8.167	187	87.958	9.837	289
Monthly Wage (1,000 KRW)									
Men	2,617	362	187	3,266	191	187	2,941	435	374
Women	1,790	255	187	2,370	164	187	2,080	361	374
Economic Value (1 bil. KRW)									
Men	891	1,784	187	1,193	2,366	187	1,042	2,098	374
Women	335	686	187	565	1,136	187	450	944	374
Relative Value	2.817	0.600	187	2.265	0.466	187	2.541	0.604	374
GRDP per capita (1 mil. KRW)	20.326	9.358	187	31.864	10.580	187	26.095	11.526	374
GRDP (1 tri. KRW)	124	246	187	190	374	187	157	318	374

Note: This table shows summary statistics of key variables at the national level for the whole sample periods. Nominal variables (wages and GRDP) are converted to real terms by Consumer Price Index (2015 = 100). Housing price index is provided for December of each year (2021.6 = 100).

Appendix Table 2. Correlation matrix of the variables of the estimation model

Variables	1	2	3	4	5	6	7	8	9	10	11
1. Log. Marriage rates	1.00										
2. Log. Rel. Value	0.39	1.00									
3. Log. Value of Men	0.10	-0.08	1.00								
4. Log. Value of Women	0.00	-0.33	0.97	1.00							
5. Share of Tertiary Edu	-0.29	-0.74	0.43	0.59	1.00						
6. Sex Ratio of 2nd Child	0.18	0.28	-0.02	-0.09	-0.23	1.00					
7. Log Housing Price	-0.45	-0.42	0.17	0.27	0.58	-0.28	1.00				
8. Log real GRDP per capita	-0.33	0.04	0.26	0.23	0.39	-0.17	0.72	1.00			
9. Share of PA Men	0.80	0.33	0.28	0.18	-0.22	0.29	-0.51	-0.43	1.00		
10. Share of PA Women	0.78	0.27	0.24	0.16	-0.16	0.31	-0.49	-0.45	0.98	1.00	
11. Log real GRDP	0.02	0.07	0.94	0.88	0.32	-0.05	0.23	0.46	0.11	0.05	1.00

Note: All variables are exploited in the main empirical regression from 1998 to 2019.